# Current Scientific Evidence for Why Periodontitis Should be Included in Diabetes Management

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# SUPPLEMENTARY MATERIAL



## A) Prevalence and cost of care for periodontitis and diabetes mellitus (DM)

The following information regarding the prevalence and financial costs of treatment/management of periodontitis and DM is provided to illustrate the importance of both diseases.

### PERIODONTITIS

*Prevalence*

While gingivitis affects up to 90% of adults (1-4) and can be reversed by home oral hygiene measures, such as tooth brushing, flossing, and interdental brushing, periodontitis requires professional intervention. As per the Global Burden of Diseases, Injuries, and Risk Factors study (GBD), severe periodontitis is the 6$^{th}$ most prevalent condition in the world (5), affecting about 796 million or 10%-20% of dentate persons globally in 2010 (6, 7). About 1.1 billion people had severe periodontitis in 2019, an increase of 99.0% from 1990 (8, 9), so severe periodontitis continues to present a serious public health problem, especially in less developed regions, with Africa and the age group 50 – 59 years carry the heaviest burden, but with increasing incidence among younger age groups (10). During the 3 decades from 1990 to 2019, population growth caused two-thirds (67.9%) of the increase in number of cases (8).

Severe periodontitis is the 6$^{th}$ most prevalent condition in the world (5-7), including 7.8% of US dentate people (11, 12).

Among dentate US 30-79-year-olds, 42.2% suffer from periodontitis, with 7.8% having severe periodontitis (11, 12).

*Effect of hyperglycemia*

People with DM in the US have a 40% greater risk for periodontitis than those without (13),with around 50% greater prevalence (12, 13). Periodontitis among seniors aged ≥65 years with DM, 83.1 % have periodontitis with 10.8% being severe (14).

*Costs*

The estimated direct costs of dental diseases amounted to $356.80 billion and indirect costs were estimated at $187.61 billion, totaling worldwide costs due to dental diseases of $544.41 billion in 2015 (15).

Periodontitis treatment costs in the US in 2018 were estimated at $3.49 billion with another $150.57 billion in indirect costs mostly due to periodontitis-related edentulism (16). The latter represents on average 0.73% of the annual gross domestic product (GDP).

The corresponding costs in Europe were Euro2.52 billion and Euro156.12 billion, respectively, with the indirect costs amounting to 0.99% of Europe's annual GDP (16)

Periodontitis is associated with greater medical care costs (17), whereas receiving preventive dental care (dental cleaning and non-surgical periodontal therapy) leads to decreased financial costs for outpatient (including emergency department visits for dental issues) and inpatient medical care in general (18-21).

## DIABETES MELLITUS (DM)/HYPERGLYCEMIA

*Prevalence*

The International Diabetes Federation (IDF) estimated the global prevalence of DM in 20-79 year-olds in 2021 was 10.5% (536.6 million) -- that is more than half a billion people -- and is projected to increase to 643 million by 2030 and to 12.2% (783.2 million) in 2045 (22-24), with older age groups suffering most.

In the US, about 37.3 million people have DM of whom 8.5 million (22.8%) are undiagnosed (25). Additionally, 96 million adults have pre-DM, including 26.4 million (48.8%) of seniors ≥65 years (25).

*Costs*

IDF estimated the DM-related global health care costs at USD 966 billion in 2021 and USD 1.054 trillion by 2045 (22, 23).

The estimate global cost of diabetes for 2015 was US 1.31 trillion (1.8% of global GDP, of which indirect costs accounted for 34.7% with North America being the most affected region relative to GDP and also the largest contributor to global absolute costs.(26).

In the US, DM care increased from $37 costs billion in 1996 to $101 billion in 2013 (27). The most recent total estimated cost of diagnosed diabetes in 2017 was $327 billion, including $237 billion in direct medical costs and $90 billion in reduced productivity (DM-related morbidity and premature mortality), representing about 25% of all health care costs, with half of that for DM care (28). Additional costs are

USD 31.7 billion for undiagnosed diabetes, USD 43.4 billion for prediabetes, and nearly USD 1.6 billion for GDM, totaling USD 404 billion (29).

According to the American Diabetes Association (AD(M)A), people with diagnosed DM in the US incur average medical expenditures of approximately USD 16,750 per year, of which approximately USD 9,600 is attributed to diabetes care (28). This is similar to the IDF's estimate of USD 8,208.90 for the North America and Caribbean region (22).

The mean medical expenditures were 2.3 times greater than in those not suffering from DM (28, 30).

The median US state medical care expenditure was USD 18,248 (range: USD 15,418 - USD 30,915) per person with diabetes (31), with direct medical care costs of USD 8,544 (range: USD 6,591 - USD 12,953) and indirect costs USD 9,672 (range: USD 7,133- USD 17,962) (31). Prevention of DM can decrease theses costs considerably (32, 33).

**B) How to screen for periodontitis in the medical setting**

Because the relevant topics are not generally included in the curricula for medical health care professionals, they are often unaware of the important role periodontitis plays in DM management, or feel unqualified to assess their patients' periodontal health status (34, 35).

Periodontitis may be symptomless until the tooth is loose (36), at which time it is too late to salvage it. However, all health care providers recognize inflammation and suppuration, which signs also are displayed by gingivitis and periodontitis. Here follow verbatim the items for the patient to watch out for listed in the 2018 IDF/European Federation of Periodontology (EFP) consensus document published simultaneously in the two organizations' scientific journals, Diabetes Research and Clinical Practice and Journal of Clinical Periodontology, respectively (37, 38):

- *Red or swollen gums;*
- *Bleeding from your gums or blood in the sink after you brush your teeth;*
- *Foul taste;*
- *Longer looking teeth;*
- *Loose teeth;*
- *Increasing spaces between your teeth;*
- *Calculus (tartar) on your teeth*.

Responses to self-report questionnaire items regarding a patient's periodontal health have good correlation with the clinical status (39-41), except when using non-validated questions (42). The following validated, easily answerable questions for self-report were developed by the Centers for Disease Control and Prevention (CDC)/American Academy of Periodontology (AAP) workgroup (43-45):

- *Do you think you might have gum disease?*
- *Overall, how would you rate the health of your teeth and gums?*
- *Have you ever had treatment for gum disease such as scaling and root planing, sometimes called "deep cleaning"?*
- *Have you ever had any teeth become loose on their own, without an injury?*
- *Have you ever been told by a dental professional that you lost bone around your teeth?*
- *During the past three months, have you noticed a tooth that doesn't look right?*
- *Aside from brushing your teeth with a toothbrush, in the last seven days, how many times did you use dental floss or any other device to clean between your teeth?*
- *Aside from brushing your teeth with a toothbrush, in the last seven days, how many times did you use mouthwash or other dental rinse product that you use to treat dental disease or dental problems?*

These questions were validated in several countries in several languages, including in Japanese adults (39); and based on these items (43-45), a Dutch easy and quick, free online screening tool was developed for the medical settings without an oral examination (46-50). Importantly, general physicians are obligated to screen their patients for periodontitis in The Netherlands (47). A 3-item question (51) and a 7-item tool also screen for periodontitis in non-dental settings (52). Finally, self-reported bleeding on brushing (BoB) is correlated with clinically assessed bleeding on probing (BoP) (53).

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