

## Evidence of Strong Relationship Between Good Oral Hygiene and Preventing and Delaying Chronic Condition Progression

By Dennis Nash and Robert S. Simms

### Summary

Dental hygiene is not just about having clean teeth and fresh breath. Good oral hygiene plays an important role in maintaining overall health and alleviating chronic conditions such as diabetes, hypertension, and dementia. There is pressing need to better coordinate care between Dentistal and traditional Medical care.

The authors discuss the strong relationship between dental hygiene and chronic condition progression in this article, and propose helping Dentists and their staffs collaborate with Medical care coordination teams for eligible chronic care patients. This complements and is incremental to traditional dental insurance, and generates additional care management reimbursements for Dentists (~\$30 PPM) with potential to improve seniors annual dentist visits consistency.

### Evidence of Strong Relationship

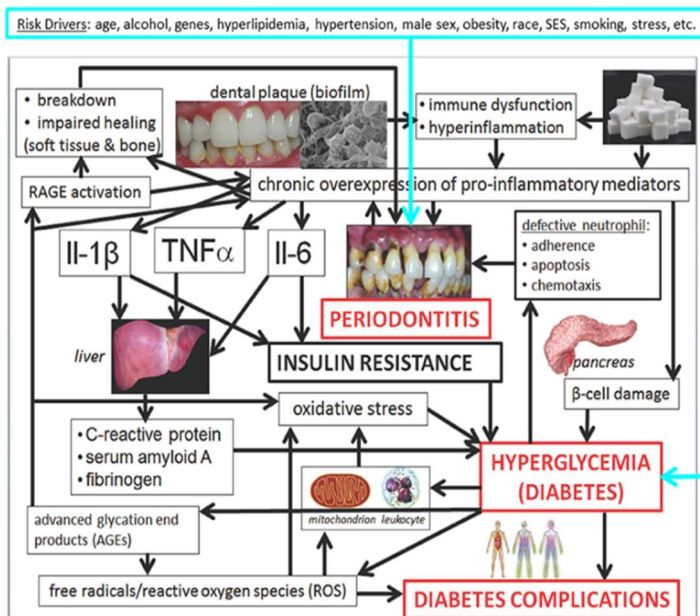


Image from reference article below: *Diabetes and Oral Health: Summary of Current Scientific Evidence for Why Transdisciplinary Collaboration Is Needed*

Dentists are aware of the connection between good oral hygiene and good health. Federal and state health systems have invested in training to connect good dental hygiene with primary care.

Maintaining good oral hygiene is essential for preventing chronic conditions such as diabetes, hypertension, and dementia. Regular brushing, flossing, and professional dental cleanings and examinations can help alleviate chronic conditions and associated complications. By practicing good oral hygiene, individuals can improve their oral health, reduce the risk of developing chronic conditions, and improve their overall health and well-being.

According to research studies<sup>i</sup>, there is a strong correlation between poor oral health and an increased risk of developing **type 2 diabetes**. The inflammation caused by periodontal disease can lead to insulin resistance, a major factor in the development of type 2 diabetes. Regular brushing, flossing, and professional dental cleanings can help prevent periodontal disease, thereby reducing the risk of developing diabetes. Patients with poor oral health have higher levels of hemoglobin A1c, a measure of long-term blood glucose control. Good oral hygiene and regular dental visits should be a part of the management of diabetes.

**Hypertension**, or high blood pressure, is a major risk factor for heart disease and stroke. Research has found<sup>ii</sup> that there is a link between periodontal disease and hypertension. Inflammation caused by periodontal disease can cause damage to the lining of blood vessels, which can lead to an increase in

blood pressure. Patients with periodontal disease have a higher risk of developing hypertension than those without periodontal disease. Maintaining good oral hygiene helps prevent hypertension and its associated complications.

**Dementia** is a chronic condition that affects memory, thinking, and behavior. Research has found<sup>iii</sup> that poor oral hygiene may be a risk factor for developing dementia. The bacteria that cause periodontal disease can enter the bloodstream and travel to the brain, causing inflammation and damage to brain cells. Poor oral hygiene is associated with an increased risk of dementia in older adults. Maintaining good oral hygiene helps prevent cognitive decline and dementia in older adults.

Additional supporting research is cited below.

## **Background Context**

Medicare and Medicaid have created new CPT billing codes and made funds available specifically for chronic care management since 2015, and commercial insurers have followed this lead. But in general, Dentists have not yet fully participated in this effort. Patients with multiple chronic conditions (MCC) average \$41,000<sup>iv</sup> per year in total healthcare costs. Medicare pays \$24,700 per year, with private insurance and patients paying out-of-pocket to cover the difference.

As these costs had historically been growing 3% to 6% per year, Medicare regulations focused on funding quality and care management reimbursement. It is now possible to link the multiple silos of the healthcare system in the USA, but it requires new levels of care coordination and much improved data collection and accurate data analysis.

New value-based care, alternative payment models, and quality initiatives were also introduced to lower total utilization costs.

## **Proposed Collaboration**

There exists an opportunity to better integrate Dental care with existing Medical care management/care coordination to improve patient engagement and outcomes. Managing Dental and MCC health risks simultaneously, combined with population health and existing evidence based medicine, provides the opportunity for a more holistic care experience.

The IndividuALLYtics *HealthConnectplus* patient community engagement platform, in combination with its *HealthQuestplus* data analytics and workflow platform, provides a powerful system for accomplishing this.

A Dentist, a primary care physician, and a patient are assigned a care manager who directs small incremental patient behavior changes (micro-interventions) and analyzes daily outcomes data (supported by statistically-derived precision analytics), in order to identify the best care decisions to consistently improve chronic conditions, mental health and health risk management for that patient. IndividuALLYtics refers to these care managers as “Care Captains.”

A dental management system data sharing platform bridged to medical EHR patient chart data, along with coordinated care management under a Care Captain, would help higher-need, lower-resource

patients who have challenges getting to the Dentist office for regular dental appointments in to see their Dentist, and improve daily at home brushing, flossing and mouth rinsing.

### **Early Results from *HealthConnectplus* and *HealthQuestplus***

Early results have shown<sup>v</sup>, with high statistical confidence for each MCC patient, 4 to 10 times improvement in patient outcomes and engagement. This new level of clinical excellence and realtime care coordination demonstrated a reduction of 0.75 annual average major chronic health events compared to average Medicare MCC patient with 1.2 major chronic health events and/or ED visits (and 0.2 non-chronic health events or ED visits per year). The primary care physician's time per patient was decreased by over 50% (typically 2 hours per year with four 30-minute exams compared to under 1 hour) due to leveraging the Care Captains under their medical oversight.

Individuallytics' proactive, precision, personalized 360-degree care solution has demonstrated early progress and good results clinically and financially for all healthcare parties, while addressing regulatory compliance, billing rules, technology, care coordination, and valid measurement science.

### **Conclusion**

Care coordination to manage dental care and major chronic conditions and health risks simultaneously would mutually improve dental outcomes and multiple chronic conditions outcomes for the patients most at risk for major health events and poor dental care.

### **Further Thoughts on Collaborating**

Individuallytics care management for certain insurance and payer models (where health insurance and dental insurance are co-managed like D-SNP and other Medicare Advantage or Medicaid or self-insured employers) could organize a portion of care management minutes to compensate Dentists for the added care prevention of periodontal disease, encouraging good at home dental hygiene behaviors, and early new health risk identification. Assuming a base case of two times per year cleaning and exams, this might contribute additional \$30-\$45 per patient per year on average, likely with little additional dental office costs because Dentists and their staffs are doing some or most of this care already. Individuallytics care management is designed to fit into existing workflows and available technology (PC or Smartphone). Dentists could participate in the coordinated medical care team that Individuallytics is able to connect. This has the potential to transform the relationship between Dentists, primary care physicians and insurers/payers to better align for improved patient care and outcomes, including better dental health as people age.

Individuallytics care management includes:

- 1) Value-based Enterprise and/or Fee For Service Care Management compliant and audit ready care services contracting, minutes of care tracking, billing management, and billing-minutes-care optimization and delivering accountable clinical outcomes improvement for each patient
- 2) *HealthConnectplus™ SaaS* – a connected digital health literacy for patient and family caregivers to help the Care Captain maintain meaningful and engaging 2-way daily touches with each patient to support their adherence to the agreed upon care plan (which includes basic dental hygiene)

- 3) Care Captain and Care Team – Trained, Licensed and available RN or LCSW (or other similar medical frontline provider) with multiple specialist care team meet with patient (and sometimes caregivers) to better agree on key care goals and care plan micro-interventions with better and broader patient data, for example blood pressure, blood sugar level, depression or anxiety level, weight, smoking levels, daily medication adherence, activity level, level of sleep, mindfulness activities, daily dental habits, modest diet changes, falls detection, access to personal emergency support.
- 4) Better At Home Easy To Use and Support Device Kit (works with Smartphone or PC) to gather and share data and information between patients and providers
- 5) *IAQplus™* Decision Support SaaS Tools – Physician/Provider Views and Patient/Caregiver Views powered by patent-pending over 90% statistical confidence analysis of micro-intervention and outcomes associations, typically every 2 weeks, saving time and generating clinically actionable insights from hundreds to thousands of data points into simple dashboard with drill down capabilities
- 6) *HealthQuestplus™ SaaS* – Daily, weekly, and bi-weekly cycles of engaging and supporting small improvement steps to find the best multi-therapy that works for best outcomes and the patient can adhere to and improve quality of life and satisfaction in partnership with their physicians and dentist. The Care Captain helps aid the real time care coordination to improve outcomes and optimize billing for primary care physicians and specialists with multi-disciplinary care team.

## References

### **Oral Hygiene and Diabetes**

<https://pubmed.ncbi.nlm.nih.gov/23979781/> Dental findings and identification of undiagnosed hyperglycemia

*“A change in the American Diabetes Association guidelines added hemoglobin A1c (HbA1c) to the assays for diabetes diagnosis, but evidence suggests that glucose vs. HbA1c criteria may identify different segments of the affected population. We previously demonstrated that oral findings offer an opportunity for the detection of undiagnosed abnormal fasting plasma glucose (FPG) among dental patients who present with diabetes risk factors. In this new cross-sectional study, we sought to extend these observations. The first goal, using data from 591 new participants, was to assess our previously identified hyperglycemia detection models when HbA1c is used for case definition. The second goal, using data from our total cohort of 1,097 participants, was to evaluate the models' performance regardless of whether an FPG or an HbA1c is used for diagnosis. The presence of  $\geq 26\%$  teeth with deep pockets or  $\geq 4$  missing teeth correctly identified 72% of pre-diabetes or diabetes cases in the HbA1c sample and 75% in the total population. The addition of a point-of-care HbA1c  $\geq 5.7\%$  increased correct identification to 87% and 90%, respectively. These results demonstrate the validity of our prediction models regardless of the test used for diabetes or pre-diabetes diagnosis in the clinical setting and underscore the contribution dentists can make.”*

<https://www.scirp.org/journal/paperinformation.aspx?paperid=70524> Diabetes and Periodontal Diseases: An Established Two-Way Relationship

*“Background: Periodontal diseases (PD), including periodontitis, are chronic inflammatory pathologies caused by bacteria in the subgingival biofilm which affect the periodontal tissues. PD is now considered a localized, chronic, oral infection that activates the host immuno-inflammatory responses both locally and systemically, and also constitutes a source of bacteraemia. It is a known fact that periodontal diseases exercise an important influence on the pathogenesis of numerous systemic diseases, including diabetes mellitus (DM). In the mid-nineties, sufficient scientific evidence emerged to confirm an association between DM and periodontitis, which then began to be regarded as the sixth complication of DM. Current scientific evidence points to a two-way relationship between DM and periodontal disease, whereby DM is associated with an increase in the incidence and progression of periodontitis, while periodontal infection is associated with worsening glycemic control in diabetic patients. This two-way relationship points to a need to promote oral health in DM patients, and to implement a joint management protocol between endocrinologist and dentist that aims to create adequate conditions for early diagnosis and the effective treatment of both diseases.”*

<https://www.frontiersin.org/articles/10.3389/fdmed.2021.709831/full> Diabetes and Oral Health: Summary of Current Scientific Evidence for Why Transdisciplinary Collaboration Is Needed

Regrettably, dentistry was separated from general health care and became an independent profession (1), leaving little education and awareness regarding oral health and its links to general health among the other health professions (2–10).

The most prevalent chronic diseases share the same “common risk factors” (11–13) (Figure 1) and hence often occur in the same patients, regardless of whether causal links and not merely associations exist. Nonetheless, rapidly emerging scientific evidence demonstrates that oral diseases and hyperglycemia (elevated blood glucose concentration), including manifest diabetes mellitus (DM), independently and mutually affect each other.

### Oral Hygiene and Hypertension

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3403746/> PERIODONTAL BACTERIA AND HYPERTENSION: The Oral Infections and Vascular Disease Epidemiology Study (INVEST)

“Chronic infections, including periodontal infections, may predispose to cardiovascular disease. We investigated the relationship between periodontal microbiota and hypertension. **Methods and Results:** 653 dentate men and women with no history of stroke or myocardial infarction were enrolled in INVEST. We collected 4533 subgingival plaque samples (average of 7 samples/subject). These were quantitatively assessed for 11 periodontal bacteria using DNA-DNA checkerboard hybridization. Cardiovascular risk factor measurements were obtained. Blood pressure and hypertension (systolic blood pressure  $\geq 140$  mmHg, diastolic blood pressure  $\geq 90$  mmHg or taking antihypertensive medication, or self-reported history) were each regressed on the level of bacteria: (1) considered causative of periodontal disease (etiologic bacterial burden); (2) associated with periodontal disease (putative bacterial burden); (3) associated with periodontal health (health associated bacterial burden). All analyses were adjusted for age, race/ethnicity, gender, education, body mass index, smoking, diabetes, LDL and HDL cholesterol. Etiologic bacterial burden was positively associated with both blood pressure and prevalent hypertension. Comparing the highest vs. lowest tertiles of etiologic bacterial burden, SBP was 9 mmHg higher, DBP was 5 mmHg higher ( $p$  for linear trend  $< 0.001$  in each case), and the odds ratio for prevalent hypertension was 3.05 (95%CI:1.60,5.82) after multivariable adjustment.”

<https://www.frontiersin.org/articles/10.3389/fcvm.2023.1114927/full> Periodontal disease is associated with the risk of cardiovascular disease independent of sex: A meta-analysis

“Results: Twenty-six studies were included. In patients with periodontal disease, the prevalence of CVD was 7.2% [9 studies; 95% confidence interval (CI): 2.7–13.6%], and prevalence for CHD, hypertension, stroke, and heart failure was 6.6, 25.3, 1, and 1.1%, respectively. There was a significant association between periodontal disease and CVD in men [odds ratio (OR) = 1.22; 95% CI: 1.12–1.34] and women (OR = 1.11; 95% CI: 1.05–1.17), with no significant sex difference ( $P > 0.05$ ).

Conclusion: Cardiovascular disease is relatively common in patients with periodontal disease, and an increased risk of CVD is associated with periodontal disease independent of sex. Interventions targeting periodontal disease may be beneficial for CVD.”

<https://bmcoralhealth.biomedcentral.com/articles/10.1186/s12903-021-01951-z> Risk of coronary heart disease in patients with periodontitis among the middle-aged and elderly in China: a cohort study

This research points to shared association with CHD because “it is difficult to interpret the association due to common risk factors such as diabetes and smoking are shared between CHD and periodontitis [7, 8].” This fits what physicians have been pointing out the multiple chronic conditions and other health risks need to be co-managed. A Care Captain with meaningful data and decision support/alerting can help co-manage with patients the many risks including learning or relearning or supporting brushing teeth daily and the right frequency of dental cleanings and examinations (and address care gaps like transportation and scheduling support).

### Oral Hygiene and Dementia

<https://pubmed.ncbi.nlm.nih.gov/26963387/> Periodontitis and Cognitive Decline in Alzheimer's Disease

“Periodontitis is common in the elderly and may become more common in Alzheimer's disease because of a reduced ability to take care of oral hygiene as the disease progresses. Elevated antibodies to periodontal bacteria are associated with an increased systemic pro-inflammatory state. Elsewhere raised serum pro-inflammatory cytokines have been associated with an increased rate of cognitive decline in Alzheimer's disease. We hypothesized that periodontitis would be associated with increased dementia severity and a more rapid cognitive

decline in Alzheimer's disease. We aimed to determine if periodontitis in Alzheimer's disease is associated with both increased dementia severity and cognitive decline, and an increased systemic pro inflammatory state. In a six month observational cohort study 60 community dwelling participants with mild to moderate Alzheimer's Disease were cognitively assessed and a blood sample taken for systemic inflammatory markers. Dental health was assessed by a dental hygienist, blind to cognitive outcomes. All assessments were repeated at six months. The presence of periodontitis at baseline was not related to baseline cognitive state but was associated with a six fold increase in the rate of cognitive decline as assessed by the ADAS-cog over a six month follow up period. Periodontitis at baseline was associated with a relative increase in the pro-inflammatory state over the six month follow up period. Our data showed that periodontitis is associated with an increase in cognitive decline in Alzheimer's Disease, independent to baseline cognitive state, which may be mediated through effects on systemic inflammation.”

<https://content.iospress.com/articles/journal-of-alzheimers-disease/jad220760> Unlocking Modifiable Risk Factors for Alzheimer's Disease: Does the Oral Microbiome Hold Some of the Keys?

“Advancing age is recognized as the primary risk factor for Alzheimer's disease (AD); however approximately one third of dementia cases are attributable to modifiable risk factors such as hypertension, diabetes, smoking, and obesity. Recent research also implicates oral health and the oral microbiome in AD risk and pathophysiology. The oral microbiome contributes to the cerebrovascular and neurodegenerative pathology of AD via the inflammatory, vascular, neurotoxic, and oxidative stress pathways of known modifiable risk factors. This review proposes a conceptual framework that integrates the emerging evidence regarding the oral microbiome with established modifiable risk factors. There are numerous mechanisms by which the oral microbiome may interact with AD pathophysiology. Microbiota have immunomodulatory functions, including the activation of systemic pro-inflammatory cytokines. This inflammation can affect the integrity of the blood-brain barrier, which in turn modulates translocation of bacteria and their metabolites to brain parenchyma. Amyloid- $\beta$  is an antimicrobial peptide, a feature which may in part explain its accumulation. There are microbial interactions with cardiovascular health, glucose tolerance, physical activity, and sleep, suggesting that these modifiable lifestyle risk factors of dementia may have microbial contributors. There is mounting evidence to suggest the relevance of oral health practices and the microbiome to AD. The conceptual framework presented here additionally demonstrates the potential for the oral microbiome to comprise a mechanistic intermediary between some lifestyle risk factors and AD pathophysiology. Future clinical studies may identify specific oral microbial targets and the optimum oral health practices to reduce dementia risk.”

<https://www.karger.com/Article/Abstract/526683> Utilization of Dental Care and the Incidence of Dementia: A Longitudinal Study of an Older Japanese Cohort

“Introduction: A relationship between periodontal disease and dementia has been reported. It is important to visit a dentist to maintain healthy periodontal tissue. Few studies have been reported on the association between dental visits and the risk of dementia. This study examined the relationship between the use of dental care among older people and the incidence of dementia based on health insurance claims data. Materials and Methods: We targeted 31,775 people aged 75 or 80 years. Dental utilization was obtained from the health insurance claims data from April 2014 to March 2015. The month when dementia medical costs were first incurred during the 4-year follow-up period was defined as the dementia onset month. Cox proportional hazard models were used to estimate hazard ratios (HRs) and 95% confidence intervals (CIs) of the incidence of dementia for the use of dental care. Results: Regarding the type of dental visit, the adjusted HR of overall dementia was significantly lower (0.89: 95% CI, 0.81–0.98) in those who received periodontal treatment compared with those who did not receive any dental treatment. Regarding the days of periodontal treatment, participants with  $\geq 5$  days had significantly lower adjusted HRs for overall dementia, Alzheimer's disease, and vascular dementia than those with 0 days, and the adjusted HRs were 0.84 (95% CI, 0.75–0.94), 0.88 (95% CI, 0.77–1.00), and 0.82 (95% CI, 0.69–0.99), respectively. Conclusion: Individuals who received periodontal treatment on many days had a low risk of dementia. Regular dental visits to treat or prevent periodontal disease may be important to prevent dementia.”

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<sup>i</sup> Lalla et al. (2011)

<sup>ii</sup> Chiu et al. (2015)

<sup>iii</sup> Ide et al. (2016)

<sup>iv</sup> Milliman Research Report 8/13/2020

<sup>v</sup> IAQ+ actual patient MCC Outcomes, 16 AH patients 2022, results of preliminary analysis not yet peer-reviewed