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Abstract:	Increasingly more responsive and accountable healthcare systems are demanded, which are characterized by transparency and explicit demonstration of competence by individual healthcare providers and by the systems they work in. This study aimed to establish measures of oral health for transparent and explicit reporting of routine data, in order to facilitate more patient-centered and prevention-oriented oral healthcare. To accomplish this, an intermediate objective was to develop a comprehensive list of topics, which are perceived as valid, important and relevant for describing oral health and oral healthcare by a wide range of stakeholders. A four-stage approach was used: (i) scoping of literature and its appraisal, (ii) a meeting of experts (iii) a two stage Delphi process (online), and (iv) a World Café discussion, to develop the list of topics. The approach was used to create consensus through structured conversations with a wide range of stakeholders (general dental practitioners, patients, insurers and policy makers) from the Netherlands, Germany, the United Kingdom, Ireland, Hungary and Denmark. The study was part of the ADVOCATE project. The study resulted in a list of 48 topics grouped into six clusters: (i) access to dental care, (ii) symptoms and diagnosis, (iii) health behaviors, (iv) oral treatments, (v) oral prevention and (vi) patient perception. All topics can be measured as they all have a data source with defined numerators and denominators. This study is the first to establish a comprehensive and multiple stakeholder consented topic list designed for

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A consensus-based set of measures for oral healthcare.

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Abstract

Increasingly more responsive and accountable healthcare systems are demanded, which are characterized by transparency and explicit demonstration of competence by individual healthcare providers and by the systems they work in. This study aimed to establish measures of oral health for transparent and explicit reporting of routine data, in order to facilitate more patient-centered and prevention-oriented oral healthcare. To accomplish this, an intermediate objective was to develop a comprehensive list of topics, which are perceived as valid, important and relevant for describing oral health and oral healthcare by a wide range of stakeholders. A four-stage approach was used: (i) scoping of literature and its appraisal, (ii) a meeting of experts (iii) a two stage Delphi process (online), and (iv) a World Café discussion, to develop the list of topics. The approach was used to create consensus through structured conversations with a wide range of stakeholders (general dental practitioners, patients, insurers and policy makers) from the Netherlands, Germany, the United Kingdom, Ireland, Hungary and Denmark. The study was part of the ADVOCATE project. The study resulted in a list of 48 topics grouped into six clusters: (i) access to dental care, (ii) symptoms and diagnosis, (iii) health behaviors, (iv) oral treatments, (v) oral prevention and (vi) patient perception. All topics can be measured as they all have a data source with defined numerators and denominators. This study is the first to establish a comprehensive and multiple stakeholder consented topic list designed for guiding the implementation of transparent and explicit measurement of routine data of oral health and oral healthcare. Successful measurement within oral healthcare systems is essential to facilitate learning from variation in practice and outcomes within and between systems, and potentiates improvement towards more patient-centered and prevention-oriented oral healthcare.

Keywords: Oral Health, Quality Improvement, Delivery of Health Care, Delphi, World Café, Patient-Centred.

Introduction

Societies increasingly demand a responsive and accountable healthcare system (Berwick 2016; Baâdoudi et al. 2016). In addition, many "patients" are no longer passive recipients of care but wish to participate in their own healthcare and treatment decisions (Hanley et al. 2001; Ward et al. 2009; Caron-Flinterman et al. 2005). The patient has become a "consumer" of care with the internet, social media, and other informal networks influencing patient-clinician conversations. This has contributed to changes in the therapeutic relationship, reducing the previous "unquestioned" trust in the care provider. Together with the consolidation and industrialization of care, there is an increasing expectation of an explicit demonstration of competence (Moses et al. 2013).

In order to fulfil the growing need for transparency and explicit demonstration of competence by individual care providers, routinely available data describing clinical practice and the development of measures are needed (Starfield 1998; Schnackenberg and Tomlinson 2014). This facilitates the comparison of practice at individual and system level (Jamtvedt and Young 2006). Measures may describe the healthcare delivered or preventive behaviours in the population (the processes of care) and the health of the population (the outcomes of care) (Baâdoudi et al. 2016). Successful measurement within healthcare systems is essential to facilitate learning from variation in practice and outcomes within and between systems, and potentiates quality improvement and quality assurance in healthcare. While moving towards more transparency, measures and data of care should be used as part of an overall approach to provide feedback, and not be used for normative judgments and complicated remuneration schemes (Smith 2009; Navathe and Emanuel 2016). Excessive and complex measurements should be avoided as they bring forward risks - inefficient use of clinician's time, feelings of discomfort and even anger (Berwick 2016).

Over the last decade, several efforts have been made to develop measures in healthcare (Williams et al. 2004; Alliance 2016; Herndon et al. 2015). The trend towards more explicit demonstration of competencies and with this, the increasing need for measures also applies to dentistry (Baâdoudi et al. 2016) but progress is slow. In oral health there is neither a diagnostic oral health coding system, nor a set of oral healthcare quality measures that are generally accepted, implemented or used. Recently, the FDI World Dental Federation has established a new theoretical definition for oral health and highlighted the development of consented measures for implementation in clinical practice as a key challenge for the research community (Glick et al. 2016; Lee et al. 2016).

An important step in the development of relevant measures for oral healthcare is the identification of topics that are valid, important and relevant to (i) measure the quality of care, (ii) describe aspects of oral health in patients and populations, and (iii) identify and describe the factors which potentially affect delivery of care or oral health and may therefore explain warranted as opposed to unwarranted variation (Baâdoudi et al. 2016; Navathe and Emanuel 2016). The aim of this study was to establish measures of oral health for transparent and explicit reporting of routine data to facilitate more patient-centred and prevention-oriented oral healthcare. To accomplish this, an intermediate objective was to develop a comprehensive list of topics, which are perceived as valid, important and relevant for describing oral health and oral healthcare by a wide range of stakeholders.

Methods

This study is part of the ADVOCATE project ('Added Value for Oral Care'), funded by the EU Commission's Horizon 2020 programme (Leggett et al. 2016). Six countries participate in the project; Denmark, Germany, Hungary, the United Kingdom, Ireland, the Netherlands. To establish a set of oral health topics, a four-stage approach was used: (i) scoping of literature and appraisal, (ii) a meeting of experts, (iii) an online, two stage Delphi process followed by (iv) a World Café discussion (Figure 1.).

This approach was used to create an initial broad list of potential topics and then to have structured conversations with a wide range of stakeholders (general dental practitioners (GDPs), patients, insurers and policy makers) to refine that list.

Scope of literature and appraisal

Literature scoping was conducted by one researcher to obtain an overview of already existing measures in oral healthcare. A Pubmed and Google scholar literature search was conducted during July 2015 and supplemented with governmental reports, using the following search terms: (i) (performance OR process OR outcome OR quality OR indicator OR measure OR outcome OR comparator) AND (oral OR dental) AND (health OR health care); and (ii) ("process assessment" OR "outcome assessment" OR "oral health") [MeSH]. Title and abstract reviews identified twelve relevant articles/reports (Bourgeois et al. 2008; Ottolenghi et al. 2007; Ireland et al. 2001; Nordblad et al. 2010; El et al. 2012; Herndon et al. 2015; Tsichlaki and O'Brien 2014; Rodríguez et al. 2005; Petersen et al. 1994; Nutbeam 1998; Gezondheidsraad 2012).

A long list of topics from the literature was created. Initial appraisal of the relevance, validity and importance of the retrieved topics was performed through "sense check" conversations with a convenience sample of GDPs at ACTA Amsterdam and Heidelberg Dental School (n = 6). Duplicate topics were removed or merged and the remaining topics were pragmatically split up in two groups: the A and B-list. Topics were placed in the A-list if they met the following criteria:

i) Topic is measurable by using data from available sources, such as health insurance claims data, dental practice records or patient questionnaires,
ii) Topic is considered important, useful and relevant by the dentists for comparison purposes,
iii) Topic was not a disease-severity index.

Indices were excluded since the information on them is usually not routinely available, and different practices will use different indices according to their preferences. The B-list consisted of topics that were identified but failed to meet one or more of the above criteria. A second "sense check" was performed with other GDPs from the same localities (n = 8) to check whether the division into an A and B-list was sensible, and whether any missing topics could be identified.

Expert meeting

To extend the consensus process, an expert meeting was held in Frankfurt in October 2015. Expert participants from the six EU countries, identified by stakeholders, were invited (n = 15). The experts were active in either dental practice, dental policy or dental research. Participants discussed (i) the A and B-list, regarding validity, importance and relevance of each topic, (ii) how imprecise topics could be rephrased, and (iii) how the topics could be clustered.

Conversations were held in two sessions in two randomly created groups. Discussions were audio-tape recorded and facilitated by one moderator and two note-keepers. Each session consisted of 45 minutes of discussion. Analysis of discussions was undertaken by cross-checking the notes and tape-recordings against the live adjustments made in the A and B-lists.

Delphi

A two-round Delphi process was performed *t*o make further progress on consensus and refinement of topics. The Delphi method enables a structured group communication and allows judgments on specific topics, which reflect the views and opinions of a specified group (Geist 2010; Goodman 1987). The Synmind electronic platform (http://www.synmind.com/) was used for the Delphi process, which consisted of an online questionnaire covering the degree of agreement about each potential topic, and a discussion process. This allowed a real-time (RT) electronic Delphi, where respondents receive immediate feedback as the online platform updates the opinions and comments. Participants could revisit the platform at any time during the Delphi process.

The experts who attended the expert meeting recruited participants from their own countries for the Delphi process. Stakeholders who were GDPs, patients, insurers and policy makers with backgrounds in the public and private sector were invited to participate (n = 57). Of those, 46 (81%) participated in the first round of Delphi, of whom 27 were men and 19 were women (Table 1). From the first round of Delphi, 61% also participated in the 2nd round (n = 28).

The first round of Delphi ran for three weeks in December 2015 and the second round ran for two weeks in February2016. In the first week of each round, the participants were asked to score their level of agreement on the inclusion or exclusion of the topics for the development of oral health measures ('strongly disagree' (0), 'disagree' (1), 'agree' (2) and 'strongly agree'(3)) and to comment on the topics to explain their decision. For the remainder of each round, the Synmind platform was open for discussion between participants and moderators; participants could see comments and ratings of others and were able to give and receive comments. The comments and individual ratings were presented per topic and per participant. The ratings of participants were visualized in a spider diagram. The Delphi was anonymous to both the moderators and participants.

Analysis of the first round of Delphi included:

i) Reviewing the level of agreement for each topic by using percentage of agreement, mean and mode. The percentage of agreement was the sum percentage of the scores for 'agree' and 'strongly agree';
ii) Reviewing the comments to gain understanding of why the responses tended towards agreement or disagreement;
iii) Making a decision on removing, including or amending the topic depended on consensus within the research team based on steps i and ii. Any disagreements were resolved by discussion.

After the first round, the topics were revised and included into a second round of Delphi. In this round, the participants received more information about the reasons expressed to that point about why that topic was being considered, and a descriptor was provided to indicate how information on that topic could potentially be obtained from available data sources (Appendix 2).

Analysis of the second round of Delphi was based on the following criteria:

i) If the score mean was above 2, the topic remained in the list;
ii) If the score mean was 2 or less the comments were used to gain understanding why the topic should be included;
iii) Decision on removing, including or amending the topic and the adjustments within and between clusters were based on consensus within the research team based on steps i and ii and consideration of all comments and suggestions made by participants.

World Café

The World Café method enables large group dialogue and can reveal the collective intelligence of a group through multiple rounds of conversation to further develop consensus (Holman et al. 2007; Pagliarini 2006).

A World Café meeting was held in June 2016 in Amsterdam. Participants were recruited purposefully from the network of the ADVOCATE project partners (n=19). Criteria were that all groups of relevant stakeholders were involved and that all participating EU countries were represented. Every participant was allocated into six table discussions using a random sequence, so that each discussion was between a unique group of participants. Each table discussed a cluster of topics in groups of 5-6 participants for six rounds, with participants changing tables after each round. Every participant therefore discussed each group of topics once. During the discussions the moderators made sure that the following three questions were discussed: (i) whether topics were important, relevant and valid, (ii) whether there were any topics missing, (iii) whether the topics needed amendment. Participants were encouraged to write, draw or doodle points from their conversation on the tablecloth, creating a record of incremental discussions as rounds progressed. The

moderators' role was to summarize the previous, accumulating discussions on the cluster of topics, and to ensure all topics were considered in each round.

At the end of the sixth round of discussions the moderators discussed the main findings of the conversations, and made preliminary adjustments to the topics. The participants were given the opportunity to endorse the revised topics via an anonymous voting system SOCRATIVE (http://www.socrative.com/). The results of the voting were displayed live, allowing an opportunity for clarification of any remaining issues for each of the topics.

Following the meeting, a review was undertaken by the moderators to ensure all revisions to the topic list had been captured. Final revisions were agreed using the following non-exclusive criteria to guide judgements:

(i) Topics with <50% agreement during the voting were excluded from the topic list;
(ii) For topics that scored 50-75% agreement decisions for inclusion depended on the arguments made by participants during the discussions;
(iii) Topics with an agreement of >75% were included in the final topic list.

Measures development

The four-stage approach of creating consensus on oral healthcare topics resulted in a list of 48 relevant and important topics for stakeholders in oral healthcare (Figure 2, Table 2). The research team then developed measures; through discussion numerators and denominators were defined for the topics. The definition of numerators and denominators was guided by the characteristics of data likely to be available from health insurance claims data or data that can be obtained from a patient questionnaire deployed in dental practices.

Results

The scope of the literature yielded inconsistent and incomplete results for addressing the task of creating measures for oral healthcare. A total of 625 potential measures were identified from the literature search. From these only 147 were described in sufficient detail to be potentially useable, and most did not describe a clear numerator or denominator. For this reason they could only be considered as potential topics that might be developed into measures. The initial "sense check" conversations added 46 topics to the long list of topics. After removal of duplicates and the second "sense check" the A-list consisted of 39 topics and the B-list of 41 topics.

During the expert meeting, six topics were moved from the A-list to the B-list and two topics were moved from the B-list to the A-list. Two topics were added to the A-list and three topics were divided, each forming two separate topics. The expert meeting resulted in a total of 85 potential topics (45 in the A-list and 40 in the B-list), which were grouped in nine clusters (Appendix 1).

After the first round of Delphi 39 topics remained in the A-list, grouped in six clusters, and 41 topics were excluded. Forty of these 41 were in the B-list at the start of the Delphi. From the initial B-list 2 topics were combined to one topic and this was added to the A-list. Twelve topics in the original A-list were rephrased and two new topics were added (Appendix 1).

After the second round of Delphi, 38 potential topics remained (Appendix 2). In this round, agreement on the topics was, as expected, higher. Only one topic was removed and one new topic was added; in addition two topics merged to form one topic. The mean agreement for the remaining topics after the second round of Delphi on the 3-point ordinal scale was 2.5 and the mean percentage of agreement was 89%.

During the World Café the participants identified 10 missing topics, these were added to the topic list. Five topics were rephrased from the list of topics. There were four topics where agreement was 50-75% and one topic with less than 50% agreement (Appendix 3). Table 2 shows the final list of 48 topics for oral healthcare

categorized into six clusters: (i) access to dental care, (ii) symptoms and diagnosis, (iii) health behaviours, (iv) oral treatments, (v) oral prevention and (vi) patient perception.

Potential numerators and denominators based on claims data or patient questionnaires are presented in Table 3.

Discussion

Using a four-staged approach to determine valid, important and relevant topics created a strong base for the development of measures for oral healthcare. The six clusters cover all aspects of oral healthcare that were important to the stakeholders. Measures can be adjusted according to the available data source, allowing them to be utilised for comparisons at local, regional or national levels; these newly established measures are anticipated to allow more robust comparability of oral healthcare within and between countries.

Previous approaches to establish measures have been limited in number and methodological rigor,(Ottolenghi et al. 2007; Ireland et al. 2001; Nordblad et al. 2010; El et al. 2012). By using an extensive approach for development, these measures are more robust. The four approaches worked synergistically in creating consensus among relevant groups of stakeholders. Moreover, including stakeholders from six European countries allowed for the incorporation of experiences from different systems of healthcare provision, financing and education. Therefore, the set of topics developed may be applicable in different countries and for multi-country projects. As this project was restricted to the six European countries, further research may focus on whether any refinements are required for other European, non-European and especially less developed health systems.

The methods used in the present studies have some limitations. The literature search was necessarily pragmatic, because research into the development of measures was limited, but at the same time the terms “measure”, “topic” or “indicator” are widely used. By this pragmatic approach it is possible, but unlikely that any relevant topics could have been missed since an extensive approach was used. At each stage the stakeholders were asked to provide input about any potentially missing topics.

Earlier experiences with the Delphi methodology showed limitations in participants not returning to the web application to read and comment on other participants and perhaps change their own ratings and views (Freedman et al. 1980; Geist 2010). This study mitigated these risks by providing clear instructions before starting the Delphi to the participants as well as reminders to join the discussion and information about comments of other participants. The majority (61%) of the participants responded in both rounds.

Another potential limitation is that there might be items in the topic list that have been defined by stakeholders as valid, important and relevant, but which has evidence demonstrating limited effectiveness. The evidence was not formally checked for all proposed topics; this research was based on a stakeholder-centred approach. Some topics were included where current practice is subject to continuing debate about effectiveness at the population level, and similarly for topics where provision might be considered appropriate for some individuals, but probably would not be best practice for a population.

The measures developed by this study were focused on two data sources, namely insurance claims data and patient-sourced data from different countries. It is feasible that the same measures could be applied with limited modifications to different data sources, for example dental practice records.

Conclusion

To the knowledge of the authors, this study is the first to establish a set of core items for strengthening patient-centred and prevention-oriented oral healthcare by means of broad stakeholder consensus. As this study is based on international stakeholder involvement, it gives insight from the perspectives of a broad spectrum of stakeholder groups on important and relevant aspects within oral healthcare. The method adopted allowed the stakeholders to select and endorse the topics. The topics form a well-established basis that can be developed and further refined into measures that can be used in oral healthcare at different levels in the healthcare system - local, regional national or even international - to provide insight into dental practice by comparison within and among systems. Using these measures for practice feedback has the potential to strengthen the focus on prevention as well as patient-centeredness and therefore stimulate patient engagement and the trust and understanding between patients and their providers.

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Contibutorship

Idea and conception of this consensus study: Maskrey, Listl, Van der Heijden. Design of this consensus study: Baâdoudi, Trescher, Maskrey, Duijster, Gabel, Listl, Van der Heijden. Collection, analysis and interpretation of study data: Baâdoudi, Trescher, Maskrey, Duijster, Gabel. Drafting of manuscript: Baâdoudi. Critical revision of drafts and review of intellectual content of manuscript: Baâdoudi, Trescher, Maskrey, Duijster, Gabel, Listl, Van der Heijden. Confirmation of agreement with and approval of submitted manuscript: Baâdoudi, Trescher, Maskrey, Duijster, Gabel, Listl, Van der Heijden and ADVOCATE consortium. Supervision and guarantors of this consensus study: Listl & Van der Heijden on behalf of the ADVOCATE Consortium.

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Tables

Table 1. Delphi participants' characteristics

Characteristics n = 46	***mean (range)***
Age (years)	44 (26-69)
	n (%)
Gender	
Male	27 (59)
Female	19 (41)
Occupation	26 (46)
Dentist	11 (19)
Dental specialist	6 (11)
Hygienist/therapist	2 (4)
Dental policy sector	2 (4)
Insurance sector	2 (4)
Patients	3 (5)
Practice	26 (46)
Public	10 (18)
Private	3 (5)
Part public/private	6 (11)
Other	7 (12)

Table 2. Topics list after four-stage process of scoping the literature, expert meeting, Delphi and World Café.

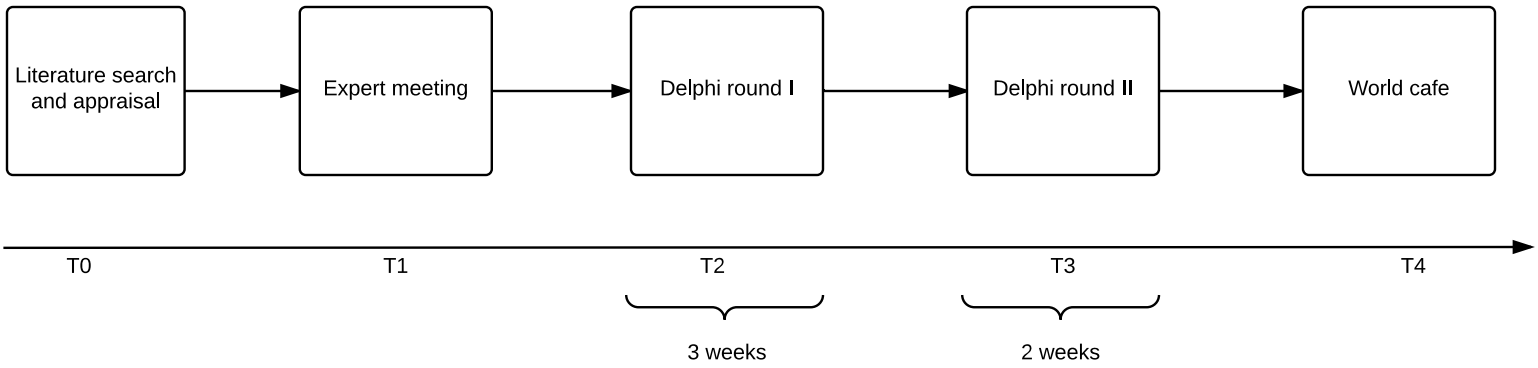
Topic
Group 1-Access to dental care
Reason for dental visit *
Funding of dental care provided *
Interval of dental check-ups by a dentist *, **
Referrals *
Decision not to proceed with recommended dental care solely due to costs *
Decision not to proceed with recommended dental care for other reasons than costs *
Access to dental care (affordability, availability and acceptability) *
Group 2- Symptoms and diagnosis
Current symptoms *
Communication about symptoms and wishes *
Medical history *
Social history *
Number of teeth *
Radiographs (x-rays) *, **
Periodontal examination *, **
Oral mucosa and cancer screening *
Examination for new caries lesions *
Group 3- Health behaviours
Tooth brushing *
Use of fluoride toothpaste *
Interdental cleaning *
Smoking *
Alcohol consumption *
Diet *
Group 4- Oral treatments
Fillings *, **
Root canal treatment *, **
Crowns and bridges *, **
Retreatment *, **
Periodontal treatment *, **
Extraction *, **
Partial removable dentures *, **
Full removable dentures *, **
Dental implants *, **
Aesthetic treatment (veneers, facings, whitening) *, **
Complications as a result of treatment *
Antibiotics prescribing *
Group 5 – Oral prevention

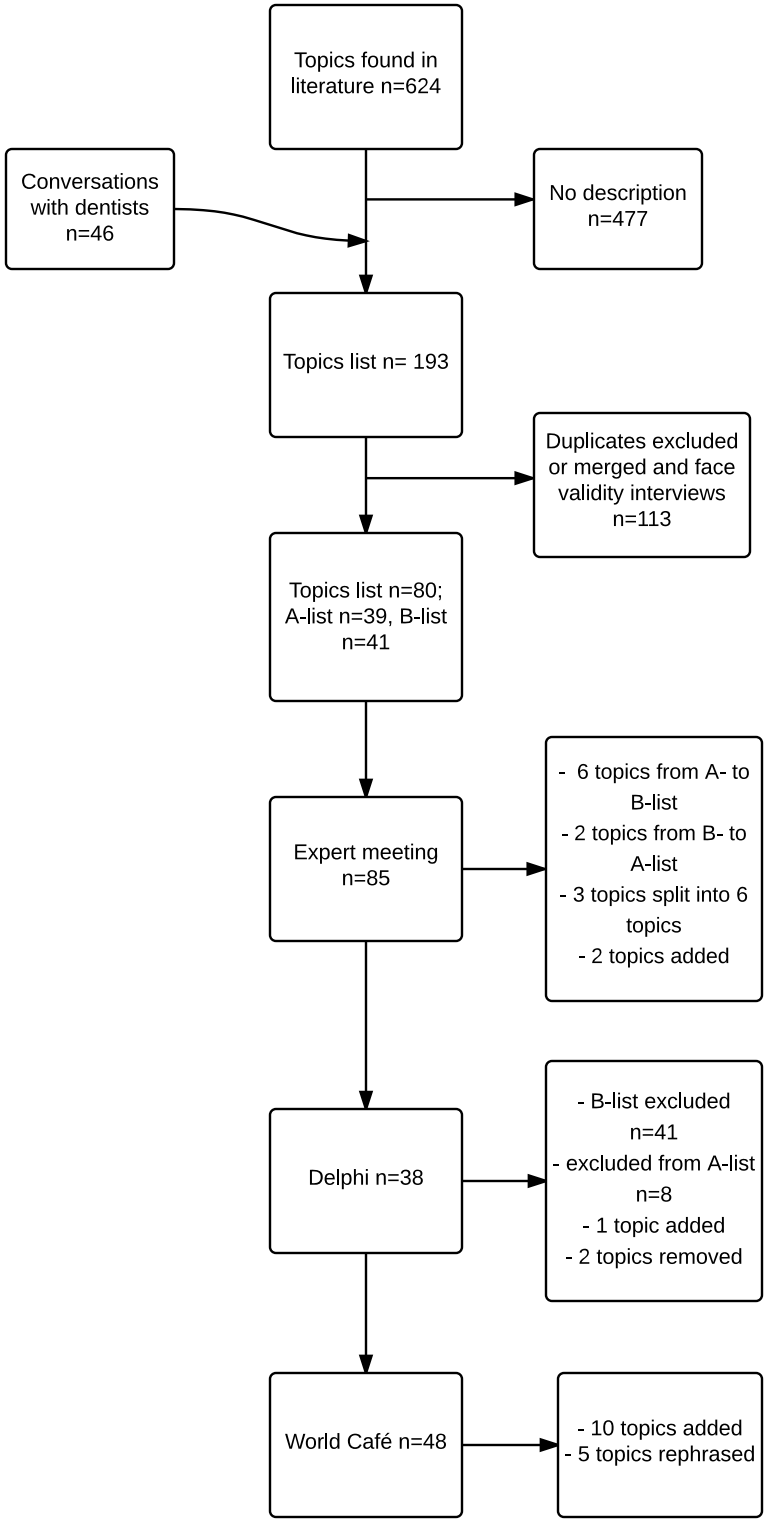
	Fissure sealants *, **
	Fluoride application *, **
	Professional cleaning (clean and polish) *, **
	Oral hygiene advice *, **
	Dietary advice *
	Smoking advice *
	Caries under surveillance *
	Risk assessment for tailored prevention***
Group 6 – Patient perception	
	Oral function (chewing, speaking, etc.) *
	Appearance of teeth *
	Dental anxiety *
	Shared decision making (active patient involvement in treatment planning) *
	Patients' satisfaction with received treatment*
	Patients' perception on dental care *

* Measure available through patient questionnaire data
** Measure available through claims data
*** Measure not available through patient questionnaire data or claims data

Table 3. Oral health measures: numerators and denominators

	Data from claims data sources	**Data from patient questionnaires deployed in a dental practice**
Numerator/ Denominator	The number of patients with a specific treatment or diagnostic test performed / the total number of claimed services per year	The number of people responding to the question with a specific answer / the total number of people responding to the question
Example	**Extraction**	**Medical history**
Numerator / Denominator	Total number of extractions in a given age group/ Total number of patients with at least one service claimed per year	The number of people responding "yes" to the question: "Does your dentist ask you in every visit about your medical history and medicines you use?"/ the total number of people responding to the question.


Literature search and appraisal
Expert meeting
Delphi round I
Delphi round II
World cafe
T0
T1
T2
T3
T4
3 weeks
2 weeks


Topics found in literature n=624
Conversations with dentists n=46
No description n=477
Topics list n= 193
Duplicates excluded or merged and face validity interviews n=113
Topics list n=80; A-list n=39, B-list n=41
Expert meeting n=85
- 6 topics from A- to B-list
- 2 topics from B- to A-list
- 3 topics split into 6 topics
- 2 topics added
Delphi n=38
- B-list excluded n=41
- excluded from A-list n=8
- 1 topic added
- 2 topics removed
World Café n=48
- 10 topics added
- 5 topics rephrased

Appendices

Appendix 1 Analysis Delphi round I

Topics	Mean	Agreement in- and exclusion (%) *	Excluded/Included	Reason
List A -Group 1 – General dental practice and attendance				
1.1 Type of dental practice funding (public, private, both)	2.1	86%	Included	Funding may impact the treatment choices or show lack of resources; important for good comparison
1.2 Total number of dental visits in (time horizon to be specified)	2.0	76%	Excluded	Topic is covered by topic 1.3, 1.4 and 1.5.
1.3 Interval of regular dental check-ups	2.4	92%	Included (rephrased)	Important to know whether interval is patient-based and provides information on interest of patient in oral health – says something on preventive attitude
1.4 Number of acute dental visits	2.2	90%	Excluded	Replaced by topic 1.5
1.5 Reasons for dental visit (problem, treatment, check-up)	2.5	93%	Included (rephrased)	Topics, 1.2, 1.3 and 1.4 could be merged together into one topic

1.6 Reasons for non-attendance (costs, anxiety, etc.)	2.3	90%	Excluded	Not possible to measure non-attendance in people who attend. Part on anxiety included in group 6
1.7 Care continuity (duration of being registered at the same dentist)	1.8	68%	Excluded	Care continuity should be measured together with satisfaction, access and mobility. Care continuity cannot be retrieved appropriately.
1.8 Decision not to proceed with recommended dental treatment due to cost	1.9	75%	Included (rephrased)	Costs are important in treatment choice and non-attendance.
1.9 Referral to dental specialist	2.0	75%	Included (rephrased)	Gives insight into whether there is knowledge of the boundaries of care and might reflect the complexity of treatment undertaken within the practice
Additional topics on access: - Distance to practice (km) - Age of first attendance	-	-	Included (new)	
List A – Group 2 -Oral symptoms and diagnoses				
2.1 Current symptoms	2.5	92%	Included (rephrased)	Provides important information for treatment and prevention planning. Furthermore it reflects reasons for attendance
2.2 Medical history (co-morbidities and medication)	2.6	93%	Included (rephrased)	The mouth is part of the body and both interact, so information is essential for diagnosis, treatment and prevention.

2.3 X-rays (including bitewings, solo's and OPT's)	2.4	92%	Included (rephrase with comment)	Important and inevitable in daily practice. Remark: X-rays on indication cannot be measured, since patients won't remember and the information is not registered or claimed. Total number of x-rays reimbursed/claimed can be measured.
2.4 Periodontal examination (BPE, PI, BI, PSI, PD)	2.8	97%	Included (remark)	Gives basic information that is essential for the oral health status and it tells something about the awareness of the dentist. However information cannot be retrieved in all countries (e.g. Netherlands)
2.5 Bleeding gums (after/during tooth brushing)	2.2	76%	Excluded	Topic is covered in the topics 2.1 and 2.4
2.6 Pain/discomfort	2.5	87%	Excluded	Topic is covered in the topic 2.1.
2.7 Mirror/probe examination (general check-up)	2.5	91%	Excluded	It is part of the regular check-up/screening process, this topics would not provide additional information besides the topic on check-up
2.8 Number of teeth	2.5	95%	Included	Important topic on the oral health status, however the acquisition of this information is for discussion.
List A – Group3 -Health behaviours				
3.1 Tooth brushing (frequency, duration, method)	2.6	95%	Included	Important topic for oral health, hygiene and might be an indicator of compliance. However people give social desirable answers to this.
3.2 Use of fluoride toothpaste	2.4	95%	Included (add remark)	Might give information on how the dentists inform their patients. Remark added is that probably >99% of people use fluoride toothpaste, information collected through this topic will be an exception.
3.3 Interdental cleaning (tooth picks, floss, toothbrush)	2.6	97%	Included	Important topic, especially with increasing age. But compliance is often a problem and there is doubt on the true effectiveness of interdental cleaning.
3.4 Smoking	2.6	95%	Included	Relevant for general health and oral health. You can even speak of a legal

			(with remark)	and ethical obligation for the dentists to inform patients on the consequences and dangers. However patients might not want to hear another expert-opinion.
3.5 Alcohol use	2.1	76%	Included (with remark)	Same reasons as topics 3.4, but with alcohol use it seems likely that even more social desirable answers occur.
3.6 Diet (sugary foods & drinks, fruits, bottle use, acids, etc.)	2.5	95%	Included (rephrased)	Important topic for caries and erosion. But also important for dietary habits that can lead to other oral and general health problems. Remark on how and what to measure, number of eating moments, sugary foods and drinks and/or acidic.
List A – Group 4 - Oral treatments				
4.1 Fillings	2.7	97%	Included(with remark)	An important topic where a lot of specific information can be retrieved from, for example, filling placed where decay has gone through enamel, type of filling, restorations etc. Remark: However many of these specific information on fillings cannot be retrieved from claims data or patients
4.2 Extractions	2.6	94%	Included (with remark)	Important for assessing dental health, more important is why the extraction is done, however this information cannot be retrieved.
4.3 Root canal treatment	2.6	95%	Included	Important in a dental practice. Not much discussion on this topic.
4.4 Periodontal treatment	2.6	92%	Included (rephrase)	Important topic that relates to retreatment. Rephrase to make it clearer.
4.5 Retreatment	1.9	64%	Included (rephrased)	Low retreatment rates are one of the best indicators for a high standard of initial care.
4.6 Crowns, bridges and veneers / facings	2.3	76%	Included	Aesthetics are an important component of oral health
4.7 Dental implants	2.3	84%	Included	Depends on availability and preference of the dentists. Questionable whether it improves oral health, but an important topic for comparison of dentists.

4.8 Full removable dentures	2.4	86%	Included	Large agreement and no counterarguments given for exclusion. Dentures are especially important with the ageing population.
4.9 Partial removable dentures	2.5	89%	Included	Large agreement. Important for quality of life.
4.10 Orthodontic treatment	1.9	68%	Excluded	Orthodontic treatments are usually not performed by the general dental practitioner.
4.11 Trauma-related treatment	2.1	78%	Excluded	Is included in topic 1.5
4.12 Sedation	1.2	35%	Excluded	Not essential in general dental practice- very specialised
List A – Group 5 - Preventive treatment and surveillance				
5.1 Fissure sealants	2.4	95%	Included	Prevention, especially important for children.
5.2 Fluoride application	2.6	95%	Included	Important, question that can be answered is whether its performed as a regular treatment (mainly in children) or only for high risk patients.
5.3 Health advice (dietary advice, oral hygiene instruction, smoking cessation, etc. and follow-up)	2.7	100%	Included (rephrased)	Full agreement, important for oral health and oral health policy. Topic separated into a topic on oral hygiene advice, dietary advice and smoking advice.
5.4 Professional cleaning (scale & polish, plaque removal)	2.4	85%	Included	The effectiveness is questioned but it is still considered an important topic.
5.5 Caries under surveillance	2.1	81%	Included (rephrased)	The topic means: whether there is shared knowledge about early caries, and not supervised neglect.

5.6 Time without restoration	1.8	65%	Excluded	Although it would be interesting to know, but almost impossible to collect this information. Even if collected through a questionnaire there would be a high risk of reporting bias.
List A – Group 6 – Patient's perception				
6.1 Patient satisfied with function (speaking, chewing, smiling, etc.)	2.5	92%	Included (rephrased)	Important topic, only smiling is already covered by topic 6.2.
6.2 Patient satisfied with appearance of teeth	2.3	95%	Included	Important topic, however only relevant when the expectation are realistic
6.3 Patient involved in decision making	2.5	90%	Included (rephrased)	"This is crucial and reflects the capability of the dentist as well as the healthcare/insurance system to offer time to educate and inform patients about risks, possibilities, alternatives and prognosis of several treatment options".
6.4 Patient recommends dentist to friends and family	1.7	57%	Excluded	Provides feedback for the dentists but is not a core topic.
Additional topic on: - Anxiety				Topic 1.6 on dental anxiety is placed in group 6
List B – Group 7 – Signs and symptoms				
7.1 Teeth grinding	1.4	56%	Excluded	Not measurable and too specific.
7.2 Teeth wear	1.6	54%	Excluded	Not measurable, although many find this important especially since it is a growing problem.
7.3 Temporomandibular joint disorder (TMD)/jaw dysfunction.	1.3	46%	Included (rephrased and remark)	Mentioned as a comment at several topics, but there are difficulties accurately assessing whether patients have TMD problems. Remark: do you have suggestions for measuring TMD through patients (claims data won't give this information)

7.4 Halitosis (bad breath)	1.8	64%	Excluded	Majority agrees to exclude and partially it is covered in topic 2.1.
7.5 Bad taste	1.9	66%	Excluded	Majority agrees to exclude and partially it is covered in topic 2.1.
7.6 Saliva problems	1.1	40%	Excluded	Important part of oral health but not a core topic. Partially included in topic 2.1.
List B – Group 8 – Preventive				
8.1 Adverse habits (e.g. pen biting)	2.0	79%	Excluded	Not a core topic.
8.2 Bottle milk during the night	1.5	58%	Excluded	Partially covered in the topic on dietary advice in group 5. Furthermore it concerns a specific group
8.3 Obesity	1.7	62%	Excluded	Controversy whether the dentists should give advice on this.
8.4 Exercise	3.1	90%	Excluded	Not the role of the dentist to give advice on this.
8.5 Compliance (following the preventive advice of the dentist)	1.0	22%	Excluded	Important in practice, however cannot be reliably measured.
8.6 Mother's knowledge of fluoride toothpaste	1.5	54%	Excluded	Specific topic and partially covered in topic 3.2.
8.7 Preventive care-seeking for pregnant women	1.6	57%	Excluded	Too specific – not core topic. But agreement that this is important for this specific group.
8.8 Fluoride exposure rates	1.5	52%	Excluded	Information cannot be retrieved from claims data or patients, other sources would not provide practice specific information.

8.9 Plaque improvement	1.3	43%	Excluded	Partially covered in periodontal examination and it is difficult to measure.
8.10 Prevention programs at school	1.4	44%	Excluded	Specific group and is not dental practice related
Additional topic: - Elderly			Excluded	Not a core topic.
List B – Group 9 – Dental practice provided to patient				
9.1 Population per dentist	1.5	50%	Excluded	Partially measured by the social demographic characteristics.
9.2 Patients with special needs	1.5	57%	Excluded	Specific group and difficult to measure.
9.3 Training in motivational interviewing	1.8	69%	Excluded	Difficult to measure.
9.4 Orthodontic failures	2.2	78%	Excluded	Not a core topic and difficult to measure.
9.5 Orthodontic after care - retentions	1.9	75%	Excluded	Not a core topic.
9.6 Teeth with fracture	1.6	53%	Excluded	Partially covered by topic 1.6.
9.7 Complaints from patients	1.6	57%	Excluded	Access to this information is difficult to retrieve, however partially information for this topic is retrieved in topics 6.1 and 6.2.
9.8 All indexes	1.3	46%	Excluded	This information is usually not registered, so not measurable.

(DMFT, DMFS, DPSI, etc)				
9.9 Replacement of restoration	1.6	59%	Excluded	Covered in topic 4.5.
9.10 Use of composite or amalgam	1.5	60%	Excluded	Not essential information.
9.11 Use of dental dam	1.8	76%	Excluded	Evidence is not strong- not a core topic
9.12 Number of teeth with a mobility >1mm	1.9	71%	Excluded	Covered by topic 2.4.
9.13 Pocket assessment	1.4	46%	Excluded	Covered by topic 2.4.
9.14 Surgical periodontal treatment	1.8	65%	Excluded	Evidence is not strong. Covered by topic 2.4.
9.15 Presence of infection (sepsis)	1.5	64%	Excluded	Not measurable- often not registered
9.16 Treatment of dental anxiety	1.7	62%	Excluded	Covered in group 6.
9.17 Treatment plan and costs	1.4	51%	Excluded	Covered in topic 6.3.
9.18 Cost of	1.7	64%	Excluded	Covered in topic 1.8.

treatment acceptable to patient				
9.19 Visiting hygienist for treatment or by referral	1.7	65%	Excluded	Not a core topic for all countries and is partially covered in topic 1.9.
9.20 Mouth guards	2.1	84%	Excluded	Not a core topic.
9.21 Oral mucosal lesions	1.0	40%	Excluded	Added to topic 9.23
9.22 Dental fluorosis	2.0	81%	Excluded	Not a core topic.
9.23 Oral cancer screening	0.7	27%	Included (rephrased)	Merged with oral mucosa screening.
9.24 Absence of plaque	1.8	70%	Excluded	Covered in topic 2.4.

* topics in groups 1-6 were asked whether the topics should be included, the topics in the groups 7- 9 were asked whether the topics should be excluded.

Appendix 2 Analysis Delphi round II

Topics	Descriptor	Source/Note	Mean	Agreement (%)	Included	Reason
Group 1 – Information about attendance						
1.1 Reason for dental visit	'I visited the dentist today, because…' • New symptoms/ unplanned treatment • Planned check-up • Planned treatment • Planned preventive treatment • Trauma/emergency treatment (more than one possible)	patient questionnaire	2.8	100	In	Basic information that gives insight in expectations and habits of the patient.
1.2 Travel time to dental practice	'How long does it take you to travel to your dental practice?' • < 15 min • 15 - 30 min • 30 - 60 min • > 60 min	patient questionnaire	1.3	38	Out	Not relevant for majority of patients to get the care they need and it is biased by the mode of transportation.
1.3 Funding of dental care provided	'How is your dental care for today funded'? • Public sector / public insurance scheme – fully funded • Public sector / public insurance scheme – with co-payment • Private insurance scheme • Self-payer	Patient questionnaire, some countries also from claims data	2.2	93	In	Important since there might be a perceived difference of care according to the type of funding.
1.4 Interval of dental check-ups	Time between dental check-ups AND / OR 'How often do you come to the dentist for a dental check-up?' • 3-4 times a year • 2 times a year	Patient questionnaire and/or claims data	2.5	93	In	Important for measuring and improving overall oral health

	• Once a year • Irregularly • Never					
1.5 Referral by your dentist	'Have you ever been referred by your dentist to:' • Oral hygienists • Periodontist (gum disease) • Root canal specialists • Orthodontist • Other (none or more than one possible)	Patient questionnaire	1.9	70	In	For some countries this will provide important information since a substantial part of care is provided by others.
1.6 Decision not to proceed with recommended dental care solely due to costs	'Have you ever decided not to proceed with dental care solely due to costs?' Yes / No	Patient questionnaire	2.2	90	In	Important since it might affect the decision for a treatment (plan).
Group 2 – Symptoms and diagnosis						
2.1 Current symptoms	'Do you currently suffer from:…?' • Pain • Discomfort • Bleeding • Dry mouth • Bad taste • Bad breath	Patient questionnaire	2.7	96	In (topic 2.7 merged together)	Important basic information that is vital for diagnosis and treatment planning.
2.2 Medical history	'My dentist asked me about my medical history and what medicines I am taking?' Yes/No	Patient questionnaire	2.5	92	In	Basic information that is needed for an appropriate treatment (plan). Note: some find only dental history important and not medical history.
2.3 Number of	'Adults can have up to 32 natural teeth (that	Patient	2.1	68	In	Important for oral

teeth	includes wisdom teeth), but over time people lose some of them. How many natural teeth have you got? …. (Count total number of teeth)'	questionnaire				health, however difficult as self-reported measure of patients.
2.4 X-rays	'Number of X-rays taken in the previous 12/24/36 months' AND/OR 'Have you had any x-rays taken by your dentist in the last 12/24/36 months?'	Patients questionnaire and/or claims data Note: It is unlikely that we will be able to obtain information on the reason why the x-ray has been taken.	2.1	79	In	Important for diagnosis and further treatment, but self-report by patients might be biased as they will not remember.
2.5 Periodontal examination	'Dentist performs formal periodontal disease scoring (bleeding score, plaque score, pocket depth, etc.)'	Claims data	2.5	92	In	Important for oral health status. Especially an important topic since in some countries there is no registration of this.
2.6 Oral mucosa and cancer screening	-	Important topic, But how to retrieve this information accurately, completely and reliable?	2.5	89	In	Important for a dentists to measure however question are raised on how this could be measured, since in most cases patients won't know because it is part of the dental examination.
2.7	'My dentist asks me about any problems	Patient	1.9	64	Out	

Temporomandibular joint dysfunction (dysfunction of muscles, joints and/or jaw)	with my jaw muscles or joints' Yes/No	questionnaire Note: Should this be added to topic 2.1?			(Merged with topic 2.1)	
Add new topic on dental caries examination	'Does your dentist usually examine your teeth for new cavities?' Yes/No	Patient questionnaire	-	-	In (added)	Rose to be a missing topic in the list while it is an important part of daily practice.
Group 3 – health behaviours						
3.1 Tooth brushing	'How often do you usually brush your teeth?' • Irregularly • Less than once a day • Once a day • Twice a day More than twice day	Patient questionnaire	2.8	96	In	Important topic however might give social desirable answers.
3.2 Use of fluoride toothpaste	'Do you use fluoride toothpaste?' • Yes/No/Don't know	Patient questionnaire Note: Since most people use fluoride toothpaste (>95%) does this topic add any value?	2.2	77	In	Debated topic. Some people agree that it's not relevant because >95% use fluoride toothpaste. Others are still interested in capturing the percentage that does not use fluoride (nature trend) as this might affect oral health.
3.3 Interdental cleaning	'How often do you use tooth picks, floss or interdental brushes?'	Patient questionnaire	2.5	89	In	Found important however evidence is

	• Never • Once a month or less • Several times a month • Several times a week • Daily					not clear on this.
3.4 Smoking	'Do you smoke tobacco?' • Yes, I am a current smoker • No, but I have been a smoker in the past • No, I have never been a smoker	Patient questionnaire	2.6	93	In	Important topic for general and oral health.
3.5 Alcohol consumption	'How often do you drink alcohol?' • Never • Once a month or less • 2-4 times a month • 2-3 times a week • 4-5 times a week • More than 5 times a week	Patient questionnaire Note: Alcohol is a risk factor for oral cancer, but the absolute increase in risk is very small.	2.0	74	In	Important topic for health however debate on the effectiveness of advice on alcohol intake is part of the role of a dentist.
3.6 Diet	'How often do you eat something between meals? • Never • Less than once a day • 1-2 times a day • 3-5 times a day • More than 5 times a day 'How often do you drink acidic drinks during the day (fruit juices, fizzy drinks, energy drinks or squash)?' • Never • Less than once a day	Patient questionnaire Note: Dietary information is prone to reporting bias. The provision of dietary advice by dentists is covered in group 5.	2.3	81	In	Basic information especially important in relation to caries.

	• 1-2 times a day • 3-5 times a day • More than 5 times a day					
Group 4 – Oral treatments						
4.1 Fillings	Number of fillings in the past 12/24/36 months, AND/OR 'Have you had any new fillings in the last 12/24/36 months?'' • Yes/No	Claims data and perhaps patient questionnaire	2.6	100	In	Important basic information, but patients might not remember or know this.
4.2 Root canal treatment	Number of root canal treatment in the past 12/24/36 months, AND/OR 'Have you had any root canal treatment done in the last 12/24/36 months?'' • Yes/No	Claims data and perhaps patient questionnaire	2.3	96	In	High agreement on including this topic
4.3 Crowns, bridges and veneers/facings	Number of crowns, bridges or veneers/facings in the past 12/24/36 months, AND/OR 'Have you had any crowns, bridges or veneers/facings in the last 12/24/36 months?'' • Yes/No	Claims data and perhaps patient questionnaire Note: veneers and facing kept in the topics list because esthetics was found an important issue in oral health care	2.2	88	In	Majority agrees to include the topic, but comments are made on this topic being an aesthetic topic and not an oral health measure.
4.4 Retreatment	'In the last 12/24/36 months, have you had any filling, root canal treatment, crown or bridges that had to be redone within 12 months of the original treatment?' • Yes	Claims data and perhaps patient questionnaire	2.1	78	In	Suggestion to use 24 months. Some doubts on the reliability of the gathered information

	• No • Unsure/can't remember					
4.5 Periodontal treatment	Number of patients with claims for periodontal treatment in the past 12/24/36 months, AND/OR 'Did you receive any treatment from a dental healthcare provider for gum disease in the last 12/24/36 months?'' • Yes/No	Claims data and perhaps patient questionnaire	2.4	100	In	Part of basic oral healthcare.
4.6 Extractions	Number of extractions in the past 12/24/36 months, AND/OR 'Have you had any teeth removed in the last 12/24/36 months?'' • Yes/No	Claims data and perhaps patient questionnaire	2.6	96	In	Useful information and can validate the topic on how many teeth do you have.
4.7 Partial removable dentures	Number of partial removable dentures placed in the past 12/24/36 months, AND/OR 'Did you get a new partial removable denture in the last 12/24/36 months?'' • Yes/No	Claims data and perhaps patient questionnaire	2.2	89	In	Majority agrees this is important information for the dentist and patients will be able to answer this.
4.8 Full removable dentures	Number of full removable dentures placed in the past 12/24/36 months, AND/OR 'Did you get a new full removable denture in the last 12/24/36 months?'' • Yes/No	Claims data and perhaps patient questionnaire	2.3	93	In	Majority agrees this is important information for the dentist and patients will be able to answer this.
4.9 Dental implants	Number of dental implants in the past 12/24/36 months, AND/OR 'Have you had any dental implants placed	Claims data and perhaps patient questionnaire	2.3	93	In	Majority agrees this is important information for the dentist and patients will be able to

	in the last 12/24/36 months?'' • Yes/No					answer this.
Group 5 – Oral prevention						
5.1 Fissure sealants	Number of fissure sealants in the past 12/24/36 months.	Claims data and patient questionnaire	2.3	89	In	Important prevention topic. Note that the cases where it has fallen out are probably not included
5.2 Fluoride application	Number of fluoride application in the past 12/24/36 months.	Claims data and perhaps patient questionnaire	2.4	89	In	Important prevention topic. Note: how to measure over and under use.
5.3 Professional cleaning (scale, polish and plaque removal)	Number of claims for professional cleaning in the past 12/24/36 months, AND/OR 'Have you had a 'clean and polish' done in the dental practice in the last 12/24/36 months?'' • Yes/No	Claims data and perhaps patient questionnaire	2.4	100	In (rephrase)	Important part of daily practice. Clean and polish instead of scale and polish.
5.4 Oral hygiene advice	'My dentist advises me on tooth brushing and other aspects of oral hygiene' • Yes/No	Patient questionnaire	2.6	100	In	Essential advice
5.5 Dietary advice	'My dentist gives me dietary advice to prevent dental caries and/or erosion. • Yes/No	Patient questionnaire	2.4	93	In	Important information in relation to caries and erosion which are important factors in oral health
5.6 Smoking advice	'My dentist advises me about the effects of smoking on my health' • Yes/No	Patient questionnaire	2.3	89	In	Question only for adults (not children)
5.7 Caries under surveillance	'Has your dentist talked to you about an early caries lesion in the last 12/24/36	Patient questionnaire	2.0	73	In	Informative but difficult to get this

	months that only required observation?'					data from patients and dentists might provide social desirable answers.
Group 6 – Patient perception						
6.1 Oral function (chewing, speaking, etc.)	'I am satisfied with my ability to chew, eat and speak.' • Strongly agree • Agree • Disagree • Strongly disagree	Patient questionnaire	2.4	93	In	Important feedback information (quality of life)
6.2 Appearance of teeth	'I am satisfied with the appearance of my teeth.' • Strongly agree • Agree • Disagree • Strongly disagree	Patient questionnaire	2.0	77	In	Important factor for patients, aesthetics increasingly important to people (quality of life).
6.3 Dental anxiety	'I was anxious before attending the dentist today' • Strongly agree • Agree • Neutral • Disagree • Strongly disagree	Patient questionnaire	2.1	81	In	Important from patient management perspective.
6.4 Shared decision making	'Does your dentist involve you in making clinical decisions as much you want to be?' • Always • Sometimes • Rarely • Never	Patient questionnaire	2.4	92	In	It is an obligation for the dentist to involve their patient in the decision making.

Appendix 3 voting of oral healthcare topics during the World Café

Topics of oral healthcare	Agreed (%)	Disagreed (%)	Abstained(%)
Group 1 : Access to dental care			
Reason for dental visit	100	0	0
Funding of dental care provided	95	0	5
Interval of dental check-ups by a dentist	95	5	0
Referrals	50	30	20
Decision not to proceed with recommended dental care solely due to costs	95	0	5
(Decision not to proceed with recommended dental care for other reasons than costs)	100	0	0
Access to dental care	100	0	0
Group 2: Symptoms and diagnosis			
Current symptoms	100	0	0
Communication (prompting questions) about symptoms and wishes	90	5	5
Medical history	95	0	5
Social history	85	10	5
Number of teeth	60	30	10
X-rays	65	15	20
Periodontal examination	90	0	10
Oral mucosa and cancer screening	65	5	30
Examination for new caries lesions	85	5	10
Group 3: Health behaviours			
Tooth brushing	100	0	0
Use of fluoride toothpaste	100	0	0
Interdental cleaning	90	10	0
Smoking	95	0	5
Alcohol consumption	75	10	15
Diet	85	10	5
Recreational drug use	35	35	30
Group 4: Oral treatments			
Periodontal treatment	100	0	0
Fillings	100	0	0
Root canal treatment	100	0	0
Crowns, bridges and veneers/facings	95	0	5

Retreatment	75	15	10
Extraction	100	0	0
Partial removable dentures	95%	5	0
Full removable dentures	100	0	0
Dental implants	95	0	5
Complications as a result of treatment	85	10	5
Antibiotics prescribing	95	5	0
Group 5: Oral prevention			
Fissure sealants	100	0	0
Fluoride application	100	0	0
Professional cleaning (clean and polish)	85	15	0
Oral hygiene advice	100	0	0
Dietary advice	80	10	10
Smoking advice	80	10	10
Caries lesions under surveillance	90	0	10
Risk assessment for tailored prevention	90	0	10
Group 6: Patient perception			
Oral function (chewing, speaking, etc.)	100	0	0
Appearance of teeth	90	5	5
Dental anxiety	95	0	5
Shared decision making (active patient involvement)	100	0	0
Patients' satisfaction with received treatment	95	0	5
Patients' perceptions on dental care	100	0	0