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### Implementation of oral care in primary diabetes care

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# Chapter 6

## Summary, discussion and conclusion

Interest for the association between diabetes mellitus (DM) and oral conditions has been growing the past few decades, particularly focusing on periodontitis. In the period between 1965 and 2012, the number of publications on periodontal disease and DM, indexed in PubMed, had increased to 2,278. Strikingly, approximately half of these articles were published in the final eight years of that period (1). This trend has persisted, as a quick search showed that PubMed per March 1, 2019, contained more than 3,500 citations on the term “periodontal disease and DM”. Not surprisingly, this accumulation of scientific reports and reviews has resulted in a better understanding of the relationship between DM and periodontitis. As a result, awareness for oral health among diabetes care providers has increased, and several guidelines recommend to implement oral care into daily primary diabetes care. However, the impact on daily practice has been very limited, and several potential pitfalls could hamper the effective execution of these recommendations. Moreover, it still remains unclear whether patients with DM themselves will actually benefit from more attention to oral health. The aim of this thesis was to address these issues and to assess implementation of oral care in primary diabetes care.

## Diabetes Mellitus and oral health

As stated in the introduction of this thesis (**Chapter 1**), successful implementation of oral care in primary diabetes care begins with education of diabetes care providers. For the studies that are presented in **Chapter 4** and **Chapter 5** of this thesis, introductory admission interviews with general practitioners (GP) and nurse practitioners were set up. Although some of them claimed to have heard of the association between DM and oral health during these interviews, most GPs and nurse practitioners were unfamiliar with this subject. Apparently, education has fallen short, despite numerous updates in national and international diabetes care guidelines (2-5).

It is important for the diabetes care professional to know what they can encounter in the oral cavity of their patients. Therefore, in **Chapter 2** of this thesis, a comprehensive review of the literature on potential oral complications of DM is presented. This chapter aimed to review epidemiologic associations between DM and oral diseases and conditions. Furthermore, it explored whether there were pathogenic similarities to other well-known chronic diabetic complications. In brief, DM can be considered as a risk factor for the development, progression, and severity of periodontitis, as has been summarized in numerous other narrative publications as well (6-16). The fact that patients with well-controlled DM and non-diabetic individuals have a similar

risk to develop periodontitis suggests that hyperglycemia – the main characteristic of poor metabolic control – is a particularly important pathogenic factor (17, 18). This is supported by the finding that pathogenic pathways related to hyperglycemia might be involved, such as the polyol pathway (19), advanced glycation endproducts (20) and the protein kinase C pathway (21). Other metabolic and hemodynamic disturbances, such as insulin resistance (22), dyslipidemia (23) and hypertension (24), also potentially contribute directly and indirectly to the development of periodontitis. These disturbances seem to induce dysregulation of the immune system. In the case of periodontitis, this is characterized by enhancement of the exaggerated host immune response to pathogenic microorganisms in the dental biofilm, initiating and contributing to the destruction of connective tissue and bone (25, 26). The pathogenic pathways by which DM contributes to the development and progression of periodontitis show striking similarities with other chronic, microvascular complications of diabetes, such as retinopathy, neuropathy, and nephropathy. Together with the epidemiologic association, this strengthens the concept that periodontitis indeed is the sixth complication of DM, as suggested by Loë 26 years ago (27).

Although epidemiologic and pathogenic associations between DM and other oral diseases are less evident, the prevalence of dental caries (28), dry mouth (29), *Candida* infections (30), oral cancer (31), and taste disorders (32) are generally increased. There is only limited evidence for an increased prevalence of apical periodontitis (33) and peri-implantitis (34), while the literature on burning mouth syndrome and temporomandibular joint disorders is inconclusive.

Despite these interesting findings, a critical note is appropriate, as variation in the quality of evidence was high. Except for research into periodontitis, which includes several longitudinal studies, the vast majority of studies into associations between DM and oral complications had a cross-sectional design. Causal relationships are therefore impossible to establish. Moreover, those studies investigating pathogenic associations often used animal models. Although this is understandable from a financial and practical point of view, it limits the generalizability to humans subjects. Therefore, if we truly want to unravel the complex associations between DM and oral conditions, future research should focus on the quality of the study design and aim to improve generalizability. However, the high prevalence of several oral complications cannot be ignored. Prevention and treatment of these complications are always needed and worthwhile for the individual patient, regardless of the presence or absence of a causal relationship.

## Oral health and Diabetes care

Besides limited knowledge among primary diabetes care providers about the link between DM and oral health, the lack of time and resources further prevents them from implementing oral care into their daily routine. According to the care guidelines, they should be inspecting the oral cavity and pay attention to signs of periodontitis (2-4). Diagnosis and, if needed, subsequent treatment of periodontitis as a complication of DM is important, considering the fact that periodontitis is an important cause of tooth loss (35) and negatively affects quality of life (36). Moreover, it could also help to achieve better metabolic control and contribute to the prevention of diabetic complications (3). However, to date, without a thorough inspection of the mouth – performed by a trained dental professional – a reliable estimation of periodontal health cannot be made. A clinical, “quick and easy” tool is required to enable screening for periodontitis in a medical care setting.

In **Chapter 3**, such a tool was developed, using demographics, self-reported oral health and/or salivary biomarkers. Here, we further developed existing and validated self-reported oral health questions (37, 38). To do so, 156 consecutive, newly admitted patients from the ACTA dental clinics were recruited, who completed a self-reported oral health questionnaire, provided a 30 seconds oral rinse sample and underwent a full-mouth periodontal examination. Patients were classified according to the case definition for periodontitis, proposed by Page *et al.*, 2007, including total and severe periodontitis (39). This classification was also used for the validation of the original questions (37, 38). Binary logistic regression analyses were used to create prediction models. Total and severe periodontitis could be predicted with an accuracy of 91% and 89%, respectively, when demographics, self-reported oral health, and biomarkers were included in the prediction models. Interestingly, omitting the salivary biomarkers only marginally decreased the accuracy of the models, with 88% for total periodontitis and 82% for severe periodontitis. Similar studies from the United States (37) and France (40) achieved comparable results, supporting the validity of the findings in **Chapter 3**. Importantly, the self-reported oral health questionnaire is now validated in the Netherlands.

Although the results above were promising, the prediction models still needed to be converted into an easily applicable screening tool. The regression equation – derived from the analysis – provided the algorithm necessary for building the tool. This resulted in a rapid, web-based calculator, which can be accessed on [www.perioscreening.com](http://www.perioscreening.com). By answering 13 questions, only taking a few moments, this calculator can accurately predict whether it is likely that the user has periodontitis

or not. In a medical setting, where thorough inspection of the oral cavity is not possible, this screening tool provides a good alternative. In addition to the outcome (periodontitis yes or no), the screening tool also recommends to visit the dentist regularly. This will support primary diabetes care providers to adhere to the two central aspects of the diabetes care guidelines in relation to oral health: screen for periodontitis and urge the patient to visit a dentist regularly. However, before realizing widespread implementation in primary diabetes care, the screening tool will require further assessment of its performance through external validation, as is recommended for all clinical prediction models (41). This work is already in progress.

Identification of oral health characteristics of the target population was the next step deemed necessary for effective implementation of oral care in diabetes care. Therefore, **Chapter 4** of this thesis aimed to investigate dental care utilization and the extent of perceived oral health problems of patients with T2DM attending the GP office. This chapter, the first of two articles on a cluster-randomized controlled trial performed in the area of Amsterdam, presents the findings of a cross-sectional baseline analysis. The results from the longitudinal analysis will be discussed below. For the project, 24 GP offices were recruited. The GPs and/or nurse practitioners at these offices enrolled patients with T2DM and collected data on general health characteristics, self-reported oral health, general health-related quality of life (QoL) and oral health-related QoL. A total of 764 patients were included, of whom 76% self-reported to visit a dentist regularly. In contrast to previous research from the United States, where dental care utilization was low among patients with DM ( $\pm$  60%) (42, 43), the proportion found in the current study is not very different from the general Dutch population (44). The same was true for dental insurance, with 69% reported to have dental insurance coverage. A relatively high prevalence of dental care utilization and dental insurance may be the result of the a priori formulated inclusion criteria: including individuals who could not speak and read the Dutch were excluded. As a result, the socio-economic status (SES) of the recruited study population was apparently relatively high, which has been shown to contribute to dental care utilization (45). However, certain subpopulations, such as edentulous individuals and smokers, clearly demonstrated to have poor dental care utilization and might need extra motivation. Moreover, we cannot exclude the possibility that participants provided socially desirable answers regarding dental care utilization, and some might not have been sure to have dental insurance coverage.

Despite the fact that the majority of the study participants reported visiting the dentist regularly, the prevalence of self-reported oral health problems was high. Dry mouth (37%), pain in the mouth (15%) and bad breath (12%) were reported relatively often, but with 69%, the prevalence of self-reported periodontitis – calculated using the screening tool from **Chapter 3** – was particularly high. In addition, oral health-related QoL was impaired in patients suffering from one or more of these oral health problems, as well as in smokers, patients with dental non-attendance and individuals with non-Western European ethnicity. Interestingly, impaired oral health-related QoL seemed to coincide with impaired general health-related QoL. As a matter of fact, study participants without impairment in oral health-related QoL presented a level of general health-related QoL comparable to the general population from the Netherlands and Amsterdam (**Chapter 4**).

As stated in the introduction of this thesis (**Chapter 1**), modern diabetes care programs mainly focus on the prevention, management, and treatment of diabetic complications, to optimize QoL (2, 46). For this thesis, it was hypothesized that, by introducing attention to oral care in primary diabetes care, optimization of oral health-related QoL could also be achieved. To investigate this, a cluster-randomized controlled trial was initiated. **Chapter 5** presents the results from the longitudinal analysis of this trial. The 24 GP offices participating in this study were randomly allocated to either the experimental or the control group. In the experimental group, the GPs and nurse practitioners were instructed to implement an oral care protocol into their daily routine. This protocol consisted of:

Education of the patient about the importance of oral health and motivate them to pay attention to their oral hygiene.

Encouragement of the patient to visit the dentist regularly, supported by a standardized referral letter for the dentist.

Offer an introduction kit to the patient, containing oral hygiene products (provided by Sunstar GUM) and an information brochure that explains the association between DM and oral health.

The GP offices in the control group did not pay any extra attention to oral health. The effect of the intervention on oral health-related QoL (OHIP-NL14 questionnaire), general health-related QoL (SF-36 questionnaire), and self-reported oral health complaints was assessed after one year.

Of the 764 patients with T2DM that were enrolled in the study, 543 individuals (71%) completed the follow-up period of one year. In brief, the rate of improvement in oral health-related QoL was significantly higher in the experimental group (35%), compared to the control group (26%) ( $p=0.046$ ). Intraclass correlation coefficients (ICC) were computed to adjust for the potential effect of clustering within GP offices in the analysis, but the effect remained significant ( $p_{adj}=0.049$ ). Interestingly, when the analysis included patients from GP offices with good adherence to the introduced oral care protocol (based on a follow-up rate  $\geq 60\%$ ), the effect of the intervention became even stronger (38% improved in experimental group vs. 25% in the control group,  $p$  and  $p_{adj}=0.011$ ).

Rates of improvement in self-reported oral health complaints (pain in the mouth, dry mouth, bad breath) did not differ between the groups. Furthermore, changes in general health-related QoL were comparable for both groups, despite the fact that **Chapter 4** demonstrated that oral health-related QoL and general health-related QoL coincided. Apparently, the effects of the intervention on oral health-related QoL aspects were too limited to achieve improvement in general health-related QoL as well. However, several limitations might have masked the effects of the intervention in this study (**Chapter 5**). As discussed above, the recruited study population might have been rather motivated to start with. Also, GPs and nurse practitioners from offices in the control group were fully aware of the importance of good oral health. They read and agreed on the study protocol before they were randomly allocated to the control group. This might have prompted them unwillingly or unconsciously to pay more attention to oral health than usual, despite instructions not to do so. As a result, some form of "contamination" might have been introduced, despite randomization on the level of GP office rather than on patient level.



## **Implementation of oral care - a primary Diabetes care professional's point of view**

In this thesis, one important aspect of the implementation of oral care in primary diabetes care has not yet been discussed: the opinions, perspectives and personal experiences of those who are providing the actual care. Therefore, a survey was conducted among the GPs and nurse practitioners who participated in the project presented in **Chapter 4** and **Chapter 5**. This survey was initiated to provide some insight into the implementation of oral care in primary diabetes care from primary diabetes care professionals' point of view. The survey questions and the results are presented in Table 1.

In total, 25 out of 28 primary diabetes care providers that contributed to the project responded to the survey (2 GPs and 23 nurse practitioners). In general, the responses to the survey did not differ between the GPs and nurse practitioners from the experimental and control GP offices. The GPs and nurse practitioners were receptive to the implementation of oral care in their daily routine. Most of them agreed that oral health and attention to oral health problems are important enough to become part of the regular diabetes check-up. They also recognized that this will require shared responsibility for both medical and dental professionals. The majority believes that they have sufficient capabilities and knowledge to pay attention to oral health and that this is just a matter of building in routine. According to most respondents, it should be possible to structurally monitor and register whether a patient visits a dentist annually. When asked what would be useful to include in a standardized oral care protocol, 92% of the participants indicated an information brochure about DM and oral health, followed by a standardized referral letter for the dentist (82%) and a self-reported oral health questionnaire (76%).

In general, knowledge about the association between DM and oral health was also good (Table 1). Most of the GPs and nurse practitioners knew that patients with DM have an increased risk for periodontitis. They were also familiar with the relationship between metabolic control on the one hand and dry mouth and periodontitis on the other hand. The fact that periodontitis can develop and exist asymptotically, and that signs of periodontitis can be difficult to recognize, was also known for most respondents. Most GPs and nurse practitioners agreed that their knowledge about potential oral health problems had improved by participating in this study. Therefore, the up-to-date knowledge among the GPs and nurse practitioners participating in the current study might therefore not be representative for all primary diabetes care professionals.

Based on the survey, important barriers that could complicate implementation of oral care in primary diabetes care were identified: insufficient educational opportunities, inadequate medical guidelines, and difficulties to motivate patients without dental insurance coverage and/or patients with a full denture to visit the dentist (Table 1). A substantial number of GPs and nurse practitioners also experienced difficulties in engaging collaboration with dentists, perceiving a certain distance between the two disciplines. Only few GPs and nurse practitioners reported knowing which dentists and oral hygienists were active in their region. A considerable proportion believed that some of their patients might not visit a dentist regularly, even though the patients claimed to do so. This was especially the case for GPs and nurse practitioners from the control group. Furthermore, it was estimated that on average only one-third of the patients with type 2 DM is aware of the association between DM and oral health. Although the majority of GPs and nurse practitioners reported having sufficient time to pay attention to oral health, many also mentioned that including oral care to their protocol caused a shortage in time for their usual activities.

The results of this survey corroborate those from previous research, which also observed a positive attitude and a willingness among primary care providers towards implementation of oral care in diabetes care (47). However, strikingly, similar barriers were reported in the latter study. The challenge for the future will be to overcome these barriers, in order to elicit true change in how primary diabetes care professionals deal with oral health. The currently observed improvement in oral health-related QoL attests to the need and usefulness.

**Table 1.** Knowledge and personal opinions, perspectives and experiences of primary diabetes care professionals regarding diabetes mellitus and oral health, based on a survey provided to all participating GPs (n=2) and nurse practitioners (n=26). The response rate was 89% (25/28), results are presented separately for experimental and control offices.

	GPs and nurse practitioners from the experimental offices (n=12)				GPs and nurse practitioners from the control offices (n=13)			
	(Strongly disagree)	Don't agree/disagree	(Strongly agree)		(Strongly disagree)	Don't agree/disagree	(Strongly agree)	
<b>Questions on personal experiences and perspectives to assess feasibility of implementation of oral care in primary diabetes care</b>								
1	1 (8.3)	0 (0.0)	11 (91.7)		0 (0.0)	4 (30.8)	9 (69.2)	
2	3 (16.7)	3 (16.7)	6 (50.0)		4 (30.8)	1 (7.7)	8 (61.5)	
3	2 (16.7)	2 (16.7)	8 (66.7)		4 (30.8)	6 (46.2)	3 (23.1)	
4	3 (25.0)	1 (8.3)	8 (66.7)		1 (7.7)	4 (30.8)	8 (61.5)	
5	0 (0.0)	3 (25.0)	9 (75.0)		2 (15.4)	3 (23.1)	8 (61.5)	
6	6 (50.0)	4 (33.3)	2 (16.7)		6 (46.2)	4 (30.8)	3 (23.1)	
7	0 (0.0)	2 (16.7)	10 (83.3)		2 (15.4)	5 (38.5)	6 (46.2)	
8	6 (50.0)	3 (25.0)	3 (25.0)		7 (53.8)	3 (23.1)	3 (23.1)	
9	6 (50.0)	5 (41.7)	1 (8.3)		7 (53.8)	4 (30.8)	2 (15.4)	
10	0 (0.0)	1 (8.3)	11 (91.7)		0 (0.0)	2 (15.4)	11 (86.4)	
11	0 (0.0)	2 (16.7)	10 (83.3)		2 (15.4)	4 (30.8)	7 (53.8)	
12	3 (25.0)	1 (8.3)	9 (75.0)		3 (23.1)	3 (23.1)	7 (53.8)	

<b>Statements to assess knowledge about oral health and its relationship with diabetes mellitus</b>		<b>(Strongly disagree)</b>	<b>Don't agree/disagree</b>	<b>(Strongly agree)</b>	<b>Don't know</b>	<b>(Strongly disagree)</b>	<b>Don't agree/disagree</b>	<b>(Strongly agree)</b>	<b>Don't know</b>
13	Metabolic control affects complaints of a dry mouth.	0 (0.0)	0 (0.0)	12 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	13 (100.0)	0 (0.0)
14	Poor metabolic control increases the risk of developing gum diseases.	0 (0.0)	0 (0.0)	11 (91.7)	1 (8.3)	0 (0.0)	0 (0.0)	13 (100.0)	0 (0.0)
15	Periodontitis can be one of the reasons why it is difficult to achieve good metabolic control in certain patients.	1 (8.3)	0 (0.0)	11 (91.7)	0 (0.0)	0 (0.0)	0 (0.0)	13 (100.0)	0 (0.0)
16	There are medications that contribute to complaints of a dry mouth.	0 (0.0)	0 (0.0)	10 (83.3)	2 (16.7)	0 (0.0)	1 (7.7)	9 (69.2)	3 (23.1)
17	Periodontitis can easily be recognized when inspecting the mouth.	8 (66.7)	3 (25.0)	1 (8.3)	0 (0.0)	7 (53.8)	2 (15.4)	2 (15.4)	2 (15.4)
18	Periodontitis always causes complaints.	7 (58.3)	2 (16.7)	1 (8.3)	2 (16.7)	5 (38.5)	4 (30.8)	3 (23.1)	1 (7.7)
19	The risk for periodontitis is as high for patients with diabetes as it is for healthy individuals.	8 (66.7)	1 (8.3)	1 (8.3)	2 (16.7)	8 (61.5)	0 (0.0)	5 (38.5)	0 (0.0)
<b>Statements to assess personal perspectives on implementation of oral care in primary diabetes care</b>		<b>(Strongly disagree)</b>	<b>Don't agree/disagree</b>	<b>(Strongly agree)</b>	<b>Don't know</b>	<b>(Strongly disagree)</b>	<b>Don't agree/disagree</b>	<b>(Strongly Agree)</b>	<b>(Strongly) Don't know</b>
21	Oral health is the responsibility of dental care, not of diabetes care.	8 (66.7)	3 (25.0)	1 (8.3)	0 (0.0)	6 (46.2)	4 (30.8)	3 (23.1)	0 (0.0)
22	Oral health should be part of the regular diabetes check-up.	1 (8.3)	0 (0.0)	11 (91.7)	0 (0.0)	0 (0.0)	5 (38.5)	8 (61.5)	0 (0.0)
23	Oral complications of diabetes are as important as complications elsewhere in the body.	1 (8.3)	2 (16.7)	9 (75.0)	0 (0.0)	0 (0.0)	3 (23.1)	10 (76.9)	0 (0.0)
24	I find it hard to initiate cooperation with the dentist.	1 (8.3)	6 (50.0)	5 (41.7)	0 (0.0)	3 (23.4)	4 (30.8)	6 (46.2)	0 (0.0)
25	Cooperation with the dentist is not my responsibility.	3 (25.0)	5 (41.7)	4 (33.3)	0 (0.0)	2 (15.4)	9 (69.2)	2 (15.4)	0 (0.0)
26	I perceive a certain distance between diabetes care and the dental care.	1 (8.3)	1 (8.3)	10 (83.3)	0 (0.0)	0 (0.0)	2 (15.4)	11 (84.6)	0 (0.0)
27	I believe it is important to know whether a patient visits the dentist and/or oral hygienist.	0 (0.0)	1 (8.3)	11 (91.7)	0 (0.0)	0 (0.0)	1 (7.7)	12 (92.3)	0 (0.0)

28	It is possible to monitor and register for all patients whether they visit a dentist and/or oral hygienist annually.	1 (8.3)	0 (0.0)	11 (91.7)	1 (7.7)	2 (15.4)	10 (76.9)
29	It is not important for patients with a full denture to visit a dentist.	8 (66.7)	2 (16.7)	2 (16.7)	11 (84.6)	1 (7.7)	1 (7.7)
30	Dental treatment should always be reimbursed for patients with diabetes.	1 (8.3)	0 (0.0)	11 (91.7)	1 (7.7)	3 (23.1)	9 (69.2)
<b>Statements about the feasibility and utility of the research project, and which aspects might be useful for the future</b>							
31	During this study, I learned more about potential problems in the mouth.	0 (0.0)	2 (16.7)	10 (83.3)	2 (15.4)	0 (0.0)	11 (84.6)
32	Because of this study, I am paying more attention to the oral health of my patients.	0 (0.0)	2 (16.7)	10 (83.3)	0 (0.0)	1 (7.7)	11 (84.6)
33	Sometimes I was short in time for my usual activities because of this study.	1 (8.3)	3 (25.0)	8 (66.7)	3 (23.1)	4 (30.8)	6 (46.2)
34	The referral letter for the dentist is useful for daily practice (only for experimental GP offices).	0 (0.0)	5 (41.7)	6 (50.0)	n/a	n/a	n/a
35	The questionnaire regarding oral health is useful for daily practice.	3 (25.0)	3 (25.0)	6 (50.0)	2 (15.4)	4 (30.8)	6 (46.2)
<b>Other questions</b>							
36	Do you think there are patients who claim to visit the dentist and/or oral hygienist at least once a year, but in reality do not do so?	6 (50.0)		6 (50.0)	11 (84.6)		2 (15.4)
37	In case you answered the previous question with yes, for how many percent of the patients do you think this is true? (% , range)	4.0–30.0			10.0–30.0		
38	Can you try to estimate what proportion of patients with diabetes at your practice is aware of the relationship between diabetes and oral health? (% , mean ± SD)	43.8 ± 32.0			23.5 ± 18.8		
39	How long does a consultation at your office takes on average?	10 min.	15 min.	20 min.	25 min.	30 min.	
		1 (8.3)	1 (8.3)	7 (58.3)	0 (0.0)	3 (25.0)	1 (7.7)
		Mean ± SD	Median (IQR)	Range	Mean ± SD	Median (IQR)	Range

40	How many extra minutes did it take to explain the importance of good oral health? (only for the experimental offices) (minutes)	9.6 ± 6.6	8.5 (5.0)	3.0–25.0	n/a	n/a
41	How many extra minutes did it take to conduct the self-reported oral health questionnaire? (minutes)	9.6 ± 7.1	10.0 (6.0)	3.0–30.0	7.9 ± 3.6	10.0 (5.0)
42	How many extra minutes did it take to ask the patient to fill in the oral health-related quality of life questionnaires? (minutes)	7.9 ± 8.2	5.0 (8.0)	1.0–30.0	6.3 ± 4.0	7.5 (9.0)
43	How many extra minutes did it take to motivate a patient to visit the dentist? (only for the experimental GP offices)? (minutes)	5.7 ± 4.2	5.0 (7.0)	2.0–15.0	n/a	n/a
44	How many extra minutes did it take to provide the patients with the oral hygiene introduction kit, and motivate them to actually use it? (only for the experimental GP offices) (minutes)	6.2 ± 4.7	5.0 (2.0)	3.0–20.0	n/a	n/a
<b>Pretend a national oral health protocol will be implemented, do you believe it would be important to include:</b>						
45	A self-reported oral health questionnaire?	<b>Yes</b> 9 (75.0)	<b>No</b> 3 (25.0)		<b>Yes</b> 10 (76.9)	<b>No</b> 2 (23.1)
46	A standardized referral letter for the dentist?	<b>Yes</b> 9 (75.0)	<b>No</b> 3 (25.0)		<b>Yes</b> 12 (92.3)	<b>No</b> 1 (17.7)
47	An information brochure about the importance of oral health?	<b>Yes</b> 10 (83.3)	<b>No</b> 2 (16.7)		<b>Yes</b> 13 (100.0)	<b>No</b> 0 (0.0)
48	A questionnaire about oral health-related quality of life?	<b>Yes</b> 5 (41.7)	<b>No</b> 7 (58.3)		<b>Yes</b> 4 (30.8)	<b>No</b> 9 (69.2)

Unless indicated otherwise, data are presented as n (%), with n representing number of GPs and nurse practitioners.  
n/a = not applicable

## Conclusion

The research presented in this thesis aimed to initiate and assess implementation of oral care in primary diabetes care. It showed that DM is associated with several oral conditions and diseases. Oral complaints, self-reported periodontitis, and impaired oral health-related QoL also appeared to be very common in patients with T2DM attending the GP office, with certain subpopulations demanding additional attention. To support GPs and nurse practitioners in their responsibility to screen for periodontitis in their patients, a rapid, non-invasive screening tool was developed and assessed, now freely accessible online. The actual implementation of an oral care protocol demonstrated that patients with T2DM can benefit from extra attention to oral health at the GP office. GPs and nurse practitioners appeared to be receptive to integrating oral care into their daily routine, but several barriers need to be dealt with.

Finally, because of the complexity of DM, the focus of modern diabetes care increasingly shifts towards individual patient needs and wishes. On the condition that each patient receives sufficient education, and with individual circumstances in mind, treatment plans and goals are established based on shared decision making, where patient input plays an important role. In the end, the patients themselves are responsible for achieving these treatment goals; the GPs' and nurse practitioners' roles are to support them as good as possible during this process (2). Future initiatives to implement oral care in primary diabetes care should keep this in mind.

In conclusion, this thesis demonstrated that implementation of oral care in primary diabetes care is justifiable from a scientific point of view, feasible from a healthcare professional's point of view, and most importantly, worthwhile from a patient-centered point of view.

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