

Dentists' attitudes towards the phase-down of dental amalgam in Ireland

Précis

This paper identified training and remuneration as the two main barriers to a future total phase-out of dental amalgam in the Republic of Ireland.

Abstract

Aim: This study aimed to explore the attitudes of dentists in Ireland towards the phase-down of dental amalgam in relation to the Minamata Convention on Mercury.

Methods: A cross-sectional survey design was adopted using a quantitative 53-question survey piloted and distributed to dentists working in general dental practice.

Results: The study had a response rate of 11.8% (n=285). The study found a high level of awareness regarding recommended guidelines concerning the Minamata Convention on Mercury, with 96% of participants reporting that they were aware of the recommendations. Over half of the participants (61%) reported that they felt the phase-down was a good idea.

Conclusions: Training and remuneration were identified as the main barriers to a total phase-out of dental amalgam in Ireland in the future.

Journal of the Irish Dental Association 2020; 66 (2): 75-79.

Introduction

The management of caries is and will continue to be a large proportion of the day-to-day treatment carried out by dental practitioners.¹ Globally, dental caries prevalence is high and accounts for the largest proportion of the oral disease burden.² Dental amalgam has been used successfully for more than 165 years in the treatment of carious lesions.^{1,3} A combination of liquid mercury and a metal alloy, dental amalgam was the most commonly used material in restorative dentistry until relatively recently.^{4,5} Since the 1980s new materials and techniques have been developed and mastered, which have been slowly replacing dental amalgam. Resin composite, which has been used for many years in the restoration of anterior teeth, has been increasingly used in the restoration of posterior teeth. Following the introduction of the acid-etch technique and

methacrylate monomers, composites have continued to develop since the 1950s.⁶

The Minamata Convention on Mercury is an internationally binding treaty concerned with the protection of human health and the environment from emissions of mercury. The use of dental amalgam is one of the areas the Minamata Convention seeks to address.⁷ Measures aimed at reducing mercury emissions have been set out in relation to the area of dental practice and came into effect in July 2018. Since that date dentists have not been permitted to place amalgam in deciduous teeth, in permanent teeth in children 15 years and under, and in pregnant and breastfeeding women, unless medically necessary and with patient consent. Further changes were introduced in January 2019



Aileen Callanan
Research Assistant

All at University School and Dental
Hospital, University College Cork

Prof. Christopher D. Lynch
Professor and Consultant in
Restorative Dentistry

Dr Máiréad Harding
Senior Lecturer in Dental Public Health
Deputy Director of Oral Health
Services Research Centre

Dr Francis M. Burke
Senior Lecturer in Restorative
Dentistry
Vice Dean of Academic Affairs

Dr Martina Hayes
Senior Lecturer in Restorative
Dentistry

Corresponding author: Dr Martina Hayes, University Dental School and Hospital, Wilton, Cork. martina.hayes@ucc.ie

with the compulsory fitting of amalgam separators at dental practices and a prohibition on the use of bulk mercury.⁸

The changes in line with the Minamata Convention have the potential to have a significant impact on the practice of dentistry in Ireland. Some of the potential barriers faced in the phase-down of dental amalgam in Ireland relate to concerns around dentists' technical ability and training. There were also some concerns regarding the physical limitations of mercury-free alternatives. Financial implications relating to the use of mercury-free alternatives were also raised, and also negative experiences of the patient when placing mercury-free alternatives. The phase-down and phase-out of dental amalgam have been successfully introduced in European countries including Sweden, Norway, Finland, Denmark, and the Netherlands. Phase-down of dental amalgam relates to restrictions placed on its use, with phase-out meaning a total ban on dental amalgam use. Sweden began phasing out amalgam in the 1980s in a voluntary capacity; however, not having achieved the desired reduction during the 1990s the Swedish Parliament ceased to reimburse amalgam restorations. Sweden introduced a ban on mercury, including dental amalgam, in 2009. The phase-down began in Norway more than 15 years ago with a recommendation that dental amalgam not be the first choice for dental restorations. Dental amalgam was permitted in special cases during a temporary exemption period, leading to a total ban in 2011. Denmark, Finland, and the Netherlands have also successfully phased down dental amalgam to 1-5%.^{9,10}

This study aimed to explore the attitudes expressed by dentists in relation to the placement of restorations, both amalgam and mercury-free alternatives, and the phase-down of dental amalgam in the Republic of Ireland.

Methods

Study design

The study adopted a cross-sectional survey design. This involved distributing a survey aimed at a nationally representative sample of dentists. Ethical approval was provided by the Social Research Ethics Committee (SREC) in UCC (Log 2018-108). Informed consent was obtained from each participant; a consent form was included in the mailing to each dentist and completing the form was considered as the participant giving their informed consent to participate in the study.

Survey instrument

The survey instrument was modelled on a previous survey, 'No more amalgams', designed by Prof. Chris Lynch and used in a similar study in Wales.¹² The survey was adapted for use in the Irish context and, prior to distribution, was piloted locally by dentists in private practice and staff at Cork University Dental School and Hospital (CUDSH). The survey instrument had a total of 53 questions, with most of the questions adopting a tick box response. The survey instrument consisted of both fixed-choice and open-ended item questions and was laid out over six distinct sections: current practice; waste management; knowledge of phase-down; attitudes; training; and, demographics.

Sampling frame

The sampling frame used for the recruitment of participants into the study was the Dental Register. All dentists practising dentistry in Ireland must be listed on the Dental Register. The register (comprising the names of 3,124 dentists at the time of receipt in June 2018) was requested from the Dental Council of Ireland and all specialist dentists were removed from the sample. Others removed from the register were those with registered addresses outside of Ireland. The 2,400

remaining dentists on the register were used as the sampling frame and all were invited to participate.

A mailing company was used for distribution of the surveys and returns were forwarded to investigators in the CUDSH. Unique identifiers were assigned to each envelope (but not questionnaire) to enable follow-up of non-responders and to preserve anonymity. A stamped addressed envelope was provided in the mailing to increase participation, along with an information leaflet describing the nature of the study, a consent form and contact information of investigators. At follow-up, non-responders who were contacted were offered to have the survey posted again or emailed to them. Follow-up was made via telephone where the participants could be identified. The Dental Register addresses supplied by dentists include either practice or home addresses; all dentists followed up were found via internet search and contacted at their practices as the register does not provide phone numbers or email addresses.

Survey instrument distribution

The survey was distributed via post from September to December 2018 across three waves. Wave 1 (750 surveys) was distributed in September, Wave 2 (600 surveys) in November, and Wave 3 (1,050 surveys) in December. Postal distribution was the method of choice as it was agreed by investigators that dentists were more likely to complete a hard copy form rather than an online form following consultation with dentists in the CUDSH. Convenience sampling was also adopted at several key events including dental conferences, meetings and study groups, to maximise participation levels. At events, dentists in attendance were asked to fill in the questionnaires and put the completed questionnaires in boxes before leaving. Follow-up was also conducted following the distribution of Wave 1 and Wave 2 of the survey to maximise participation.

Data entry and analysis

Data entry was performed by a data management company, Seefin Data Management, Seefin DM Head Office, Seefin House, Listowel, Co. Kerry, V31 AK27, and uploaded in an Excel format. The Excel file was cleaned by investigators at the CUDSH and uploaded to IBM SPSS software for data analysis. The data were analysed using IBM SPSS statistics version 24 for Windows at IBM House, Shelbourne Road, Ballsbridge, Dublin 4. Quantitative analysis of survey data using frequencies was performed. Frequency tables were used to calculate minimum, maximum and means, and were also used to calculate proportions for relevant variables. Tables and graphs were used to display the results where appropriate.

Results

The response rate to the survey was 11.8%, with 285 dentists agreeing to participate. The participants were 41% (n=118) female and 59% (n=166) male. The overall age profile of respondents to the survey is displayed in **Table 1**. The practice location of participants was 45% city, 45% town and 10% rural. The participants who were the principal within the practice accounted for 56% and associates accounted for 44%. The proportion of patients that participants reported treating privately was 47%, the proportion treated under the Dental Treatment Services Scheme (DTSS) was 28%, and those treated under the Dental Treatment Benefit Scheme (DTBS) was 34%. Respondents did not always complete all sections and questions; thus, percentages do not always reflect all 285 participants. The results are based on responses from participants and not observed activity.

Table 1: Overall age profile of all respondents to the survey.

Age categories	Under 35	35-45	46-55	56-65	Over 65
Number	58	83	74	54	14
(%)*	(20%)	(29%)	(26%)	(19%)	(5%)

* Percentages do not always reflect all 285 respondents, but those who answered the question.

Table 2: Feelings and attitudes of dentists towards the phase-down of dental amalgam.

	Agree	Disagree	Neither
The phase-down of amalgam is a good idea	169 (60%)*	66 (24%)	44 (16%)
The phase-down of amalgam will be a major disruption to my practice	68 (25%)	145 (53%)	62 (22%)
The phase-down of amalgam does not cause me concern	121 (44%)	96 (35%)	56 (21%)

* Percentages do not always reflect all 285 respondents, but those who answered the question.

Knowledge of phase down

A total of 96% (n=268) of dentists were aware of the recommended guidelines relating to the phase-down in the use of dental amalgam.

Attitudes towards phase down

Dentists were asked a series of questions relating to their attitudes towards the phase-down of dental amalgam. Their responses are outlined in **Table 2**. They were also asked what they felt was the most appropriate timeline to introduce a complete phase-out of dental amalgam (**Table 3**).

Potential barriers – concerns about technical abilities and training

Table 4 outlines respondents' attitudes towards the placement of the various restorative materials when compared to each other.

A large proportion of dentists (84%) reported that they felt confident in their technical ability to use posterior composites for restoring unretentive cavities, 5% did not feel confident and 7% did not feel strongly either way. Some 80% felt that they had sufficient training to allow them to place posterior composites properly, while 11% did not feel that they had sufficient training. In relation to current techniques and practices relating to the placement of composite, 84% of dentists felt up to date, while 67% felt up to date with the placement of glass-ionomer cement (GIC) and 62% felt up to date with the placement of resin-modified glass-ionomer cement (RMGIC). Some 14% did not feel up to date with GIC placement and 19% did not feel up to date with RMGIC placement.

A large proportion of dentists (91%) reported having attended continuing professional development (CPD) courses about the placement of posterior composite restorations. Of these, 19% were didactic, 8% were hands-on and

Table 3: Timeframe in which respondents reported they believed a total phase-out could be achieved.

Years	under 5	5-9	10-29	over 30
Timeframe for a complete phase-out (i.e., total ban)	93 (34%*)	76 (28%)	54 (20%)	47 (17%)

*Percentages do not always reflect all 285 respondents, but those who answered the question.

Table 4: Dentists' attitudes towards the placement of various restorative materials.

	Agree	Disagree	Neither
I feel more confident placing an amalgam restoration than a composite restoration	71 (25%*)	75 (27%)	135 (48%)
I feel more confident placing a composite restoration than a GIC restoration	141 (50%)	94 (34%)	46 (16%)
I feel more confident placing a GIC restoration than a RMGIC restoration	50 (18%)	148 (53%)	79 (29%)

* Percentages do not always reflect all 285 respondents, but those who answered the question.

73% were a combination of both. Furthermore, 61% of dentists reported having plans to attend CPD on the topic. Hands-on courses or a combination of hands-on and either lectures or seminars were reported as the most suitable type of CPD required.

Potential barriers – concerns about physical limitations of mercury-free alternatives

The prognosis of restorations if composite alone was permitted in all posterior restorations concerned 48% of those surveyed, and 42% said that they would not be concerned. Just under half (44%) said that they would not be confident placing resin composite in a cavity with a subgingival margin, and 38% would be confident using composite in this scenario. In the case of a deep cavity that was close to the pulp, 21% of participants would not be confident placing composite, while 69% disagreed with this statement and would be confident in placing resin composite in a deep cavity. GIC would be considered as a "temporary" restorative material rather than a permanent one by 65%, and 45% would consider RMGIC restorations as "temporary" restorations.

Potential barriers – financial implications

In the restoration of posterior teeth, 21% of dentists believed that having to place composite routinely instead of amalgam could have negative financial implications for their practice, and 52% disagreed. Providing posterior composites in DTSS-funded treatment was considered too expensive by 72% of dentists surveyed. Some 12% of dentists said that they would place a composite restoration for the current DTSS fee for an amalgam filling, while 88% said that they would not be willing to provide the treatment for this fee. When dentists were

asked what they felt would be an appropriate fee to place a composite filling in a back tooth on the DTSS, the mean fee was €94 (minimum €50, maximum €160). In their current fee structure for private patients, 77% of dentists have a different fee for a posterior composite and a posterior amalgam, while 23% charge the same fee regardless of filling material.

Potential barriers – negative patient experience

To restore a moderately deep two-surface mesio-occlusal cavity in a lower first molar with amalgam, the average number of minutes estimated was 21 (min. 1 minute, max. 60 minutes). To restore the same sized cavity with a composite it would take 30 minutes on average (min. 3 minutes, max. 60 minutes). When asked if they felt that routinely placing posterior composites would cause appointment delays in the practice, 38% agreed and 50% disagreed.

In relation to postoperative sensitivity, 36% of respondents believed that patients experience less following an amalgam compared to a composite restoration. When asked if they believe that patients are more likely to experience food packing following a composite restoration, 37% agreed and 38% disagreed, with the remainder being unsure or expressing no difference. Dentists were also asked if they believed that their patients experience fewer postoperative restorative fractures with amalgam and 15% agreed, while 55% believed that composite restorations were less likely to fracture.

Discussion

There was a low response to the survey, which may have an impact on the generalisability of the results and introduce bias to the findings. Overall there was a high level of awareness and support of the Minamata Convention on Mercury among dentists in Ireland who participated in the study. Many of the guidelines to ratify the Minamata Convention have already been implemented and most dentists (96%) have heard about these guidelines, with a large proportion (61%) reporting that they felt it was a good idea. For comparison, a study in Wales reported that 65% of dentists had heard about the phase-down of dental amalgam.¹² The largest proportion of dentists surveyed, 34%, felt that a total ban could be implemented in less than five years, but a smaller proportion of dentists felt that this should not happen for more than 30 years. Despite this, there appear to be potential barriers to the phase-down of dental amalgam. Some of the potential barriers reported include: concerns about the dentist's own technical abilities and training; concerns about the physical limitations of mercury free-alternatives; financial implications; and, concerns relating to negative patient experience with mercury-free alternatives.

A small proportion of the dentists surveyed expressed concern in their technical ability and previous training in relation to posterior composite placement. Supporting dentists by providing CPD in posterior composite placement may be required to enable Ireland to make the transition towards a total phase-out of dental amalgam in the future. Some dentists also reported not having received clinical training in posterior composite placement as part of their dental school training, and this cohort should also be provided with the opportunity to obtain accessible CPD in posterior composite placement. This could bridge a gap in knowledge that may exist for some dentists who may not have received clinical training, and those who are less confident in composite placement compared to amalgam placement.

Concerns were raised by dentists regarding the physical limitations of mercury-free alternatives relating to the placement of composite in posterior teeth, and concerns around the temporary nature of some of the mercury-free alternatives

such as GIC and RMGIC. Almost half (48%) of dentists reported concerns with prognosis if they had to replace all posterior restorations with composite. A large proportion of dentists (65%) consider GIC as a temporary material, while 45% consider RMGIC restorations as temporary. Some of these concerns around physical limitations were mirrored in an Australian study.¹³ Providing continuing updates on existing materials, and advances on new and emerging materials, particularly mercury-free alternatives, could help to address this issue. Investing in research in the development and improvement of mercury-free alternatives may be required to continue to offer both dentists and patients the optimum dental care.

Many of the dentists surveyed raised concerns regarding the financial implications of mercury-free alternatives, with 21% citing negative financial implications for their practice and a large proportion (77%) charging different fees for amalgam and composite restorations. The placement of composite material is more time-consuming on average than the placement of amalgam. Remuneration under the publicly funded DTSS was also cited as a financial issue, with 88% of dentists unwilling to place a composite restoration for the current DTSS fee for an amalgam restoration. Currently, the DTSS fee for a posterior amalgam is €50.06 and dentists under the scheme are not permitted to place composite restorations on posterior teeth. They are, however, permitted under the scheme to place composite restorations in anterior teeth.¹⁴

Patient-related factors were also found to be a potential barrier to the phase-down of dental amalgam. The average time taken to place a posterior composite is longer than that of placing a posterior amalgam, which may lead to patient delays. Over one-third of dentists also believed that postoperative sensitivity is more likely to be experienced following composite placement compared to amalgam. Dentists also believed that food packing was a more frequent complication following a composite restoration compared to an amalgam restoration. This could also pose issues for patients, generating return appointments or, if untreated, causing gingival inflammation.¹⁵ Training may be of benefit to bridge any potential gaps in knowledge, particularly in relation to new products and techniques.

Limitations

This study, as with all survey-based studies, is not without its limitations. The response rate was low and there was an issue with self-selection bias of the participants. Self-selection bias was the main issue discovered during the follow-up of potential participants. The main reasons cited for non-participation included: being an 'amalgam-free' practice; not having a HSE contract; and, working in a small practice. Information regarding non-participation was collected during follow-up of non-responders. Investigators at the CUDSH followed up non-responders by finding contact details via an internet search. Those who were contacted during follow-up were asked by investigators their reason for non-participation and their responses were recorded. Despite the low response rate, the study had a similar number of participants as a study in the UK (n=270) that had a 40% response rate,¹² while another study conducting similar research in Australia had a response rate of just over 3%.¹⁶ Healthcare professionals typically have poor response rates to survey-based studies.¹⁷ As a result, the sample may not be nationally representative. Perhaps those who participate in survey-based studies are more likely to be motivated and engaged, and more likely to attend CPD. The Dental Register also had some inherent flaws for use as a sampling frame for a survey-based study. The results of this study should be interpreted with caution.

Recommendations

To enable Ireland to achieve a total phase-out of dental amalgam in the future, further measures will need to be taken. As discussed, dentists will need to be supported, particularly in the areas of training and remuneration. Accessible CPD for those who do not feel they have received adequate training in the past, or require updating on current methods, is warranted. Remuneration was a potential barrier, particularly in DTSS-funded dentistry, but also in private care where dentists mostly charge different fees for composite and amalgam. Further research in the continuing development of mercury-free alternatives is desirable.

Acknowledgements

The authors would like to acknowledge the Environmental Protection Agency (EPA), which provided funding for this project under the EPA Research Programme 2014-2020 grant number 2017-RE-MS-8. The views expressed in this article are solely those of the authors and not necessarily those of the EPA. The authors would also like to acknowledge the dentists who gave their time to participate in this study.

References

1. Baelum, V., van Palenstein Helderma, W., Hugoson, A., Yee, R., Fejerskov, O. A global perspective on changes in the burden of caries and periodontitis: implications for dentistry. *J Oral Rehabil* 2007; 34 (12): 872-906.
2. World Health Organisation. Future use of Materials for Dental Restoration. Geneva, Switzerland. 2011. [Internet]. [Accessed January 21, 2019]. Available from: https://www.who.int/oral_health/publications/dental_material_2011.pdf.
3. Bharti, R., Wadhvani, K.K., Tikku, A.P., Chandra, A. Dental amalgam: an update. *J Conserv Dent* 2010; 13 (4): 204-208.
4. Bonsor, S.J., Burke, T., Pearson, G.J. *A Clinical Guide to Applied Dental Materials*. Amsterdam, Boston: Elsevier/Churchill Livingstone, 2013.
5. Taut, C. Dental amalgam: is this the end? *J Ir Dent Assoc* 2013; 59 (6): 311-317.
6. Banerjee, A., Watson, T.F. *Pickard's Guide to Minimally Invasive Operative Dentistry*. Oxford; Oxford University Press, 2015.
7. United Nations Environment Programme. Minamata Convention on Mercury. Geneva, Switzerland. 2017. [Internet]. [Accessed March 20, 2019]. Available from: <http://mercuryconvention.org/Convention/Text/tabid/3426/language/en-US/Default.aspx>.
8. Department of Communications, Climate Action and the Environment. S.I. 533 of 2018. European Union (Mercury) Regulations. Dublin. 2018. [Internet]. [Accessed January 7, 2019]. Available from: <https://www.dccae.gov.ie/en-ie/environment/legislation/Pages/S-I—533-of-2018.aspx>.
9. United Nations Environment Programme. Lessons from countries phasing down dental amalgam use. Geneva, Switzerland: UNEP Chemicals and Waste Branch, 2016. [Internet]. [Accessed March 28, 2019]. Available from: <https://wedocs.unep.org/bitstream/handle/20.500.11822/11624/Dental.Amalgam.10mar2016.pages.WEB.pdf?sequence=1&isAllowed=y>.
10. Lynch, C.D., Wilson, N.H. Managing the phase-down of amalgam: part II. Implications for practising arrangements and lessons from Norway. *Br Dent J* 2013; 215 (4): 159-162.
11. Streeton, R., Cooke, M., Campbell, J. Researching the researchers: using a snowballing technique. *Nurse Res* 2004; 12 (1): 35-47.
12. Lynch, C., Farnell, D., Stanton, H., Chestnutt, I., Brunton, P., Wilson, N. No more amalgams: use of amalgam and amalgam alternative materials in primary dental care. *Br Dent J* 2018; 225 (2): 171-176.
13. Alexander, G., Hopcraft, M., Tyas, M., Wong, R. Dentists' restorative decision-making and implications for an 'amalgamless' profession. Part 4: clinical factor. *Aust Dent J* 2017; 62 (3): 363-371.
14. Health Service Executive. Dental Services and Treatment. Dublin. 2019. [Internet]. [Accessed March 4, 2019]. Available: <https://www.hse.ie/eng/services/list/2/dental/>.
15. Padbury, A. Jr, Eber, R., Wang, H.L. Interactions between the gingiva and the margin of restorations. *J Clin Periodontol* 2003; 30 (5): 379-385.
16. Alexander, G., Hopcraft, M.S., Tyas, M.J., Wong, R. Dentists' restorative decision-making and implications for an 'amalgamless' profession. Part 3: dentists' attitudes. *Aust Dent J* 2016; 61 (4): 502-513.
17. Cho, Y.I., Johnson, T.P., Vangeest, J.B. Enhancing surveys of health care professionals: a meta-analysis of techniques to improve response. *Eval Health Prof* 2013; 36 (3): 382-407.

CPD questions

To claim CPD points, go to the MEMBERS' SECTION of www.dentist.ie and answer the following questions:



CPD

1. The questionnaire was modelled on a similar study conducted in:

- ☐ A: USA
- ☐ B: Wales
- ☐ C: Australia

2. The proportion of dentists who were aware of the Minamata Convention on Mercury was:

- ☐ A: 100%
- ☐ B: 70%
- ☐ C: 96%

3. The biggest limitation of the study was:

- ☐ A: Low response rate
- ☐ B: Access to participants
- ☐ C: Measurement bias