Dutch oral health care quality measures: a modified Delphi study

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Objectives: Quality measures offer opportunities for evaluation and improvement of the quality of oral health care. This study describes the development of a core set of oral health care quality measures for adults in the Netherlands, which can be used in dental practice. **Materials and methods:** A comprehensive two-stage approach was used, consisting of: (1) identification of an initial set of measures based on appraised literature; and (2) a four-round modified RAND/UCLA Appropriateness Method to establish measures that are relevant, appropriate and important to oral health care. Measures were rated anonymously on a nine-point Likert scale, ranging from 1 (lowest rating) to 9 (highest rating), followed by a group discussion to reach consensus. Multiple key stakeholder groups in the Dutch oral health care field were involved in the Delphi rounds, including dental professionals, scientists and representatives from Dutch oral health care organisations. **Results:** The study resulted in a core set of 13 oral health care quality measures. The measures cover domains related to oral disease outcomes, oral treatment and preventive services, patient experiences, patient safety, and organisational aspects of oral health care. In addition, the study led to the identification of 49 structural aspects of oral health care that are important to measure. **Discussion:** To our knowledge, this is the first study combining appraised literature from a systematic review and a rigorous multi-stage procedure with extensive stakeholder involvement to develop a core set of oral health care quality measures. In the next phase, the measures will be tested on feasibility, reliability, and will be piloted and implemented in practice.

Key words: Quality improvement, quality measures, Delphi, oral health care

INTRODUCTION

Quality measurement is a powerful method to foster quality improvement in oral health care. As a result of the high costs of oral health care, scarce resources and variations in the provided care, routine feedback information on the quality of oral health care is becoming increasingly important[1,2]. Accessible, transparent information about the quality of oral health care offers dentists and policymakers the potential to evaluate and improve the quality of care[6,7].

A quality measure can be defined as 'a measurable element of practice performance for which there is evidence or consensus that it can be used to assess and change the quality of care provided'[8]. These measurable elements can refer to the structures, processes or outcomes of care[9]. Structure measures provide information on practice organisation, process measures describe what providers do to enhance or maintain care, and outcome measures reflect on the health status of a patient[10]. A lack of oral health care quality measures (OHQMs) was previously highlighted by the National Academy of Medicine[11]. Thereafter, various quality improvement initiatives have established OHQMs[7]. In some countries, experts in the field of oral health care quality improvement even caution against a possible overproliferation of measures[12]. Prior work showed that although many measures have been developed, the clinimetric properties (e.g. reliability, validity) of measures have seldom been evaluated.

Besides scientific rigor in terms of validity and reliability, a desirable attribute of a sound quality measure is that it should be feasible to implement. In oral health care, these key attributes are challenging. At present very few measures have been piloted in practice to evaluate their feasibility[7]. Testing oral health care measures in practice requires suitable information systems that include the provision of routine data

with high quality. Another essential attribute, the quality of the supporting evidence on which the measures are based, has seldom been considered during the development process of OHQMs and this remains a challenge within the oral health care field[12]. And finally, to enhance the acceptability of measures, it is pivotal to involve all stakeholders who will use the measures, or will benefit from the measures. The development process of existing measures often lacks the involvement of one or more relevant stakeholder groups.

As a consequence, the need for feasible, reliable, valid and acceptable OHQMs remains[7]. Against the background of a possible overproliferation of quality measures, the development of a core set of measures should concentrate on solely constructing measures of high quality that are truly important to measure[13,14]. Ideally, all relevant dimensions of oral health care are covered by this core set of OHQMs. Most of the currently available OHQMs focus specifically on children, and are often aimed at technical aspects and processes of care[7]. Currently, there are no studies available describing the development of a set of measures aiming to cover all aspects of quality. OHQMs can facilitate conversations between dental professionals, policymakers and patients, and provide insights on the quality of delivered oral health care by the generation of meaningful feedback data. These data can be used to identify best practices and areas for improvement. OHQMs may encourage dental professionals to use routine feedback data to reflect on their own dental practice performance. Few sets of OHQMs have been specifically developed with the aim to provide feedback on a practice level. The aim of this study was therefore to develop a core set of OHQMs for adults that cover multiple domains of quality of oral health care and are suitable for use in general dental practice.

MATERIALS AND METHODS

Design and setting

This study was conducted in the Netherlands. A two-stage approach was used for the development of a core set of OHQMs. The approach consisted of: (1) identification of an initial set of measures based on appraised literature; and (2) a four-round modified RAND/UCLA Appropriateness Method, which is a structured modified Delphi process for soliciting expert opinion about complex problems[15]. The method consists of multiple rounds combining anonymous questionnaires, expert opinion, controlled feedback and group discussion for reaching consensus. The four rounds were carried out between November 2017 and April 2018. A waiver was obtained from the Medical Ethical Committee of the Radboud University Medical Center in Nijmegen.

Expert panel

A multidisciplinary expert panel was established consisting of 11 oral health care experts from the Radboud University Medical Center in Nijmegen, the Netherlands. Panel members were invited by the researchers based on their field of expertise, and included dentists, dental hygienists, a periodontist, a maxillofacial surgeon, and researchers focusing on (quality of) oral health care. Ten out of the 11 members of the expert panel were oral health care professionals by training. One member was an oral public health researcher. All experts participated in all rounds of the study.

Advisory board

In addition to the expert panel, an advisory board consisting of national experts in the field of quality of (oral) health care, a patient, and a representative from the Netherlands Patient Federation was formed (*n* = 9). The national experts were representatives from all three Dutch dental universities, the Royal Dutch Dental Association (KNMT), the Knowledge Institute of Oral Care (KIMO), the Scientific Center for Quality of Health care (IQ Healthcare), and the Netherlands Organization for Applied Scientific Research (TNO). Four out of the nine members of the advisory board were oral health care professionals by training. Six members work in (oral) public health. The advisory board convened during the consensus meeting.

Identification of measures

The first step in the development process consisted of the identification of an initial set of measures for adults based on the literature. A systematic review of quality measures for oral health care was performed in which OHQMs and their development process were critically appraised using the Appraisal of Indicators through Research and Evaluation (AIRE) instrument 2.0[7]. The research team selected 28 measures from high-quality studies in the systematic review, covering seven domains: (i) utilisation and access to oral health care; (ii) costs of care; (iii) disease outcomes; (iv) oral treatment or preventive services; (v) patient experience; (vi) organisational aspects of care; and (vii) patient safety. The domains described above were established based on consensus among the authors of the systematic review and informed by the literature[7]. The derived measures were listed and elaborated in an overview. The overview included the definition, numerator and denominator, domain, measure type and rationale for each measure.

Round 1: relevance

Round 1 consisted of an online anonymous questionnaire. The expert panel was asked to rate the initial set of measures on relevance with regard to quality assessment of oral health care and existing supporting evidence. Panelists were asked to score their agreement with the statements: 'The subject of the measure is relevant' and 'The measure is relevant' on a nine-point Likert scale, ranging from 1 (lowest rating) to 9 (highest rating). In addition, the panelists had the possibility to propose changes and suggest additional measures for round 2. According to the RAND/UCLA Appropriateness Method, the measures were classified based on their median score[15]. The measures with a median score of 7 or higher for both the subject of the measure and the measure as a whole were included in round 2. If the subject of the measure had a median score of 7 or higher, but the measure itself scored lower than 7, the measure was changed according to the proposed changes by the expert panel. Measures with a median score lower than 7 on the subject of the measure but with a median score of 7 or higher on the relevance of the measure itself were discussed among the researchers and possibly adapted based on the suggestions of the expert panel. Measures with a median lower than 7 on both statements were excluded. If a new subject for a measure was suggested twice or more times by the experts, the measure was included in round 2.

Round 2: appropriateness

In round 2, the expert panel assessed the remaining measures via a second online questionnaire. Panel members received personalised feedback regarding their scores compared with the overall distribution of scores and the median score. In this round, the measures were scored on appropriateness, i.e. whether the measure is suitable to provide insights in the measured aspect of oral health care. Panel members were asked to score their agreement with the statement: 'The measure is appropriate to use' on the nine-point Likert scale. Measures that were newly proposed in round 1 were scored on appropriateness, as well as relevance of the subject of the measure and the measure itself. Similar to round 1, measures with a median score lower than 7 on the Likert scale were excluded.

Round 3: consensus meeting

Members of the expert panel and advisory board were invited to a consensus meeting to discuss the results from rounds 1 and 2. The expert panel received their personalised score of the second round, and both the expert panel and advisory board received a feedback report with the overall distribution and median scores of round 2. Panel members were asked to judge the statement: 'The measure is important to improve the quality of oral health care and/or to improve the transparency of the provided care'. The discussion was chaired by an independent moderator. Discrepancies in scores and different opinions with regard to formulation were discussed during the meeting. After all opinions were heard and elucidated, all members of the advisory board and the expert panel scored the measures anonymously for importance on the nine-point Likert scale. Three members of the expert panel were not able to attend the meeting. Before the consensus meeting, a separate meeting was organised to give them the opportunity to give their opinion on the results of round 2. During the consensus meeting their opinion was represented by a member of the research team (DD).

Round 4: additionally suggested measures

When there were remaining discrepancies during round 3 on the importance of a measure, measures were adapted based on the feedback provided by the expert panel and advisory board. The members of the expert panel and the advisory board present during the consensus meeting were invited once more to judge those measures on importance via an additional online Delphi round. If during the consensus meeting it was indicated by both panels that a measure for a specific subject was missing, they were added and judged in round 4 on relevance, appropriateness and importance.

Approval of the final set

For measures judged in rounds 3 and 4, a disagreement index was calculated supplementary to the median scores. The disagreement index was calculated based on the ratio of the inter-percentile range (IPR), and the inter-percentile range adjusted for symmetry (IPRAS)[15]. If the disagreement index of a measure was <1, and if the measure had a median score of 7 or higher on relevance, appropriateness and importance, this measure was considered valid and included in the final core set of measures.

Supporting evidence from guidelines was sought for every measure to determine the level of evidence. The availability of guidelines with recommendations supporting the measure was sought in the Guideline International Network database (G-I-N), and on the website of national dental associations and institutes focusing on quality of (oral) health care. All dentistry-related guidelines in the G-I-N database were evaluated. The search in the database was restricted to available Dutch, English and German guidelines.

Working group on structural aspects of oral health care

The systematic review identified few oral health care structure measures[7] and, as such, the initial set of measures of this study included very few structure measures. Because both the expert panel and advisory board agreed that structure measures are an essential component to measure quality of care, a separate working group was organised to identify important structural aspects to measure. The working group consisted of seven members of the expert panel and advisory board who volunteered to participate in a separate session. The domains of the European Practice Assessment (EPA) framework[16] were used to structure this meeting. This framework consists of five domains: (1) quality and safety; (2) information; (3) infrastructure; (4) people; and (5) finance. During the working group meeting, members had the opportunity to suggest relevant structural aspects to measure per EPA domain. Via an online survey, the group scored the suggested structure measures that resulted from the working group on importance on a nine-point Likert scale. The final set of structural aspects for quality of oral health care consisted of aspects with a median score higher than 7. To identify the most important aspects, each member was asked to prioritise the 10 most important aspects, items in the top 10 of at least two members of the working group were indicated.

RESULTS

All panelists participated in Delphi rounds 1 and 2 (response rate: 100%). During the consensus meeting, respectively, eight out of the 11 members of the expert panel, and all seven members of the advisory board were present. Of the 15 people present at the consensus meeting, 11 also participated in round 4.

Round 1: relevance

The number of measures in each Delphi round can be found in *Figure 1*, the scores of the measures in each Delphi round can be found in *Table 1*. In the first round, 14 out of the 28 measures, identified from the literature, were scored as relevant on both the subject of the measure as well as the measure itself. For one measure, the subject received a median score below 7, while the measure itself received a median score of 7. Five measures received a median score of 7 or higher on the subject, but the measures itself received a median score lower than 7. These measures were adjusted based on the recommendations of the expert panel. Eight out of the 28 measures received a median score lower than 7 on both the relevance of the subject as

well as the relevance of the measure, and were therefore disregarded in the second round. The subjects of the measures that received a median score lower than 7 were: 'access to oral health care'; 'funding of dental care'; 'professional cleaning'; 'oral hygiene advice'; 'satisfaction with the helpfulness of the dental professionals'; and 'recommendation of the dental practice to friends or family'. Eight new measure subjects were suggested by multiple members of the expert panel (i.e. 'referrals', 'dental radiographs for caries diagnostics', 'removable dentures', 'satisfaction with dental aesthetics', 'satisfaction with hygiene in the practice', 'satisfaction with time to get an appointment', 'documentation caries risk', and 'documentation care plan'). These measures were included in round 2.

Round 2: appropriateness

In the second round, 24 measures out of 28 were scored as appropriate. The subjects of the measures with a median appropriateness score lower than 7 were 'referrals', 'decision not to proceed with recommended dental care solely due to cost' and 'dental radiographs for caries diagnostics', and were therefore discarded in the third round.

Round 3: the consensus meeting

In total, 24 measures were discussed and scored during the consensus meeting. Fifteen of those measures received a median score lower than 7 on importance and were discarded for this reason. Subjects of these measures were 'utilisation of oral health care', 'continuity of oral health care', 'reason for dental visit', 'cost of dental care', 'symptoms', 'change in periodontal health', 'restorations', 'endodontic treatment', 'periodontal treatment', 'continuity of periodontal care', 'removable dentures', 'satisfaction with chewing ability', 'satisfaction with oral health care', 'satisfaction with time to get an appointment' and 'satisfaction with dental aesthetics'. This resulted in the removal of all measures from the domains 'cost of care' and 'utilisation and access of care'. The measures 'medical history', 'documentation caries risk', 'extractions', 'missing teeth', 'documentation care plan' 'change in bleeding per sextant' and 'patient involvement in oral health care decision making' received a median score of 7 or higher and were accepted without major changes.

For the other measures, several changes in the measures were made. Initially, the patient-reported outcome measure for oral symptoms in the 'disease outcome' domain consisted of multiple variables in the numerator. The subjects of these variables were 'toothache', 'bleeding gums', 'sensitive teeth' and 'dry mouth'. From discussion it was decided that only
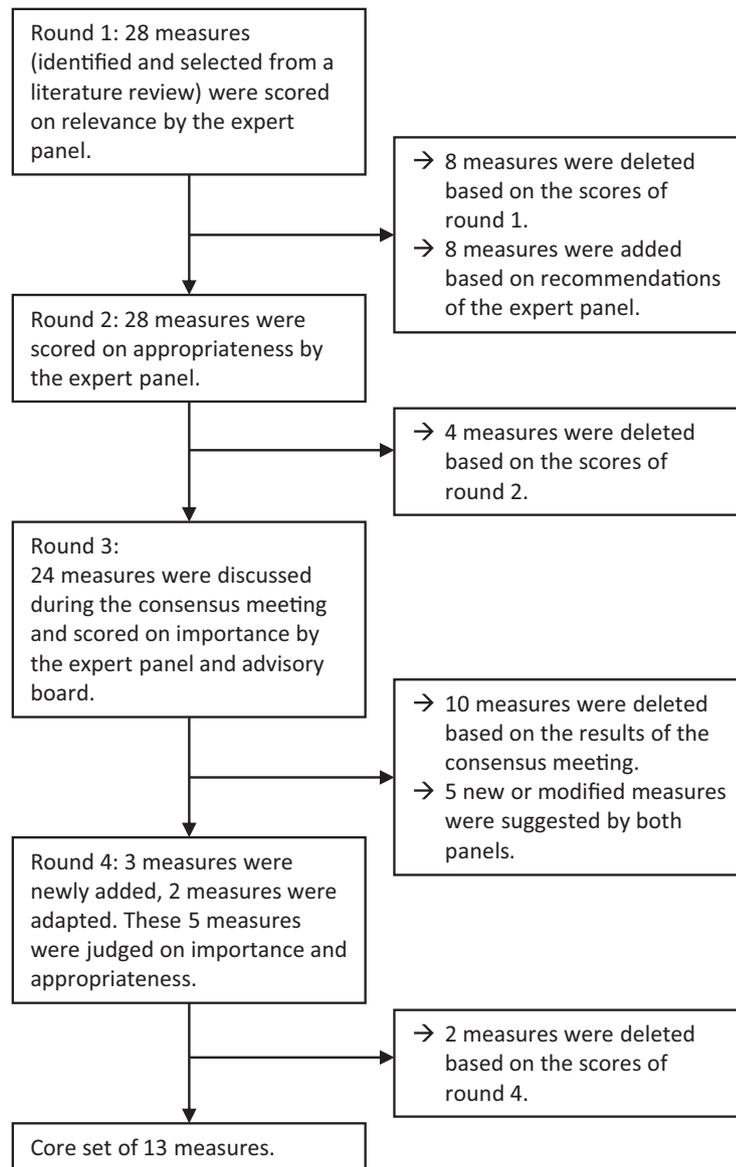
Figure 1. Flow chart of the Delphi process.

'toothache' was important to measure and should therefore be judged separately. Further, for the measure 'retreatment after restoration' the numerator was adapted. In rounds 1 and 2, there were three possible numerators for this measure: one for 'new restorative treatment'; one for 'endodontic treatment'; and one for 'extractions'. The panel agreed that only restorative treatments after the initial restorations were relevant, appropriate and important to measure. The other numerators were discarded. The panel suggested three new measures (e.g. 'dental radiographs, diagnostics', 'dental radiographs, indication' and 'dental radiographs, frequency') and two measures received major changes (e.g. 'periodontal treatment and evaluation in adults with periodontitis' and 'emergency dental care'). These measures were scored separately in round 4.

Round 4: additional measures suggested during the consensus meeting

Of the five additional measures suggested in round 3, the measures for the indication and diagnosis of dental radiographs, and the process measure for periodontal treatment and evaluation in adults were rated as appropriate and important. Based on the scores, the measures for emergency care and dental radiograph frequency were discarded.

Core set of oral health measures

The final core set of measures consisted of 13 measures that were scored as relevant, appropriate and important (*Tables* 2 and S1). Guideline recommendations to support the measures were found for seven

Table 1 Median scores of the measures in the Delphi rounds

Measure domain	Measure subject	Round 1		Round 2	Round 3/4	
		Relevance topic	Relevance measure	Appropriateness	Importance	DI
Utilisation and access of oral health care	Utilisation of oral health care	7	6	8	5	1.53
	Continuity of oral health care	7	6	7	6	0.49
	Access to oral health care	6	6	–	–	–
	Reason for dental visit	7	7	8	5	0.85
	Referrals*	5	5	5	–	–
	Emergency dental care†	–	–	6	6	0.52
Cost of dental care	Costs of dental care	6	7	7	3	0.63
	Funding of dental care	6	6	–	–	–
	Decision not to proceed with recommended care solely due to cost	7	7	6	–	–
Disease outcomes	Symptoms	7	7	7	3	0.59
	Symptoms: toothache	–	–	–	8	0.16
	Number of missing teeth	7	7	7	7	0.16
	New carious lesions	8	8	8	8	0.13
	Change in bleeding per sextant	7	7	8	7	0.22
	Change in periodontal health	8	8	8	6	0.52
Oral treatment and preventive services	Restorations	7	6	7	6	0.86
	Endodontic treatment	7	7	7	6	0.97
	Extractions	7	7	7	7	0.45
	Retreatment after restoration	7	6	8	7	0.16
	Periodontal treatment	7	5	7	6	0.52
	Continuity of periodontal care	7	7	7	6	0.52
	Professional cleaning	4	4	–	–	–
	Professional cleaning (patient-reported)	2	2	–	–	–
	Oral hygiene advice	6	6	–	–	–
	Oral hygiene advice (patient-reported)	3	3	–	–	–
	Dental radiographs, for caries diagnostics*	5	7	7	–	–
	Removable dentures*	7	7	7	5	0.95
	Periodontal treatment and evaluation in adults with periodontitis†	–	–	7	7	0.00
Patient experiences	Satisfaction with chewing ability	8	8	7	5	0.84
	Satisfaction with the helpfulness of the dental professionals	6	6	–	–	–
	Patient involvement in oral health care decision making	8	8	8	7	0.33
	Recommendation of the dental practice to friends or family	6	6	–	–	–
	Satisfaction with oral health care	7	7	7	6	0.59
	Satisfaction with time to get an appointment*	7	7	7	4	0.56
	Satisfaction with dental aesthetics*	7	7	7	3	0.95
	Satisfaction with hygiene in the dental practice*	6	7	7	–	–
Patient safety	Medical history	8	8	8	8	0.13
	Dental radiographs, indication†	–	–	7	7	0.16
	Dental radiographs, diagnostics†	–	–	7	8	0.16
	Dental radiographs, frequency†	–	–	6	6	0.37
Organisational aspects of oral health care	Documentation caries risk*	8	8	8	8	0.00
	Documentation care plan*	7	8	8	8	0.37

DI, Disagreement Index (>1 = disagreement).
*Measure added by expert panel after round 1.
†Measure added by the expert panel and advisory board after round 3, and therefore separately judged in an additional round 4.

of the 13 measures (e.g. 'periodontal treatment and evaluation in adults with periodontitis', 'documentation caries risk', 'documentation care plan', 'medical history', 'dental radiograph, diagnostics', 'dental radiograph, indication' and 'patient involvement in health care decision making'; *Table* S2). For the measures 'missing teeth', 'new carious lesions', 'change in gingival bleeding per sextant', 'toothache or pain in the mouth', 'extractions' and 'retreatment after restoration', no guideline recommendations were found.

Working group on structural aspects of oral health care

In the separate working group, members suggested 51 structural aspects of oral health care to measure (*Table* S3). A total of 49 out of the 51 aspects were

scored as important with a median of 7 or higher. Seventeen aspects were mentioned at least twice in the top 10 of the working group members.

DISCUSSION

The present study identified, on the basis of extensive stakeholder involvement, a core set of 13 quality measures across multiple domains. Throughout four Delphi rounds these measures were all scored as relevant, appropriate and important to measure the quality of oral health care delivery in dental practices. The OHQMs covered aspects related to disease outcomes, oral treatment and preventive services, patient experiences, patient safety, and organisational aspects of oral health care. In addition, a working group suggested 49 structural aspects of care that are important to measure.

The core set of 13 OHQMs provides a concise yet comprehensive set of OHQMs covering multiple domains of quality of oral health care. While long lists of OHQMs have been developed, the conciseness of the current set has the advantage that the OHQMs reflect what is truly relevant and important to measure according to the involved stakeholders, while restraining from measuring less relevant and important components of quality of oral health care. Previous research led to the development of OHQMs, which frequently focused on the assessment of processes of care and on disease outcomes on a national level. Few measures focus on patient safety and organisational aspects of care[7]. To fill the measurement gap, the aim of this study was to cover multiple domains of quality of care. The final set covered most domains; however, for the domains 'costs of dental care' and 'utilisation and access of oral health care', all measures were removed. It is plausible that context-specific factors, such as the Dutch reimbursement system, have had an influence on the exclusion of these measures. Most measures that were identified about these subjects in the systematic review do not stem from the Netherlands[7]. Kalenderian et al.[12], highlighted for example that in the USA, process and structure measures about utilisation of care are often used for reimbursement purposes while, in the Netherlands, the focus seems mainly on assessing technical and clinical aspects of oral health care[7]. The domains 'costs of dental care' and 'utilisation and access of oral health care' were covered in the list of structural aspects suggested by the working group. The list of structural aspects could serve as a first step towards the development and use of oral health care structure measures in the Netherlands.

Further, the OHQMs in this study were developed on a dental practice level. Many of the previously developed OHQMs are population-level measures developed with a different purpose (e.g. to monitor access of oral health care in health systems)[7]. It is anticipated that the data deriving from the 13 OHQMs improve the quality of oral health care by the provision of feedback data directly to oral health care professionals. The information on the quality of the provided care may offer the potential to learn from the feedback provided by discussing the data in quality improvement groups, or it can be used in new innovative ways such as academic detailing[17].

In some parts of the world, there already exists an extensive amount of quality measures[12]. Therefore, in this study, we focused only on the construction of OHQMs reflecting those aspects that are relevant, appropriate and important to measure. An explanation of the abundance of measures may be a lack of adequate IT-infrastructure, and as a consequence the need to develop measures for each setting or context separately[12]. Available IT-infrastructures may differ between different oral health care practices or different health care systems. The measures themselves are often specific to context (e.g. country) or level (e.g. practice level or population level), therefore measures cannot always be easily implemented in other health care settings[7,12,18]. In the Netherlands, there is no readily available IT-infrastructure to implement measures nationwide on a practice level. This potentially complicates the implementation of measures now and in the near future.

Another challenging factor in the dental field is that the evidence base to support practice-level measures is often limited. In the broader medical field, quality measures are often extracted from clinical practice guidelines[19]. However, the relatively limited number of currently available evidence-based guidelines or empirical studies in oral health care makes it difficult to establish measures supported by high-level evidence. Often, the level of evidence required for oral health care measures has not been established thus far[12]. Although detailed clinical practice guidelines are available for demarcated areas of oral health care (e.g. extraction of third molars; antibiotic prophylaxis against infective endocarditis), guidelines for the most common dental diseases and procedures (e.g. restorative caries treatment; tooth extractions) are not available. For process measures some clinical practice guidelines are available, for outcome measures the number of available guidelines is very limited. This highlights the importance of the development of future guidelines that can serve as an evidence base for OHQMs. In the present study, an evidence-based approach was used firstly by extracting the initial list of measures from studies that critically appraised the supporting evidence of their measures, and secondly by seeking a connection between the final OHQMs and existing guidelines. This combination provides a methodological robust starting point.

Table 2 Description of final core set of measures

Domain	Title	Description	Numerator	Denominator
Disease outcomes	Number of missing teeth	The average number of missing teeth per adult	The number of missing teeth per adult	The number of enrolled adults of whom the number of teeth has been registered in the reporting year
	New carious lesions	Percentage of enrolled adults with diagnosed new carious lesions within the reporting year	The number of adults with newly diagnosed carious lesions	The number of enrolled adults who received at least one periodic oral evaluation in the reporting year
	Change in bleeding per sextant	Percentage of enrolled adults whose number of sextants without gingival bleeding have been maintained or have increased between two consecutive reviews of the periodontium*	The number of adults whose number of sextants without gingival bleeding have been maintained or have increased between two consecutive reviews of the periodontium	The number of enrolled adults who received two consecutive reviews of the periodontium, of which the last review of the periodontium took place in the reporting year
	Toothache or pain in the mouth	Percentage of enrolled adults who indicate that they experienced tooth ache or pain in the mouth in the days prior to their appointment with the dental professional	The number of adults who indicate that they experienced tooth ache or pain in the mouth in the days prior to their appointment with the dental professional	The number of enrolled adults who visited the dental practice in the reporting year
Oral treatment and preventive services	Extractions	Percentage of enrolled adults with one or more extractions in the reporting year	The number of adults with one or more extractions	The number of enrolled adults who visited the dental practice in the reporting year
	Retreatment after restoration	The percentage of teeth that has been retreated within 6, 12 or 18 months after restoration†	The number of teeth that has been retreated within, respectively, 6, 12 or 18 months after restoration	The number of teeth that has been restored within the last 2 years
	Periodontal treatment and evaluation in adults with periodontitis	The percentage of enrolled adults with periodontitis that received periodontal care in the reporting year	The number of adults that received periodontal care	The number of enrolled adults with periodontitis in the reporting year
Organisational aspects of care	Documentation caries risk	The percentage of enrolled adults of whom the caries risk has been registered during the periodic oral evaluation within the reporting year	The number of adults of whom the caries risk has been registered	The number of enrolled adults who received a periodic oral evaluation in the reporting year
	Documentation care plan	The percentage of enrolled adults of whom an up-to-date care plan has been registered within the reporting year	The number of adults of whom an up-to-date care plan has been registered	The number of enrolled adults who visited the dental practice in the reporting year
Patient safety	Medical history	The percentage of enrolled adults of whom an up-to-date medical history has been registered within the reporting year	The number of adults of whom an up-to-date medical history has been registered	The number of enrolled adults who visited the dental practice in the reporting year
	Dental radiograph, indication	The percentage of enrolled adults of whom the indication for the dental radiographs has been documented in the electronic health record within the reporting year	The number of adults of whom the indication for dental radiographs has been documented in the electronic health record	The number of enrolled adults of whom a dental radiograph has been made in the reporting year
	Dental radiograph, diagnostics	The percentage of enrolled adults of whom the diagnoses of dental radiograph has been registered in the electronic health record within the reporting year	The number of adults of whom the diagnoses of dental radiographs has been registered in the electronic health record	The number of enrolled adults of whom a dental radiograph has been made in the reporting year
Patient experience	Patient involvement in oral health care decision making	The percentage of enrolled adults who felt they were sufficiently involved in decisions about the care provided by the dental professional in the reporting year	The number of adults who felt they were sufficiently involved in decisions about the care provided by the dental professional	The number of enrolled adults who visited the dental practice in the reporting year

*An increase in sextants without gingival bleeding implies improvement in gingival health.
†Measurements at 6, 12 and 18 months after restoration are evaluated as separate measures.

Another important added value of this study was the extensive involvement of relevant stakeholders groups. Dentists, dental hygienists, researchers, patients and policymakers were involved in the construction process of the measures. Especially, patients are frequently not included in the measure development process, while for patient experience measures their role is crucial as these measures intent to reflect the perspective of the patient[19].

The methods in this study have several limitations. First, because the measures in Delphi round 1 were based on a systematic review and few structure measures were identified in the literature, the core set consists of more process and outcome measures than structure measures. To overcome this barrier, a separate working group identifying structural aspects of quality of oral health care was organised resulting in a list of 49 structural aspects. Before using the structural aspects as quality measures, it is of importance to convert these aspects into measures and use a similar comprehensive procedure (e.g. a RAND/UCLA Appropriateness Method) to appraise these measures. Second, the present study focused on practice-level measures, population-level measures did not fall within the scope of this study. It could be possible that in a study focusing on population-level measures, more measures about cost and utilisation are in the core set of measures. The context and scope of development differ between population- and practice-level measures. Accessibility of care and information about the cost were covered in the list of suggested structural aspects to measure. Third, due to contextual differences, measures cannot simply be transferred between countries or settings[16]. Interpretations and standards of quality of oral health care differ depending on local and/or national context. In addition, due to different perceptions of various stakeholders, the acceptance of the measures among end-users is also influenced by the composition of the panels[13,14]. Further research is warranted to test the applicability of the measures in various settings and populations, specifically for older adults.

CONCLUSIONS

This study led to the development of the first set of OHQMs for adults on an oral health care practice level based on a rigorous and comprehensive multiple-stage procedure with extensive stakeholder involvement. To our knowledge, this is the first paper to develop a core set of OHQMs for adults that combines measures extracted from a systematic literature review with a rigorous modified Delphi procedure. The study provides insights regarding which aspects of quality of oral health care are relevant, appropriate and important to measure according to key stakeholders in the Dutch oral health care field. In a future study, the feasibility of the measures will be evaluated and the measures will be tested and piloted in practice. The development of an adequate information system that combines patient experiences and data from electronic health records is a crucial step forward towards a more transparent and patient-centred care system. Implementation of the measures will contribute to a more transparent health care system through the provision of routine feedback on the quality of oral health care on a dental practice level.

Conflict of interest

The authors declare no potential conflict of interest with respect to the authorship and/or publication of this article.

FUNDING INFORMATION

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Table S1. Full description of the core set of measures.

Table S2. Guideline recommendations of the core set of measures.

Table S3. Structural aspects suggested by the working group, classified by the domains of the European Practice Assessment (EPA) framework.

REFERENCES

1. Listl S, Grytten JL, Birch S. What is health economics? *Community Dent Health* 2019 36: 262–274.

2. Kassebaum NJ, Smith AGC, Bernabe E *et al*. Global, regional, and national prevalence, incidence, and disability-adjusted life years for oral conditions for 195 countries, 1990-2015: a systematic analysis for the global burden of diseases, injuries, and risk factors. *J Dent Res* 2017 96: 380–387.

3. Listl S, Galloway J, Mossey PA *et al*. Global economic impact of dental diseases. *J Dent Res* 2015 94: 1355–1361.

4. Righolt AJ, Jevdjevic M, Marcenes W *et al*. Global-, regional-, and country-level economic impacts of dental diseases in 2015. *J Dent Res* 2018 97: 501–507.

5. Herndon JB, Tomar SL, Catalanotto FA *et al*. Measuring quality of dental care: caries prevention services for children. *J Am Dent Assoc* 2015 146: 581–591.

6. Campbell SM, Kontopantelis E, Hannon K *et al*. Framework and indicator testing protocol for developing and piloting quality indicators for the UK quality and outcomes framework. *BMC Fam Pract* 2011 12: 85.

7. Righolt AJ, Sidorenkov G, Faggion CM Jr *et al*. Quality measures for dental care: a systematic review. *Community Dent Oral Epidemiol* 2019 47: 12–23.

8. Lawrence M, Olesen F. Indicators of quality in health care. *Eur Gen Prac* 1997 3: 103–108.

9. Donabedian A. The quality of care: how can it be assessed? *JAMA* 1988 260: 1743–1748.

10. Agency for Health care Research and Quality. Types of Health care Quality Measures. Rockville, MD. Available from: http://www.ahrq.gov/talkingquality/measures/types.html. Accessed 04 September 2019.

11. Institute of Medicine (IoM), Committee on Quality of Health Care in America. *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington: National Academies Press; 2001.

12. Kalenderian E, Ramoni R, Spallek H *et al*. Quality measures everywhere: the case for parsimony. *J Am Dent Assoc* 2018 149: 322–326.

13. Campbell SM, Roland MO, Buetow SA. Defining quality of care. *Soc Sci Med* 2000 51: 1611–1625.

14. Righolt AJ, Walji MF, Williams DM *et al*. An International working definition for quality of oral health care. *JDR Clin Trans Res* 2019 5: 102–106. https://doi.org/10.1177/2380084419875442.

15. Fitch KBS, Aguilar MD, Burnand B *et al*. *The RAND/UCLA Appropriateness Method User's Manual*. Santa Monica: RAND; 2001.

16. Goetz K, Campbell SM, Broge B *et al*. Effectiveness of a quality management program in dental care practices. *BMC Oral Health* 2014 14: 41.

17. Baâdoudi F, Duijster D, Maskrey N *et al*. Improving oral health care using academic detailing – design of the ADVO-CATE Field Studies. *Acta Odontol Scand* 2019 77: 426–433.

18. Marshall MN, Shekelle PG, McGlynn EA *et al*. Can health care quality indicators be transferred between countries? *Qual Saf Health Care* 2003 12: 8–12.

19. Campbell SM, Braspenning J, Hutchinson A *et al*. Research methods used in developing and applying quality indicators in primary care. *BMJ* 2003 326: 816–819.

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