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Development and validation of an International Patient's Attitudes to Prevention in Oral Health Questionnaire

Julia Csikar[1] | Heather Leggett[1] | Karen Vinall-Collier[1] | Helen Whelton[2] |
Susan Pavitt[1] | Jing Kang[1] | Gail V.A. Douglas[1]

[1]Dental Public Health, University of Leeds School of Dentistry, Leeds, UK

[2]Dental School, Cork University, Cork, Ireland

Correspondence
Julia Csikar, Dental Public Health, University of Leeds School of Dentistry, Clarendon Way, Leeds LS2 9LU, UK.
Email: denjic@leeds.ac.uk

Abstract

Objectives: To develop a patient's attitude questionnaire regarding prevention in oral health for use internationally.

Methods: Using a mixed methods approach, a questionnaire was developed and refined as part of ADVOCATE (Added Value for Oral Care) study, involving partners in six countries: Netherlands, Hungary, Denmark, Ireland, Germany, and the UK. A literature review explored the history of oral healthcare delivery systems to develop a template for each of the six ADVOCATE countries. A systematic review identified the perceived barriers and facilitators to preventive oral healthcare and underpinned a topic guide and established the patient questionnaire domains. Focus groups in each ADVOCATE country developed the first version of the questionnaire. Patient and Public Involvement and Engagement (PPIE) in each ADVOCATE country tested the questionnaire and led to further refinement. The questionnaire was produced in five languages. Content validity and reproducibility used principal component analysis (PCA) and exploratory factor analysis (EFA) refined the questionnaire.

Results: The literature review aided an understanding of each country's oral healthcare system, and the findings from the 25 studies identified in the systematic review found the main barriers/facilitators to preventive oral healthcare were cost, knowledge (preventive treatments and advice), and a patient awareness and adherence to preventive advice/treatments. Interviews and focus groups with 148 participants in the ADVOCATE study identified receiving the appropriate level of care/feeling valued, cost, level of motivation/priority, not feeling informed, knowledge, and skill mix as the main barriers/facilitators. Fifty-three PPIE members refined the questionnaire. The pilot questionnaire was tested with 160 participants. Non-essential or highly correlated variables were then removed, leaving 38 items, covering 6 domains (cost, advice received, advice wanted, message delivery, motivation, knowledge, and responsibility) within the questionnaire. A second pilot test-run was undertaken with 185 participants. The test-re-test reliability demonstrated strong consistency of responses between the two time points (kappa range 0.3–0.7, most $p < .0011$), which culminated with a final version of the Patient Attitudes to Prevention in Oral Health Questionnaire (PAPOH) questionnaire.

Conclusions: This mixed-methods approach enabled the development of a multi-language attitudinal questionnaire for use with patients (PAPOH) to compare attitudes to oral disease prevention internationally.

KEYWORDS
oral health, patient, questionnaire, restorative dentistry, validation

1 | INTRODUCTION

Poor oral health is strongly associated with health inequality and affects patients across the life course.[1] Despite some successes, the incidence of untreated oral disease is rising globally (2.5 billion in 1990 rising to 3.5 billion in 2015).[2] Managing these oral diseases accounts for 5% of the health budget across European countries,[3] with the majority of these costs for restorative treatments, which are preventable. Many healthcare systems still favour *treatment* of oral diseases rather than encouraging prevention.[4] One of the challenges to developing a responsive, preventive-focussed healthcare systems, is how little is known about what facets within a system facilitates health professionals and patients to maintain and improve oral health. Research to date has focused on how healthcare works (that is, the contextual facts) but has not attempted to understand how healthcare systems lead to better health outcomes.[5]

At the heart of a preventively focused healthcare system is the patient and so, understanding the factors that affect preventive care is essential. One way in which to understand the types of prevention services accessed and whether the offer of preventive advice is made available to them and taken up by the patient is to develop tools, which can assess these aspects. It is hoped that such investigations could support a greater understanding of how to improve and maintain oral health for, and by the patient.

Questionnaires are one way in which stakeholder perspectives can be gathered in a quick and feasible way, especially when respondents may be widely dispersed.[6] The challenge within questionnaire development is to ensure the tool is valid, reliable, and salient.[7,8] Questionnaire development must have a logical approach, which is both comprehensive and efficient[9] and considers and involves the end user.[10] Questionnaire development should employ methods that directly involve the end users to identify the key concepts, often gathering data using qualitative techniques to enhance the salience of the tool being developed.[11]

This paper will provide a methodological overview on the item-generation, development, and refinement of the questionnaire disseminated across six European countries. This research was undertaken as part of ADVOCATE (Added Value for Oral Care) study, a 4-year Horizon 2020 collaboration involving partners in six countries, these countries represented most models of oral healthcare adopted in Europe (Netherlands, Hungary, Denmark, Ireland, Germany, and the UK. Grant agreement ID: 635183). The ADVOCATE project consisted of five Work Packages (WP). Each WP had a role to play in assessing patterns of treatment, health and costs, to see how each country's healthcare system works when considering prevention. WP1 had the overall management and coordination of the project. WP2, entitled the 'European Inventory', investigated the range of influences, which can have an impact on oral health and was supported by a network of stakeholders and public/patient groups. WP3 developed a "data hub," which collected each country's data to assess preventive oral healthcare activity. WP4 developed a dashboard to compare one country with another on clinical outcomes, such as extraction and fillings and a patient engagement app so that patients could give their opinion on their dental treatment. WP5 led the proof of concept testing where "field studies" used the dashboard information, alongside data collected locally, to assess if feedback could affect patient-centred preventive care. Finally, WP6 delivered the exploitation and dissemination activities within the project to ensure that communication was consistently given to all stakeholders.[12] This paper outlines aspects of WP2 led by the University of Leeds who devised and developed this questionnaire in collaboration with the other five ADVOCATE WPs. The aim of the present research was to develop a patient's attitude questionnaire regarding prevention in oral health for use internationally.

2 | METHODS

The study received approval from the Dental Research Ethics Committee at the University of Leeds (ref: 180518/EZ/253), the University of Heidelberg, The University of Copenhagen, University Collage Cork Semmelweis University, Hungary, and ACTA Amsterdam (2018.458). The research was undertaken in full accordance with the World Medical Association Declaration of Helsinki (version 2008).

A mixed methods approach was undertaken to develop and test the questionnaire[13]: Patient Attitudes to Prevention in Oral Health Questionnaires, PAPOH (Figure 1).

2.1 | Stage one: Oral healthcare system contextualisation

The aim of stage one of the research was to provide background knowledge of each country, this was important when interviewing and developing questions that could be applicable to each country and help us understand or anticipate any country nuances related to their system or how services were used or accessed. A literature
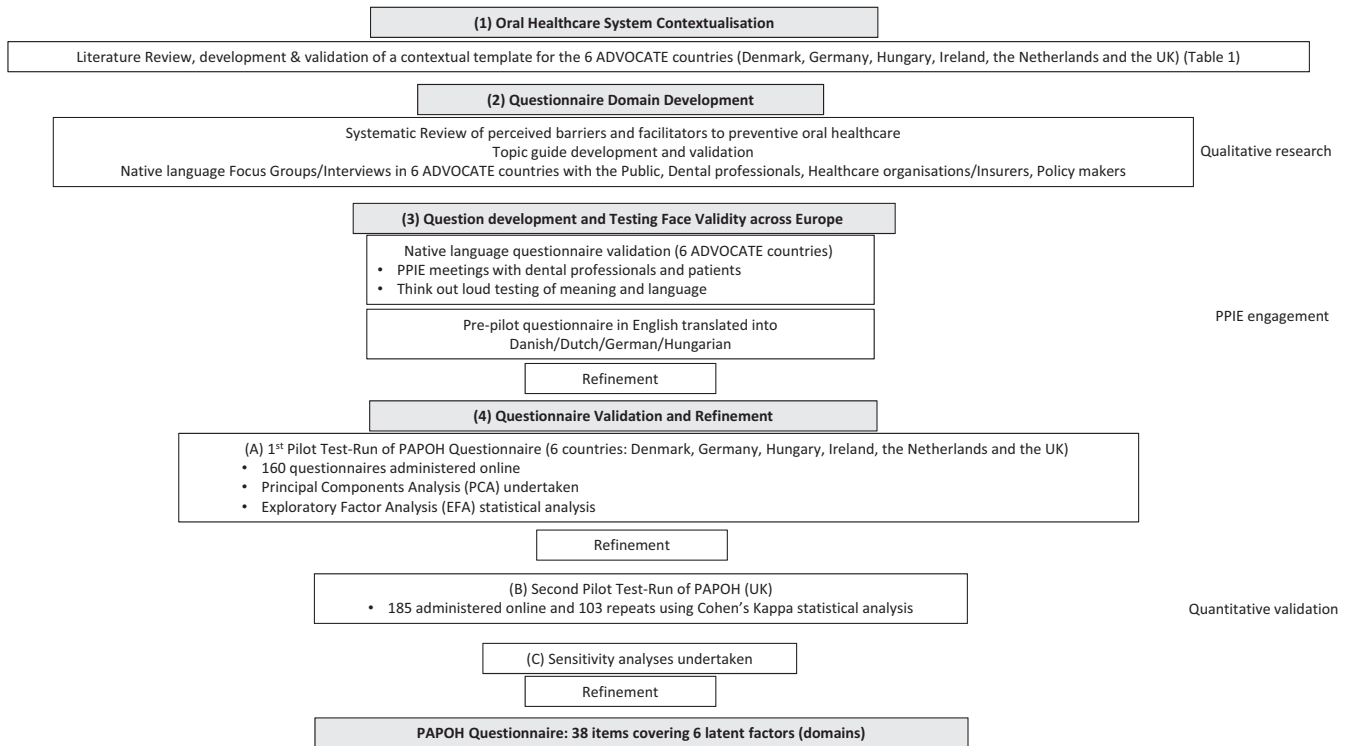
(1) Oral Healthcare System Contextualisation
Literature Review, development & validation of a contextual template for the 6 ADVOCATE countries (Denmark, Germany, Hungary, Ireland, the Netherlands and the UK) (Table 1)

(2) Questionnaire Domain Development	
Systematic Review of perceived barriers and facilitators to preventive oral healthcare Topic guide development and validation Native language Focus Groups/Interviews in 6 ADVOCATE countries with the Public, Dental professionals, Healthcare organisations/Insurers, Policy makers	Qualitative research

(3) Question development and Testing Face Validity across Europe	
Native language questionnaire validation (6 ADVOCATE countries) • PPIE meetings with dental professionals and patients • Think out loud testing of meaning and language	
Pre-pilot questionnaire in English translated into Danish/Dutch/German/Hungarian	PPIE engagement
Refinement	

(4) Questionnaire Validation and Refinement	
(A) 1st Pilot Test-Run of PAPOH Questionnaire (6 countries: Denmark, Germany, Hungary, Ireland, the Netherlands and the UK) • 160 questionnaires administered online • Principal Components Analysis (PCA) undertaken • Exploratory Factor Analysis (EFA) statistical analysis	
Refinement	
(B) Second Pilot Test-Run of PAPOH (UK) • 185 administered online and 103 repeats using Cohen's Kappa statistical analysis	Quantitative validation
(C) Sensitivity analyses undertaken	
Refinement	

PAPOH Questionnaire: 38 items covering 6 latent factors (domains)

FIGURE 1 Mixed methods approach undertaken to develop and test the Patient Attitudes to Prevention in Oral Health (PAPOH) questionnaire

review was developed to explore the history of oral healthcare delivery systems and related policies in the Netherlands, Hungary, Denmark, Ireland, Germany, and the UK. The literature review's purpose was to understand the context and strategies behind each oral healthcare system and was considered a starting point to understand each oral healthcare system in the six ADVOCATE countries. The literature review was run from 1950 to January 2016 using Cochrane databases, PsychINFO, EMBASE, MEDLINE, DARE, and Web of Science and was not limited by language. Papers were independently reviewed by two researchers. Following the literature review, a country-specific template was developed and modified to validate its contents by a panel representing all six ADVOCATE countries. The final output of this stage was to generate a template for each country regarding their oral health and healthcare system. This would subsequently act as a contextual framework to understand nuances in the data for the six ADVOCATE countries.

2.2 | Stage two: Questionnaire domain development

A systematic review entitled 'Perceived barriers and facilitators to preventive oral healthcare' was undertaken to understand reported barriers and facilitators to prevention in oral healthcare. Findings from this systematic review were needed to inform the contents of a topic guide for qualitative interviews. These interviews would explore potential questions for inclusion in the PAPOH survey for measuring patients' attitudes to prevention across Europe.[14]

The following electronic databases were searched: Cochrane Central Register of Controlled trials, Cochrane Database of Systematic Reviews, Conference Proceedings Citation Index-Science, Emerging sources citation index, PsychINFO, EMBASE, NHSEED, MEDLINE (+Epub and In-Process & Other Non-Indexed Citations), DARE, and SCOPUS. The searches were conducted on 17th November 2015. The references of included studies/reports were checked for eligibility. Contact with an expert in the field was also established to ensure that no relevant studies were missed. Hand searching of included studies reference lists was also undertaken against the inclusion criteria. An updated electronic search was conducted on 23rd August 2018.

The findings of the systematic review were valuable in developing topic guides, which were developed by WP2 researchers (Figure 2) and explored the barriers and facilitators to prevention as perceived by the general public, policy makers, dentists, and insurers in the six ADVOCATE countries. Proposed PAPOH questions were developed in English and translated into each country's language. The meaning was then discussed by the researcher in WP2 with a native speaker from each country (expert) and amended (if necessary) to maintain the salience of the question in each country. Focus groups were held in each country's native language in the six ADVOCATE countries. Written consent was obtained prior to interviews and focus group commencement. The focus groups were audio recorded and transcribed in the country's native language; these were then transcribed into English. A thematic analysis was undertaken, which led to the identification of domains[15] for inclusion in the questionnaire.

Questions	Prompts or further questions
What do you generally feel is good and bad with the current dental care system?	
What would you perceive the ideal dental care system to look like/entail?	What, in the current system is facilitating or acting as a barrier to this?
What influences whether you attend the dentist?	What makes this more or less likely? *If struggling to answer, provide examples: cost, location, dentist, pain, other responsibilities*
For what reasons do you usually attend the dentist?	*Eg. Check up, routine dental work, emergency appointment*
What would make you more likely to attend?	Can you think of any ways these could be addressed?
What would help you to maintain good oral health?	*Eg. Oral health education, lower cost, access to services*
What preventative oral health care strategies are you aware of?	Has your dentist mentioned preventative oral health care to you in a consultation
What should your role versus that of the dentist be in preventing poor oral health?	What responsibility do you have to maintain your oral health? What responsibility does your dentist have?

FIGURE 2 Topic Guide for the General Public

2.3 | Stage three: Question development and testing face validity across Europe

Researchers conducted sessions with members of the Patient and Public Involvement and Engagement (PPIE) in England, so that topics and content could be explored and derived. Through PPIE group discussions, these domains were developed into questions, which made up the first version of the (PAPOH). Proposed questions were then professionally translated[13] from English into four languages: Danish, Dutch, German, and Hungarian.

Following this, ADVOCATE countries were visited, and PPIE sessions were conducted to test salience, readability, and understanding of the proposed questions alongside a local researcher. PPIE members were required to speak English and their countries native language. The PPIE members were given a copy of the questions in English and a version in their language. A 'think-aloud' technique was used, which supported face validation and sense-checking of the questions.[16] The research team used 'probes' so the participant could expand on points and verify their interpretation of the question. Using the think-aloud technique, the group read each question and discussed the nuances and meaning of each question (based on their experiences). Questions arising from this stage would form the pilot-PAPOH questionnaire.

2.4 | Stage four: Questionnaire validation and refinement

The pilot-PAPOH questionnaire was tested in the UK with members of the public. Sample size calculation for the pilot study was based on the chance that the 'problem' exists within the study population, and the level of confidence that chance that the problem would be identified.[17] Using the online calculator, proposed by Viechtbauer et al.[18] (www.pilotsamplesize.com), a 95% confidence level with 1%–5% chance to detect the 'problem' within the population, this yielded a sample size requirement of 59 to 299 participants.

Described below are a further three quantitative validations stages, which were undertaken to develop the PAPOH questionnaire: first pilot test-run and analysis, second pilot test-run with test-re-test for reliability, and sensitivity analyses.

2.4.1 | First pilot test run and analysis

Participants were recruited through a market research company (Dynata™), which offers 'points' for targeted participant's completion of questionnaires. Representative participants were recruited from the UK; participants were excluded if they were under 18. Participants were sent an email by the marketing company inviting them to complete the questionnaire. The email informed the participants that the questionnaire would ask them a series of questions about their knowledge of and attitudes toward prevention, as well as what care they currently receive. They were informed that the questionnaire would take 5–10 min to complete and that their responses were anonymous. This option was chosen as it allowed a rapid check of how the questionnaire performed, the generalisability of responses was not a concern at this stage. Participants were required to give consent at the beginning of the questionnaire and were not able to progress to the questions without providing this.

2.4.2 | Second pilot test run and sensitivity analysis

The first stage was to explore the components (domains) identified through principal components analysis (PCA). The optimal number of domains retained using PCA was determined by a scree test, eigenvalues of chosen components greater than 1, and total variance explained by all components greater than 50%.[19] Varimax rotation was applied on factor loading and questions loading more than 0.3 were considered to be contributing to the same domain.[20] Following the PCA exploration, the pilot data underwent exploratory factor analysis (EFA).[21] EFA is a commonly used statistical technique and was used to remove non-essential variables and to explore if there was an association between the variables. The EFA was run on the pilot data and any questions that did not load on to a domain or loaded on to more than one domain (statistical relevance) were removed after a discussion and a consensus reached by the research team (clinical relevance).[21] It should be noted that as the questionnaire was anonymous, there was no opportunity to assess if a participant offered the same answers in both surveys.

3 | RESULTS

3.1 | Stage one: Oral healthcare system contextualisation

A literature review was undertaken to understand each of the six ADVOCATE country's oral healthcare systems and develop an extraction template. The literature review yielded over 10000 documents on policies and delivery changes in oral healthcare, this was used to populate the country-specific template. These templates were modified and validated through a panel discussion in Amsterdam in June 2016 with 22 key stakeholders (dental policy makers, dental insurers, dentists, and members of the general public) from the six ADVOCATE countries. Panellists scrutinized the templates and offered corrections and updates. Post-meeting, the templates were modified by the researchers in WP2 and sent to stakeholders in each country for comment. The final templates had the following domains: system demographics, dental workforce, and provision of oral care, oral health status, and economics /political aspects (Table 1).

3.2 | Stage two: Questionnaire domain development

The 'perceived barriers and facilitators to preventive oral healthcare' systematic review yielded 7919 papers, 40 papers identified through hand searching, a total of 7959 identified in two searches (2015 and then again in 2018). Following title screening, de-duplication, and abstract screening, 311 full text papers were screened and reviewed by two researchers (HL and a research fellow, SE). Full texts that did not meet the inclusion criteria were excluded. Twenty-five studies were included for the final analysis (Figure 3). The main barriers and facilitators regarding preventive oral healthcare systems surrounded cost, knowledge (preventive treatments and advice), and a patient awareness and adherence to preventive advice/treatments. The findings from the systematic review provided an insight into the barriers and facilitators to prevention that are currently experienced. This knowledge enabled the research team to develop relevant topic guides guided by the literature, which were then used in interviews and focus groups with stakeholder groups (Figure 2).

Fifty-eight interviews and 13 focus groups (148 participants in six ADVOCATE countries: Table 2) were conducted by qualitative researchers (WP2 and country specific researchers, the latter was to assist with any language or interpretation issues) between March

TABLE 1 Template domains

| Dental provision of care	Dental workforce	Demographic characteristics	Health of population
• Proportion of private / Insurance/Public • Exemptions from paying for dental care • Provision of special care in primary care • Dental care provision for children • Check-up frequency • Fluoridation (proportion of the & ppm) • GDP spend on health (%) • National spend on dental health • Who sets fees? • Payment structure • Remuneration • Patient charges • Government reforms	• Dentists Dentists • Dental Hygienists Dental Hygienists • Dental Technicians Dental Technicians • Dental Therapists Dental Therapists • Dental Nurses Dental Nurses • Additional training: extended duty dental nurses, dental hygiene Additional training: extended duty dental nurses, dental hygiene therapists	• Population (standardized) • Ratio of population to registered dentist • Population registered with a dentist • Public Schemes • Private • Insurance	• DMFT 12 year olds • Edentulous (% & standardized age range 65 years+)
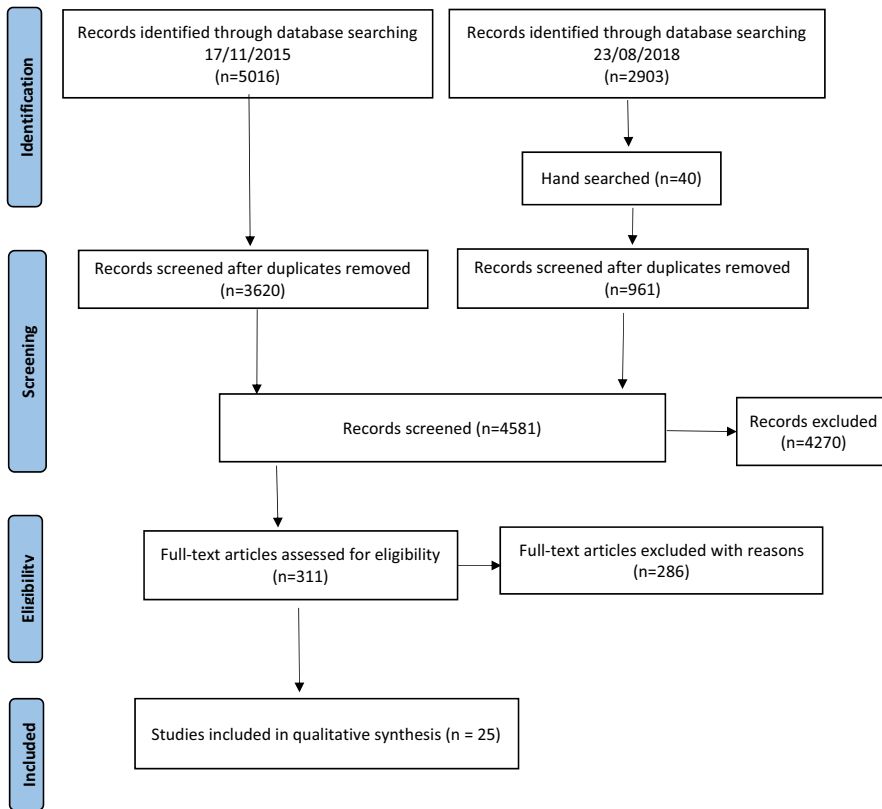
FIGURE 3 Flow diagram of study inclusion

TABLE 2 Number of Focus group and Patient and Public Involvement and Engagement (PPIE) participants in each country

	Number of focus group/Interview participants						Number of PPIE participants	
Country	Dental teams	Policy makers	Insurers	General Public	Number of interviews and (focus group)	Total focus group participants	Meeting 1	Meeting 2
England	6	10	5	11	18 (2)	31	4	5
Denmark	12	8	1	8	10 (2)	29	5	5
Netherlands	7	4	16	5	4 (4)	32	3	4
Hungary	7	7	0	7	7 (2)	21	4	4
Ireland	5	1	4	11	13 (1)	21	4	4
Germany	2	3	1	8	6 (2)	14	3	2
Amsterdam project meeting							6	

2016 and September 2017.[22] The audio recordings were transcribed, those not in English were translated into English. Following standard translation techniques,[13] transcripts were translated into the language of each country (forward translation) and back translated by a researcher to check for consistency and accuracy in meaning after translation. Transcripts were checked by English speakers and queries regarding translation were resolved by consensus. All transcripts were analysed using a deductive thematic analysis.[15] The findings from the general public interviews/focus groups were used to develop the patient questionnaire, and as such, analysis remained at the semantic level, focusing on what the participants viewed as barriers and facilitators to preventive oral healthcare without deeper exploration into their underlying thoughts and conceptualisations.

The barriers and facilitators identified for patients were receiving the appropriate level of care/feeling valued, cost, level of motivation/priority, not feeling informed, knowledge and skill mix. These themes further supported domain development for early pilot testing with patients, the themes were salient across all the oral healthcare systems.

3.3 | Stage three: Question development and testing question face validity across Europe

The themes identified from the focus groups were used to develop relevant domains to be considered for inclusion in the questionnaire.

Three researchers (JC, HL, KVC) led three sessions to discuss topics and content derived in stage two with members of the PPIE group in England and to consider proposed PAPOH questions. Through group discussion, questions were developed, this led to the first version of the PAPOH.

PPIE meetings were then undertaken to test the face validity of the questions of PAPOH between February and June 2018 in English. The PPIE members were recruited through networks and contacts of the local researcher in each ADVOCATE country. PPIE members needed to be able to speak and read English fluently, currently reside in the country, and be over 18 years of age. The meetings were conducted in English and lasted up to 2 h. Across the six countries, 53 PPIE members contributed (Table 2). To establish a set of universal 'knowledge' questions related to respondents' oral health knowledge, an evidence-based oral health guideline was explored.[23] The following questions were chosen because they were felt by PPIE members in each country to be salient and appropriate: tooth brushing, fluorides, and the link between oral and general health.

After the PPIE meetings had taken place in each country, modifications to the questionnaires were made. Following this, a meeting was held in July 2018 with a general public contributor from each country. At this meeting, the refined questionnaire was reviewed, and specific questions and wording concerns were raised by the research team. These steps led to the full pilot version of the questionnaire for patients.

3.4 | Stage four: Questionnaire validation and refinement

3.4.1 | First pilot test-run and analysis

Within the first pilot test-run: 160 participants from the UK completed the pilot questionnaire, which was within the calculated full sample size (indicated in the Methods).[18] The PCA identified six latent factors (domains) for the patients: cost, advice received, motivation, advice wanted, message delivery, and responsibility (Table A1). These six factors explained 53% of the total variance. EFA-enabled questions, which covered similar aspects or were repetitive to be identified and removed. The following questions were removed: 'Would you feel satisfied with your care if you were to receive preventive care from the: dentist, dental hygienist or nurse' as it did not fit into domain 'message'. 'Would you like to receive more advice about the following? - How to clean between your teeth' and 'Would you like to receive more advice about drug use?' were removed from the domain 'advice wanted' and 'advice received' as they did not directly relate to the focus of this study. Questions which loaded on to two domains simultaneously are revised to ensure they just reflect one domain: 'Keeping my teeth and gums healthy is a high priority for me' loaded on to the 'message' and 'motivation' domains, it was retained only in 'motivation' domain for further analysis.

3.4.2 | Second pilot test-run and test–retest for reliability

A second pilot test-run on the refined questionnaire (using the same recruitment strategy as the first pilot) with 185 participants from the UK. Of these 185, 103 were participants from the first pilot, and 82 were newly recruited participants. Test–retest reliability from the 103 repeats were analysed using Cohen's Kappa, which demonstrated strong consistency of responses between the two time points for most questions (kappa range 0.3–0.7, most $p < .001$). Within the second pilot questionnaire, equivalent results from the PCA were found when looking at the loading of questions into the six domains. This was achieved by using all participants from stage two (both who were originally recruited ($n = 103$) and newly recruited ($n = 82$) to this phase) and by using only newly recruited participants ($n = 82$), respectively, three questions were removed from the questionnaire as they were deemed not to be adding any further information (Table A2).

Construct validity using confirmatory factor analysis (CFA) was undertaken using UK data ($N = 160$). The correlation coefficients between the six domains are illustrated in Figure A1 The questionnaire was then adapted and distributed to all countries.

3.5 | Sensitivity analyses

Each question in the questionnaire was designed using the methodology described above and offered participants several options from 'strongly agree' to 'strongly disagree', and a 'do not know' option for those participants who either did not want to express an opinion or did not have an opinion on the issue. Sensitivity analyses were performed by treating the 'do not know' option as positive, neutral, or missing data to assess the robustness of the results. The sensitivity analysis showed a noticeable difference when treating 'do not know' options as a negative response or treating them as a neutral option related to questions: 'My dental professional knows enough about me to provide personalised advice about my teeth and gums' and 'Keeping my teeth and gums healthy is a high priority for me'. These questions loaded on to more than one domain, but when treating the 'do not know' option as a positive answer, these two questions did not load onto any of the domains. When treating the 'do not know' option as missing data, the sample size decreased dramatically and the results from PCA only maintained few of the original loadings. It was therefore decided that when analysing the questionnaire, the 'do not know' option would be treated as a negative response as this made the most logical sense.[24]

4 | DISCUSSION

The study has reported on the development and validation of the 38 item (six domains) questionnaire, which measured patients' attitudes

to prevention (PAPOH). Data from this questionnaire will be reported in a separate publication by Leggett et al.

This research has enabled a multi-language questionnaire to be developed to explore patients' attitudes to prevention in oral health which were then used within six European countries. Contributors from across Europe helped to develop and refine questions for a questionnaire, which was validated with members of the public in England and then piloted across all six ADVOCATE countries. To date, there has been little exploration of the patient perspective of prevention within oral healthcare systems.

Tsang and colleagues outlined that any questionnaires developed should be a sound psychometric tool, which 'is efficient and effective for use in research'.[13] Their research outlined that questionnaire development should follow a process where the construct of interest is identified, in this case, oral health attitudes to prevention from the perspective of patients. The challenge was to realize this construct for a pan-European application where language, culture, and healthcare systems varied, and no questionnaire currently existed. The mixed methods technique helped to develop the questionnaire in an iterative fashion and was borne out of the research data, which was refined and substantiated by the end-user using a range of qualitative (focus groups, interviews, 'think-aloud'). The quantitative methods such as EFA, PCA, and CFA helped to facilitate an understanding of the validity, reliability, and acceptability of the questionnaire.[25,26]

The development and translation process outlined by Tsang and colleagues[13] was followed within this study and enabled data to be drawn out of the literature and ratified by an expert panel. The literature review established the context in which each country's oral healthcare system operated and facilitated a template which was co-developed by an expert panel and patient involvement in each country. This facilitated an understanding of participants' attitudes and enabled the researchers to become immersed in the research area sufficiently so they could development a tool that reflected each country. Once the topic area had been explored sufficiently through a systematic review, end-user feedback was captured to understand their experiences and views which fed into the tool development to ground the tool in real life; this was achieved through the 'think-aloud' approach. The process enhanced the feasibility, relevance, comprehension, and content validity of the questionnaires.[27,28]

The 'think-aloud' approach within the question development stage enabled focus group participants to vocalize their thoughts while reading the questionnaire. The participants scrutinized and rationalized the questions, and researchers used probing questions to refine statements made by the participants,[29] supporting the face validity of the questionnaire. Both the participants (the experts) and the researchers could then agree on the characteristics of interest to be measured by the research tool.[30] Content validity was enhanced using qualitative research techniques (focus groups and expert panels), which revealed the perceptions of end-users and helped adjust the tone and relevance of the questions.[11]

Qualitative methods used alone to generate questionnaires often use a small, homogeneous groups, thus reducing the range of

opinions and experiences.[31] As multiple methods were employed, our trust in the tool being able to measure preventive attitudes in patients is increased. Using stakeholders to ratify/test the questionnaires across all six ADVOCATE countries is a strength, as it enabled local contexts, nuances, and healthcare systems to be appreciated and described more accurately. There was the possibility that nuances could have changed the meaning of a question and so it was paramount for the research team to be vigilant to achieve a standardized questionnaire that would allow comparison across a wide geography. However, internal validity can be challenged when undertaking cross-cultural research, this bias was managed in two ways. (1). Following refinement and translation into each country's language, the questionnaire was reviewed by a bi-lingual member of the research team and the PPIE groups to appraise if the translated questionnaire and the English questionnaire measured the same facets. (2) Data was analysed to detect the domains in which it clustered, this enabled the research team to identify any erroneous questions and support the construct validation for the questionnaires. The English research team initially developed questions within the questionnaire; however, this was ratified in each country and amended. It is hoped that the Anglo-centric view that may have evolved due to the study being led in England, was in some way mitigated, after scrutiny and adjustment in each country. Another limitation of the pilot stage was that testing of the questionnaire in terms of performance was undertaken with UK participants only.

The iterative mixed methods approach supported a triangulation of data to generate questions that were identified from a variety of sources (systematic review, expert panel, focus groups). Within the questionnaire, an internal check of criterion validity was built in using a series of questions checked within a logical pathway of responses, e.g., a person who did not brush their teeth, was not then asked how many times they brushed their teeth.

Statistical testing underpinned the development of PAPOH, which was performed to further test content validity through factor analysis.[30] This process evaluated whether the questionnaire content accurately assessed all fundamental aspects of the topic; the analysis showed reasonable results. The test–retest phase was evaluated using Cohen's kappa to confirm that responses to the questionnaire remained consistent over time.[13]

Questionnaire response analysis is challenged by how to treat 'do not know' responses. For example, in PAPOH, the proportion of participants who chose 'do not know' varied from 5% to 20% during testing. It is unclear if participants who chose the 'do not know' options were unsure of the answer or did not want to reveal their true thoughts.[32] Sensitivity analyses were performed treating the 'do not know' option as missing data, as a positive response, a middle response, and a negative response. The PCA results suggested treating 'do not know' as a negative response as it most closely matched the research team's understanding of the research area and is consistent with other authors who also treat 'do not know' as a negative response.[24]

This questionnaire enabled researchers to explore the public's attitudes to prevention in relation to oral health, using a tool that

was developed and tested for face validity in six countries within Europe and available in five languages. PAPOH offers the potential for quantitative comparisons over a variety of geographical areas and healthcare settings, which could inform policymakers and commissioners of services about their patients' attitudes to prevention in oral healthcare. This iterative mixed methods approach was developed to ensure the questionnaire could gain valid and reliable attitudinal data across Europe. The questionnaire is planned to undergo further refinements to collect information from parents and children regarding the prevention of caries both in the UK and abroad.

5 | CONCLUSION

Effective prevention in oral diseases is a common goal across healthcare systems. Conducting research across Europe is important in identifying and understanding international variation in attitudes to disease prevention and supporting the development of nationally appropriate services and can help in attempting to understand which of the many healthcare systems help to facilitate preventive care. This mixed methods approach enabled the development of a patient attitudinal questionnaire looking at prevention in oral healthcare (PAPOH). The questionnaire will enable the collection of robust international data, which, for the first time will enable an understanding of patient attitudes to prevention in oral diseases across Europe and enable critical analysis of how oral healthcare systems encourage or deter preventive care.

AUTHOR CONTRIBUTIONS

All authors have met the conditions of 1-3. (1) substantial contributions to conception and design of, or acquisition of data or analysis and interpretation of data, (2) drafting the article or revising it critically for important intellectual content, and (3) final approval of the version to be published. Authors should meet conditions 1, 2 and 3. Author elects to not share data.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

CONSENT

Participant consent was obtained this study.

ORCID

Julia Csikar https://orcid.org/0000-0002-6943-9762
Heather Leggett https://orcid.org/0000-0001-8708-9842
Karen Vinall-Collier https://orcid.org/0000-0001-6362-9824
Helen Whelton https://orcid.org/0000-0002-0881-360X
Susan Pavitt https://orcid.org/0000-0001-7447-440X
Jing Kang https://orcid.org/0000-0002-2770-1099
Gail V.A. Douglas https://orcid.org/0000-0002-0531-3909

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APPENDIX A

TABLE A1 Domains identified by Exploratory Factor Analysis (EFA) for *PAPOH*

Domains	Questions	
Cost	The cost of a dental check-up influences how often I attend a dental appointment	
	The cost of a dental treatment influences the treatment I will choose	
	I think that dental check-ups are expensive	
Advice Received	At the dental check-up does the dental professional give you advice about the following?	How to clean your teeth
		Smoking
		Consuming foods or drinks that contain sugar
		Consuming sugar free fizzy drinks
		Alcohol consumption
		The link between your oral health and general health
Advice Wanted	Would you like to receive more advice about the following?	How to clean your teeth
		Smoking
		Consuming foods or drinks that contain sugar
		Consuming sugar free fizzy drinks
		Alcohol consumption
		The link between your oral health and general health
Message Delivery	How would you like to receive information about how to keep your teeth and gums healthy?	Sent to me before an appointment
		Displayed in the waiting room
		Given to me verbally by the dentist
		Given to me verbally by the hygienist/therapist
		Given to me verbally by the nurse
		Sent to me after an appointment
Motivated by	To what extent do the following statements motivate you to care for your teeth and gums?	The dental professional taking the time to explain things to me
		The feeling of being respected by the dental professional
		Advice being specifically personalized to me
		Advice from the dentist rather than from another dental professional in the team
		Advice being given firmly
		Trusting the dental professional
		Having experience of pain in my mouth
		Preventing future oral disease
		Avoiding expensive treatments
		Aesthetic reasons
Knowledge	How often should you brush your teeth? (Single choice)	
	When is the most important time to brush your teeth? (Single choice)	
	What is the most important ingredient of a toothpaste in preventing tooth decay? (Single choice)	
	What amount of fluoride is recommended in toothpaste for healthy adults? (Single choice)	
	After brushing my teeth with toothpaste I should spit the toothpaste out and….(complete the sentence) (Single choice)	
	When is the best time to use a general everyday mouthwash? (Single choice)	
	From the following options, which is likely to be worst for your dental health? (Single choice)	
	My oral health could affect my general health (Single choice)	
	When should you start brushing a child's teeth? (Single choice)	
Responsibility	Keeping my teeth and gums healthy is a high priority for me	
	To what extent do the following statements motivate you to care for your teeth and gums?	Preventing future oral disease
		Avoiding poor oral health is within my control
		Looking after my teeth and gums is just as important to me as my overall health
		I believe that I have a good understanding of how to look after my teeth and gums

TABLE A2 Exploratory Factor Analysis (EFA) results of 1st pilot test-run (N = 160), 2nd pilot test-run (N = 185, including 103 participants from first pilot and 82 new participants), and those new participants alone from the 2nd pilot test (N = 82)

CFA domains	Question number	Detailed questions asked	1st pilot (N = 160)	2nd pilot (N = 185)	New participants in the 2nd pilot (N = 82)	Final decision to accept/Reject the question
Advice wanted	7.1	Would You like more advice about: How to brush your teeth	Accept	Accept	Accept	Accept
	7.3	Would You like more advice about: Smoking	Accept	Accept	Accept	Accept
	7.4	Would You like more advice about: Foods and drinks that contain sugar	Accept	Accept	Accept	Accept
	7.5	Would You like more advice about: Consuming sugar free fizzy drinks	Accept	Accept	Accept	Accept
	7.6	Would You like more advice about: Alcohol	Accept	Accept	Accept	Accept
	7.8	Would You like more advice about: Link between oral and general health	Accept	Accept	Accept	Accept
	1.2	From the following list of dental professionals, whose role do you feel it is to provide preventive advice and treatment? - Dental hygienist	Reject	Reject	Accept	Reject
Motivated by	4.1	To what extent do the following statements motivate you to care for your teeth and gums? - The dental professional taking the time to explain things to me	Accept	Accept	Accept	Accept
	4.2	To what extent do the following statements motivate you to care for your teeth and gums? - The feeling of being respected by the dental professional	Accept	Accept	Accept	Accept
	4.3	To what extent do the following statements motivate you to care for your teeth and gums? - Advice being specifically personalized to me	Accept	Accept	Accept	Accept
	4.4	To what extent do the following statements motivate you to care for your teeth and gums? - Advice from the dentist rather than from another dental professional in the team	Accept	Accept	Accept	Accept
	4.5	To what extent do the following statements motivate you to care for your teeth and gums? - Advice being given firmly	Accept	Accept	Accept	Accept
	4.6	To what extent do the following statements motivate you to care for your teeth and gums? - Trusting the dental professional	Accept	Accept	Accept	Accept
	4.7	To what extent do the following statements motivate you to care for your teeth and gums? - Having experience of pain in my mouth	Accept	Accept	Accept	Accept
	4.8	To what extent do the following statements motivate you to care for your teeth and gums? - Preventing future oral disease	Accept	Accept	Accept	Accept
	4.9	To what extent do the following statements motivate you to care for your teeth and gums? - Avoiding expensive treatments	Accept	Accept	Accept	Accept
	4.10	To what extent do the following statements motivate you to care for your teeth and gums? - Aesthetic reason	Accept	Accept	Accept	Accept

TABLE A2 (Continued)

| CFA domains	Question number	Detailed questions asked	1st pilot (N = 160)	2nd pilot (N = 185)	New participants in the 2nd pilot (N = 82)	Final decision to accept/Reject the question
Message delivery	2.2	Would you feel satisfied with your care if you were to receive preventive care from the: - Dental hygienist	Accept	Accept	Reject	Reject
	2.3	Would you feel satisfied with your care if you were to receive preventive care from the: - Dental nurse	Accept	Accept	Accept	Accept
	13.1	How would you like to receive advice? Sent before appointment	Accept	Accept	Accept	Accept
	13.2	How would you like to receive advice? In the waiting room	Accept	Accept	Accept	Accept
	13.3	How would you like to receive advice? Given to me verbally by the dentist	Accept	Accept	Accept	Accept
	13.4	How would you like to receive advice? Given to me verbally by the hygienist/therapist	Accept	Accept	Accept	Accept
	13.5	How would you like to receive advice? Given to me verbally by the nurse	Accept	Accept	Accept	Accept
	13.6	How would you like to receive advice? Sent to me after an appointment	Accept	Accept	Accept	Accept
	2.1	Would you feel satisfied with your care if you were to receive preventive care from the: - Dentist	Reject	Reject	Accept	Reject
Advice received	6.1	Does the dental professional give you advice about: How to brush	Accept	Accept	Accept	Accept
	6.3	Does the dental professional give you advice about: Smoking	Accept	Accept	Accept	Accept
	6.4	Does the dental professional give you advice about: Foods and drinks that contain sugar	Accept	Accept	Accept	Accept
	6.5	Does the dental professional give you advice about: Consuming sugar free fizzy drinks	Accept	Accept	Accept	Accept
	6.6	Does the dental professional give you advice about: Alcohol	Accept	Accept	Accept	Accept
	6.8	Does the dental professional give you advice about: Link between oral and general health	Accept	Accept	Accept	Accept
Cost	14a.1	The cost of a dental check-up influences how often I attend a dental appointment	Accept	Accept	Accept	Accept
	14a.2	The cost of a dental treatment influences the treatment I will choose	Accept	Accept	Accept	Accept
	14a.3	I think that dental check-ups are expensive	Accept	Accept	Accept	Accept
Responsibility	8.1	Keeping my teeth and gums healthy is a high priority for me	Accept	Accept	Accept	Accept
	14b2	Looking after my teeth and gums is just as important to me as my overall health	Accept	Accept	Accept	Accept
	14b3	Avoiding poor oral health is within my control	Accept	Accept	Accept	Accept
	14b1	I believe that I have a good understanding of how to look after my teeth and gums	Accept	Accept	Accept	Accept
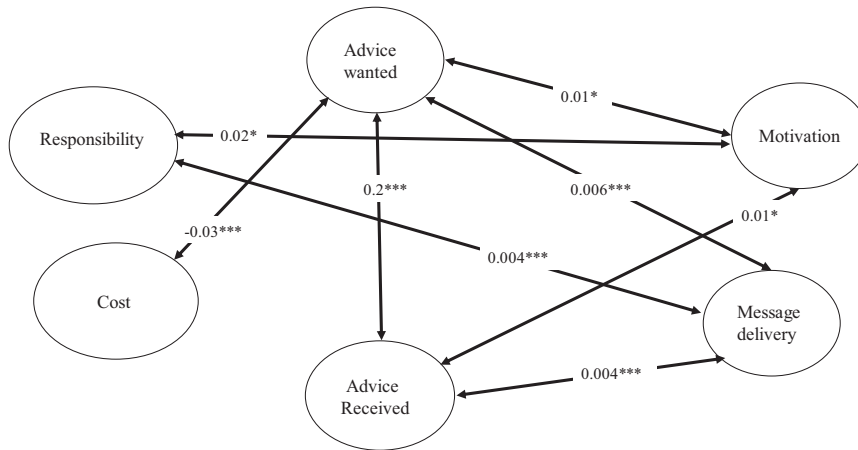
FIGURE A1 Correlation Coefficients between the different domains using Confirmatory Factor Analysis (CFA) (*N* = 160)

All values presented are the significant correlation coefficients. * p<0.05; **p<0.01, ***p<0.001