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Methodology for the Development of a National Dental PBRN Survey on Dentist's Beliefs and Behaviors concerning Antibiotic Prophylaxis

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ABSTRACT

Background

Dentists are high prescribers of antibiotics for both treatment and prevention of infection, although there are few guidelines to aid clinicians. Given the worldwide concern about unnecessary use of antibiotics, there is a need for a better understanding of dentists' use of these drugs for antibiotic prophylaxis (AP) to prevent distant site infections, *i.e.*, infective endocarditis and prosthetic joint infection.

Objective

Our objective was to develop and implement an effective, self-report, cross-sectional, survey instrument that optimized the response rate and maximized reliability and validity, for determining the beliefs and behaviors of a large and nationally representative group of generalist and specialist dentists concerning their use of AP.

Methods

A 15-question survey (58 items) was developed in a structured process by a multi-disciplinary team and configured for automated online dissemination to 3,584 National Dental Practice-Based Research Network (network) practitioners. The implementation phase consisted of three waves of more than 1000 network members. Additionally, 47 randomly selected dentists were surveyed twice to assess test-retest reliability.

Results

Of 3,584 eligible network members, 2,169 (60.5%) completed the survey. The age and geographic distributions of responders was similar to that of dentists in the 2019 American Dental Association census. Furthermore, test-retest weighted kappa values for the survey were acceptable (median 0.56, interquartile range: 0.42-0.64).

Conclusion

We have developed a highly structured survey with a high response rate and good reliability that will allow us to obtain unique data on dentists AP prescribing beliefs and practices.

INTRODUCTION

Prescribing practices for antibiotics in general have become an important issue in public health and clinical practice. Antibiotic prophylaxis (AP) use prior to invasive procedures is intended to reduce bacteremia and potentially devastating outcomes of distant site infections. The origins of this practice include the focal infection theory[1-4]; older animal studies; and hundreds of case reports. Clinical studies over the past 30 years have associated many dental procedures as a source of transient bacteremia. This led to a rise in the use of AP for people thought to be at risk for distant site infections. [5, 6]

There are multiple factors that could influence AP prescribing practice, beliefs and behavior, including: (i) the growing concern about the development of antibiotic resistance, even from a single dose[7] (ii) adverse drug reactions, to include infection with *Clostridium difficile*[7, 8], (iii) diverging opinions on, and compliance with, formal AP guidelines[9], (iv) the large number of patients who would need to receive AP to prevent one case of distant site infection[10] (v) the lack of scientific evidence to support AP use[10], and (vi) a significant financial cost and inconvenience associated with AP use in the dental office.[11, 12] The most longstanding and controversial applications of AP use are to prevent infective endocarditis (IE) in patients with specific cardiac conditions[13] and hip and knee infections in those with prosthetic joints.

Despite specific guidelines from the American Heart Association (AHA) and other authoritative bodies, the lack of data demonstrating a causal relationship between dental procedures and IE or prosthetic joint infections, has resulted in a lack of consensus on AP.[14-19] A study by Durkin *et al.* reported that AP prescribing by dental specialists, in contrast to their physician colleagues, remained stable during 2013 through 2015 in the United States emphasizing the need for Public health efforts to improve AP prescribing practices. [20]

We could find no studies of dentist beliefs and opinions on AP use for patients at risk from invasive dental procedures and we determined that a well-designed survey

instrument would provide highly useful data to both understand where the problems existed, to design solutions (*e.g.*, educational programs), and help with ongoing efforts with antibiotic stewardship. Surveys of healthcare professionals typically have lower response rates than the general public.[21] Low response rates have been associated with increased survey demands (long or complex questionnaires), insufficient range of response options, concerns over confidentiality and increased workload on healthcare professionals.[21] Thus, in an elegant study, Funkhouser *et al.* demonstrated that higher response rates required minimization of questionnaire length and work load, improving the perception of confidentiality and follow-up of non-responders.[21]

Our objective was to focus on the methodological considerations necessary for the development of a rigorous single time point, self-report, cross-sectional survey instrument targeting a representative group of members of the national dental practice-based research network (Network), whose overarching goal is to foster research endeavors to improve clinical practice.[22] Web-based tools, timeline management logistics and human resources (study team and regional coordinators) were used to improve dentist response rates and maximize validity and reliability in assessing beliefs and behaviors of Network members regarding their use of AP.

METHODS

Overall study design and network setting

The Network is a consortium of over 4,000 dentists from six regions: Midwest, Northeast, South Atlantic, South Central, Southwest, and Western. The group members include general dentists (74%) and specialists (26%) in endodontics, periodontics, prosthodontics, orthodontics, pediatric dentistry, dental public health, and oral and maxillofacial surgery. Detailed information, purpose and mission statement of the network have been described elsewhere. [23] Due to the infrequency with which oral

pathologists and oral radiologists are involved in prescribing AP, these two groups were not invited to participate in the current study.

The distribution of Network members across six regions the United States at time of the survey is shown in **Supplemental File I** (**Table SI**). The University of Alabama at Birmingham (UAB) Institutional Review Board (IRB) served as the National Dental PBRN Central IRB, from which a waiver of signed consent was sought and granted. Dentists completing the survey were remunerated with $50 for their participation. The cross-sectional AP survey instrument timeline consisted of two 9-month phases: (**1**) survey development and (**2**) survey implementation, involving a multistep process as described below.

Development of the AP survey instrument (months 0-9)

Stage 1:

A multidisciplinary study team was assembled consisting of dentists (practitioners and researchers), qualitative research experts covering psychology, informatics, statistics and survey methodology.[24] The team also included experienced data managers and research coordinators to collect and transfer data and ensure effective follow-up in the survey implementation.

During brainstorming sessions, the study team established that in order to produce an effective survey instrument and optimize the response-rate, the following topics would need to be addressed: (i) frequency of AP prescribing, (ii) knowledge and perception of AHA guidelines, (iii) decision criteria to implement or change AP practices, and (iv) the perception of risk/benefit ratio and associated comorbidities. For further optimization, we ensured proper communication with the numerous regional research coordinators within each of the six Network geographical regions involved in the study. Indeed, the regional coordinators focus is to disseminate Network communications, establish and maintain working relationships, and promote the overall goals of the Network.

Ad hoc team members established the timeline, secondary documentation, and/or contributed to the development of a preliminary survey draft consisting of 90 questions. A consolidated and more refined survey version was then created containing 37 multi-response questions (187 items) covering a broad range of issues initially thought to be important. A reduction in the number of questions was accomplished through numerous brainstorming sessions among subject experts *via* conference calls. This focus on reducing the number of questions and the formatting of these questions was intended to prevent survey fatigue and deliver a high response rate by ensuring the survey could be completed in less than 20 minutes.

The survey version of 37 multi-response questions (187 items) was tested on a focus group of 11 dentists who were not involved in the questionnaire development. They completed a cognitive "think aloud" test[25, 26] in which focus group members were recorded when reading the questions aloud and verbally expressing what they thought the question addressed prior to reading the answer choices aloud. They were also asked to provide feed-back as to whether the answer choices were reasonable and fully exhaustive. Thus, a first version of the survey instrument was developed to organize the questions based on content, and a second version was developed to organize the questions based on cognitive demand and content. The latter version allowed the study team to determine if there was a method to reduce cognitive demand, prevent survey fatigue, and thereby further increase the response rate.

Stage 2:

Once the organization of the survey questions was complete, a survey draft containing 37 questions underwent an informal review process by the National Institute of Dental and Craniofacial Research (NIDCR). The following draft, a finalized survey instrument consisting of 15 multi-response questions, was approved by NIDCR. Participant-facing documents (*i.e.*, email invitation, reminder emails, etc.) were reviewed by the central National DPBRN IRB, University of Alabama (following approval by regional IRBs') and

the IRB at Carolinas Medical Center-Atrium Health. While the survey instrument required participants to consent online, this study underwent expedited IRB review and waiver of consent documentation, as the study poses minimal risk to subjects.

Stage 3:

The final survey instrument of 15 multi-response questions was comprised of 58 items, including 8 with five-point Likert scales (2 with 4 parts, *i.e.*, substantial sub-questions), 6 with two to five multiple choices, and 1 with a percentage slider bar. These questions covered: 1) eligibility (active, USA licensed dentist) and consent, 2) knowledge and perception of AHA and prosthetic joint guidelines, 3) decision criteria to implement or change AP practices, 4) perception of risk/benefit ratio and associated comorbidities, and 5) survey closing questions (**Supplemental File II: Survey DPBRN AP Study**). Demographics were not included in the survey, since these data were available from the network.

The approved survey instrument and invitation emails were configured into the electronic data capture tool for data collection and management in the Research Electronic Data Capture (REDCap) program.[27] Final testing and system checks were performed to ensure compatibility with various internet browsers prior to launch.

Automated Survey Implementation and recruitment (months 10-18)

Eligible dentists were identified from the network Enrollment Questionnaire data, which included contact information (including active email addresses) for member dentists randomly selected for participation. As part of the enrollment process, practitioners complete an Enrollment Questionnaire that describes themselves, their practice(s), and their patient population.[28] During the 9-month implementation phase, invitations to participate in the AP survey were only delivered to active network members licensed to practice dentistry in the U.S. and currently engaged in dental practice. All eligible

dentists received an automated study invitation email from the principal investigator explaining the study and inviting them to participate.

The automatic email invitation, sent at a designated time through REDCap, contained unique hyperlinks for each network provider to access and complete the survey, which included a “Save and Return” feature in REDCap. To optimize participation, invitations resulting in an autogenerated undeliverable email messages were tracked and brought to the attention of the appropriate regional coordinator to acquire recent contact information. If requested by the practitioner, surveys were mailed to a physical address with prepaid return envelopes.

Survey and network enrollment data were linked using participant IDs. The list of eligible dentists was split into 3 waves to ensure a smooth enrollment and data collection, improve workload feasibility for the coordinators and prevent system crashes when the surveys were sent out via REDCap. The size and composition of the first wave of invitations were determined based upon pilot data from approximately 40 respondents.

The three waves of invitations could be adjusted by following the response rates live in RED Cap and using a random generator tool to reduce bias. In addition, for the 3 waves of invitations, region-specific quotas were applied to ensure representative sampling of both generalists and specialists from the six defined network regions.[28] Demographics of the participants were obtained from the network enrollment database.

Approximately two weeks after the initial survey invitation was disseminated, an email reminder was directed to those members who had not yet responded. Two weeks following the first reminder, a second email reminder was directed to the members who had still not completed their survey. Network regional coordinators then assisted the study team in delivering a third email reminder from their designated network Regional Coordinator (RC) if invited participants had not completed the survey within 7-10 days after the second reminder. The coordinators continued to contact non-responders (*e.g.*, phone, fax, email, postal mailing, etc.) until that specific wave’s response time was

closed, 10 weeks from the wave's launch date. Thus, invited dentists who had not responded within approximately 10 weeks were considered non-responders, and their survey links were deactivated.

Completion of the survey indicated that practitioners read informed consent information, and this implied consent in compliance with the UAB DPBRN Central IRB. Participants were assigned a unique identification number, which was used to maintain confidentiality for study records and organize data transcripts. Contact information was removed from the final merged dataset and data was stored/saved using Unique Participant IDs. All survey data were collected and housed in the Carolinas Medical Center - Atrium Health REDCap Survey Management System.

Statistical considerations

Assuming that 60% of the total DPBRN dentists (N=4002, as of Jan 7th, 2017, **Table SI**) were eligible, we anticipated that about 2400 (1805 generalists and 595 specialists considered in this study would be enrolled. This would result in a margin of error (MOE) of 3.15% (+/- 0.34 [SD]), on average, per region (generalists [N=3010] and specialists [N=992] combined), 1.46% for general dentists and 2.55% for specialists (all regions combined), at 95% confidence level (per online MOE survey tool at https://aytm.com/pages/mes).[29] The percentage of MOE describes how closely answers from the 60% responders represent a "true value" in the entire DPBRN population It is assumed that an MOE of 5% for a 95% confidence level is an acceptable standard for this survey, although higher MOEs can be anticipated when analyzing dentists subcategories or if a lower response rate is obtained.

To assess test-retest reliability, 47 of the initial survey responders were randomly selected to complete the online survey twice (approximately 2 weeks post initial completion). Nearly all main survey items were Likert or categorical scale, except for two items with percentiles, which were categorized into segments because percentiles represent a rough estimate. The agreement reliability for these 47 participants was

determined by using Cohen's Kappa and weighted Kappa statistics. Percentage of agreement was defined as the number of items with same responses from test and retest, divided by total of main body of survey items, and multiplied by 100. Descriptive summary statistics including frequencies, means, medians, standard deviations and percentiles were determined. The analysis was performed using SAS Enterprise Guide version 7.1 on platform of SAS version 9.4 (SAS Institute Inc., Cary, NC, USA). A two-tailed z-test for two populations proportions was used to determine differences in responders' representations regarding age and geographic distributions (significance level alpha=0.05).[30]

RESULTS

Primary results associated with the methodology are described below. The extensive results pertaining to the beliefs and behaviors of dentist about AP use will be published separately, with the present methodological manuscript serving as a reference.

Primary survey outcomes

The study design consisted of a 9-months development phase and a 9-month implementation phase, summarized in **Figure I**. The use of REDCap to distribute and administer the survey resulted in a number of efficiencies. These included, (i) the ability to send survey links to participants on a large scale (at least 3500 or more participants) *via* email and collect their responses instantly and securely, (ii) the capability to log any change made in the database to prevent accidental/erroneous changes during the study, and (iii) a user-friendly interface that enabled us to export the data in the different format required for statistical analysis etc., in various programs including SAS. In addition, it allowed us to manage the distribution of the survey in 3 waves. This helped avoid the possibility of a system crash or blockage, that could have occurred if it had been necessary to distribute the survey through the secure network's firewall, to the much larger entire group of network practitioners, in one go.

During the launch stages of the implementation phase, a total of 3,584 invitations were emailed to network members, among 4,082 network members registered on 01/07/2017. Thus, of the 2,193 dental practitioners who consented for this AP survey, 23 of them did not have an active license and information was missing in one case. The selection process yielded 2,169 eligible members consenting to the study, *i.e.*, responders (**Figure II**). The 3 waves of the implementation phase consisted of sets of 1067, 1001 and 1517 invitations, completed during an approximate 8.5-months period. Thirteen practitioners requested a paper-copy of the survey. Eight completed paper copy surveys were returned, and two "additional" online surveys were completed by practitioners who had received the paper copy.

Of the eligible practitioners who consented to the survey (N=2,169), 27 provided an incomplete survey, together representing a response rate of 60.5% (95% confidence interval of 0.59-0.62) per initial 3,584 network members approached.

AP Survey Test-retest reliability

All 47 survey participants invited to take the survey twice at two-week intervals, did so accordingly. The Kappa coefficient for 58 items of 14 AP Survey questions ranged from 0.04 to 0.56, with a median of 0.32 and an interquartile range of 0.20 to 0.42, indicating an overall fair to moderate strength of agreement between test and retest. Weighted Kappa ranged from -0.01 to 0.89, with a median of 0.56 and interquartile range of 0.42 to 0.64 (**Figure IIIa**). The median of percentage agreement is 55% with an interquartile range of 46% to 64% (**Figure IIIb**). Aggregate Kappa and weighted Kappa ranges shown in **Table I**, were acceptable considering overall number of questions and item choices per each question, *i.e.*, 14 Likert scale AP survey questions and sub-questions (excluding opening and closing survey questions). There were 2 to 7 items per question. The results suggest higher reliability was achieved for question 1., for example, which relates to an event memorization (2 items, weighted kappa range 0.71-0.89, **Table I**).

DISCUSSION

This is the first large scale DPBRN study in which a survey instrument was designed by a multidisciplinary team to identify or better understand beliefs and behaviors of DPBRN practitioners about antibiotics prophylaxis use. As noted by Funkhouser et al., surveys designed for healthcare professionals historically yield a lower response rate compared to the general public.[21] Here we report a response rate of 60.5%, which is relatively high given the complexity and controversy surrounding the AHA guidelines on AP to prevent distant site infections. Overall, the 60.5% response rate reported here, compares favorably with other surveys undertaken by the Network and is comparable to other recent dental practitioner surveys in the United States and Japan that reported response rates of 58% and 69% respectively.[31, 32]

The final questionnaire contained 12 questions focusing on AP practices and 3 companion questions, with a limited number of selection choices, and with an appropriate response time range of 15-20 minutes based on pilot testing prior to launch. The pretest 'think aloud' process significantly reduced the cognitive demand which, we believe, contributed to the success of this study. In addition, the use of REDCap provided significant efficiencies in the management, distribution and analysis of the survey.

Because dentists who are DPBRM members may not be representative of all dentists practicing in the United States, by virtue of their wish to contribute to research, we compared the demographic characteristics of our DPBRN responders to those of the dentists in the 2019 ADA Health Policy Institute (HPI) database Masterfile. [33] The ADA HPI database contains the demographic details of a census of all dentists (including non-ADA members), practicing and non-practicing in the United States, excluding dentists who are in U.S. territories or U.S. armed forces overseas. It provides the contemporary age, gender, specialty and geographic distribution of dentists Nationwide.

Responder distributions were overall similar to the ADA census data regarding gender (roughly 70% males *vs.* 30% females). There were differences and similarities regarding responder age (**Fig. IVa**) and regional location (**Fig. IVb**). The age-group distributions of AP survey responders (N=1,269) (**Fig. IVa**) compared to that of the 2019 ADA HPI database Masterfile[25] (sample size N=199,486 census records from various sources), were, in decreasing order of representation: 31.6% *vs.* 22.8% (age 55 to <65; $p<0.05$), 23.1% *vs.* 23.4% (age 35 to <45; $p>0.05$), 20.5% *vs.* 21.1% (age 45 to <55; $p>0.05$), 19.4% *vs.* 15.8% (age 65+; $p<0.05$), and 4.3% *vs.* 16.9% (age <35; $p<0.05$). However, responder distributions were overall similar regarding ranking and order of magnitude for the age categories 35 to <55 (43.6% *vs.* 44.5%), 55 to <65 (31.6% *vs.* 22.8%), and 65+ (19.4% *vs.* 15.8%), respectively, besides the <35 age category with significant lower order of magnitude correspondence (4.3% *vs.* 16.9%).

There were also geographic proportion disparities compared to the 2019 ADA HPI data, such as, with the Western (15.9% *vs.* 25%; $p<0.05$) and South Central (18.4% *vs.* 8%; $p<0.05$) regions (**Fig. IVb**). However, with the exception of the Western and South-Central regions, differences in AP survey responders' distribution did not differ by more than 1.5-fold as a percentage compared to the 2019 ADA HPI Masterfile census data.

In addition, the Southwest region produced the highest engagement rate at 67% completed surveys. The South-Central and South Atlantic regions were the second and third most engaged regions with 63% and 61% response rates, respectively. The Northeast, Midwest, and Western regions, all produced satisfactory response rates that were close to 60% (*i.e.*, 58%, 58%, and 55%, respectively).

Finally, the test-retest results were acceptable considering that the 8 main Likert scale questions (including sub-questions) represented many items (n=58). Additionally, the AP survey was not designed for diagnostic purposes but for the collection of beliefs and knowledge about AP in dental practice, and, therefore, does not necessitate a high threshold for kappa values. Indeed, the test-retest results suggest that weighted kappa

values (**Table I**) may depend on the complexity of some of the domains addressed in our survey as well as the sample size of the test-retest reliability survey.

In conclusion, we established an effective survey instrument with acceptable reliability, relatively high response rate and reasonable geographic representation, to address complex domains on the topic of AP to prevent secondary infections in dental practice.

Furthermore, the consistent representation of dentists throughout the six regions, alongside a good response rate of ~60% and a large sample size (2169 eligible respondents), should produce clinically relevant data. This survey instrument will be used to conduct a study of dentists' beliefs and behaviors regarding the use of AP to prevent distant site infections, that will be reported separately.

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AUTHORS' CONTRIBUTIONS

PBL conceived the study and was the Principal Investigator for the funding source. He collaborated with members of the National DPBRN, participated in the development of the survey instrument, and contributed to data analysis and manuscript development. JLM participated in the development of the survey instrument, led the writing of the manuscript and revisions, statistics, and data interpretation. JZ conducted statistical analyses and participated in data interpretation and preparation of the manuscript. MHT and JMD participated in the development of the survey and revisions of the manuscript. PEMcK contributed to the development of the survey, improved psychological concepts, and provided critical review of the manuscript. JZ, JMD and CS were involved in the implementation/launch of the survey in REDCap and data collection and/or analysis. KAS collected and compiled 2019 ADA HPI data and generated the comparative graphical distributions with the AP survey data. Select DPBRN members provided comments on the initial drafts of the AP survey.

SUPPLEMENTAL MATERIALS

Supplemental File 1: Table SI
Supplemental File 2: Survey DPBRN AP Study

REFERENCES

1. Mayo CH. Focal infection of dental origin. Dent Cosmos. 1922;64:1206-8.
2. Hughes RA. Focal infection revisited. Br J Rheumatol. 1994;33(4):370-7.
3. Newman HN. Focal infection. J Dent Res. 1996;75(12):1912-9.
4. Pallasch TJ, Wahl MJ. Focal infection: new age or ancient history? Endodontic Topics. 2003;4(1):32-45.
5. Lockhart PB, Loven B, Brennan MT, Fox PC. The evidence base for the efficacy of antibiotic prophylaxis in dental practice. J Am Dent Assoc. 2007;138(4):458-74.
6. Cahill T, Harrison J, Jewell P, Onakpoya I, Chambers JB, Dayer M, et al. Antibiotic prophylaxis for infective endocarditis: a systematic review and meta-analysis. Heart. 2017;103(12):937-44. doi: 10.1136/heartjnl-2015-309102.
7. Thornhill MH, Dayer MJ, Prendergast B, Baddour LM, Jones S, Lockhart PB. Incidence and nature of adverse reactions to antibiotics used as endocarditis prophylaxis. J Antimicrob Chemother. 2015;70(8):2382-8. doi: dkv115 [pii];10.1093/jac/dkv115 [doi].
8. Thornhill MH, Dayer MJ, Durkin MJ, Lockhart PB, Baddour LM. Risk of Adverse Reactions to Oral Antibiotics Prescribed by Dentists. J Dent Res. 2019;98(10):1081-7. doi: 10.1177/0022034519863645. PubMed PMID: 31314998.
9. Lockhart PB, Hanson NB, Ristic H, Menezes AR, Baddour L. Acceptance among and impact on dental practitioners and patients of American Heart Association recommendations for antibiotic prophylaxis. J Am Dent Assoc. 2013;144(9):1030-5.
10. Wilson W, Taubert KA, Gewitz M, Lockhart PB, Baddour LM, Levison M, et al. Prevention of infective endocarditis. guidelines from the American Heart Association. a guideline from the American Heart Association Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee, Council on Cardiovascular Disease in the Young, and the Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and the Quality of Care and Outcomes Research Interdisciplinary Working Group. Circulation. 2007;116(15):1736-54. doi: 10.1161/CIRCULATIONAHA.106.183095. PubMed PMID: 17446442.
11. Lockhart PB, Blizzard J, Maslow AL, Brennan MT, Sasser H, Carew J. Drug cost implications for antibiotic prophylaxis for dental procedures. Oral Surg Oral Med Oral Pathol Oral Radiol. 2013;115(3):345-53.
12. Franklin M, Wailoo A, Dayer MJ, Jones S, Prendergast B, Baddour LM, et al. The Cost-Effectiveness of Antibiotic Prophylaxis for Patients at Risk of Infective Endocarditis. Circulation. 2016;134(20):1568-78. doi: 10.1161/CIRCULATIONAHA.116.022047.

13. Jones TD, Baumgartner L, Bellows MT, Breese BB, Kuttner AG, McCarty M, et al. Prevention of rheumatic fever and bacterial endocarditis through control of streptococcal infections. Circulation. 1955;11:317-20.
14. Durkin MJ, Hsueh K, Sallah YH, Feng Q, Jafarzadeh SR, Munshi KD, et al. An evaluation of dental antibiotic prescribing practices in the United States. J Am Dent Assoc. 2017;148(12):878-86 e1. doi: 10.1016/j.adaj.2017.07.019. PubMed PMID: 28941554; PubMed Central PMCID: PMC5705569.
15. Thornhill MH, Dayer M, Lockhart PB, Prendergast B. Antibiotic Prophylaxis of Infective Endocarditis. Curr Infect Dis Rep. 2017;19(2):9. doi: 10.1007/s11908-017-0564-y [doi];10.1007/s11908-017-0564-y [pii].
16. Durkin MJ, Feng Q, Warren K, Lockhart PB, Thornhill MH, Munshi KD, et al. Assessment of inappropriate antibiotic prescribing among a large cohort of general dentists in the United States. J Am Dent Assoc. 2018;149(5):372-81.e1. doi: 10.1016/j.adaj.2017.11.034.
17. Lockhart PB. Antibiotic prophylaxis for dental procedures: are we drilling in the wrong direction? Circulation. 2012;126(1):11-2.
18. Sollecito TP, Abt E, Lockhart PB, Truelove E, Paumier TM, Tracy SL, et al. The use of prophylactic antibiotics prior to dental procedures in patients with prosthetic joints. J Am Dent Assoc. 2015;146(1):11-6. doi: 10.1016/j.adaj.2014.11.012. PubMed PMID: 25569493.
19. Little JW, Jacobson JJ, Lockhart PB. The dental treatment of patients with joint replacements: a position paper from the American Academy of Oral Medicine. J Am Dent Assoc. 2010;141(6):667-71.
20. Durkin MJ, Feng Q, Suda KJ, Lockhart PB, Thornhill MH, Warren K, et al. Longitudinal antibiotic prescribing trends among US dental specialists within a pharmacy benefits manager, 2013 through 2015. J Am Dent Assoc. 2019;150(10):846-53 e5. doi: 10.1016/j.adaj.2019.05.028. PubMed PMID: 31561761.
21. Funkhouser E, Vellala K, Baltuck C, Cacciato R, Durand E, McEdward D, et al. Survey Methods to Optimize Response Rate in the National Dental Practice-Based Research Network. Eval Health Prof. 2017;40(3):332-58. doi: 10.1177/0163278715625738. PubMed PMID: 26755526; PubMed Central PMCID: PMC5002250.
22. Gilbert GH, Williams OD, Rindal DB, Pihlstrom DJ, Benjamin PL, Wallace MC, et al. The creation and development of the dental practice-based research network. J Am Dent Assoc. 2008;139(1):74-81. doi: 10.14219/jada.archive.2008.0024. PubMed PMID: 18167389.
23. Gilbert GH, Williams OD, Korelitz JJ, Fellows JL, Gordan VV, Makhija SK, et al. Purpose, structure, and function of the United States National Dental Practice-Based Research

Network. J Dent. 2013;41(11):1051-9. doi: 10.1016/j.jdent.2013.04.002. PubMed PMID: 23597500; PubMed Central PMCID: PMC3812393.
24. Groves RM, Fowler FJ, Couper MP, Lepkowski JM, Singer E, Tourangeau R. Survey Methodology. 2 ed. Hoboken, N.J.: John Wiley & Sons, Inc.; 2009.
25. Willis GB, Artino AR, Jr. What Do Our Respondents Think We're Asking? Using Cognitive Interviewing to Improve Medical Education Surveys. J Grad Med Educ. 2013;5(3):353-6. doi: 10.4300/JGME-D-13-00154.1. PubMed PMID: 24404294; PubMed Central PMCID: PMC3771159.
26. Willis GB. Cognitive Interviewing Revisited: A Useful Technique, in Theory? In: Presser S, Rothgeb JM, Couper MP, Lessler JT, Martin E, Martin J, et al., editors. Methods for Testing and Evaluating Survey Questionnaires. Hoboken, NJ: John Wiley & Sons, Inc.; 2004.
27. Patridge EF, Bardyn TP. Research Electronic Data Capture (REDCap). J Med Libr Assoc. 2018;106(1):142-4. doi: 10.5195/jmla.2018.319. PubMed Central PMCID: PMC5764586.
28. The National Dental Practice-Based Research Network [October 11,2019]. Available from: http://nationaldentalpbrn.org/.
29. AYTM. Margin of Error & Sample size Calculator 2020 [January 20, 2020]. Available from: https://aytm.com/pages/mes.
30. Z Score Calculator for 2 Population Proportions [August 25, 2019]. Available from: https://www.socscistatistics.com/tests/ztest/Default2.aspx.
31. McCauley JL, Gilbert GH, Cochran DL, Gordan VV, Leite RS, Fillingim RB, et al. Prescription Drug Monitoring Program Use: National Dental PBRN Results. JDR Clin Trans Res. 2019;4(2):178-86. doi: 10.1177/2380084418808517. PubMed PMID: 30931705.
32. Kakudate N, Yokoyama Y, Sumida F, Matsumoto Y, Gordan VV, Gilbert GH. Dentists' practice patterns of treatment for deep occlusal caries: Findings from a dental practice-based research network. J Dent. 2019;84:76-80. doi: 10.1016/j.jdent.2019.03.009. PubMed PMID: 30935965; PubMed Central PMCID: PMC6545242.
33. Supply of Dentists in the U.S.: 2001-2018 [Internet]. 2019 [cited October 4, 2019]. Available from: https://www.ada.org/en/science-research/health-policy-institute/data-center/supply-and-profile-of-dentists.

TABLE

Table I. Kappa weighted kappa ranges, test-retest reliability for Likert scale survey questions

Survey questions	Kappa range	Weighted kappa range
1. How often do you see your IE **OR** prosthetic knee/hip joint populations in your practice? (2 items)	0.45-0.56	0.71-0.89
2. Thinking about the 2007 American Heart Association guidelines on IE patients and **YOUR** patients who are at risk for IE, to what extent do you agree with the following statements? (7 items)	0.19-0.47	0.35-0.78
3. Thinking about the 2007 American Heart Association guidelines on prosthetic knee/hip joint and **YOUR** patients who have received a prosthetic knee/hip joint, to what extent do you agree with the following statements? (6 items)	0.17-0.39	0.24-0.62
4. How important is each of the following in **YOUR** decision to prescribe (or not prescribe) antibiotic prophylaxis?		
Part A. Official Resources (6 items)	0.10-0.53	0.45-0.75
Part B. Professional colleagues (3 items)	0.18-0.27	0.45-0.62
Part C. Personal preferences (4 items)	0.16-0.33	0.47-0.64
Part D. Patient factors (3 items)	0.24-0.49	0.29-0.73
5. How likely are you to change **YOUR** antibiotic prophylaxis prescription practices if the following situations occur?		
Part A. Official Resources (3 items)	0.09-0.32	0.24-0.64
Part B. Professional Colleagues (2 items)	0.11-0.36	0.56-0.57
Part C. Personal preferences (2 items)	0.04-0.05	0.21-0.22
Part D. Patient factors (2 items)	0.28-0.32	0.64-0.69

6. To what extent do **YOU** agree that antibiotic prophylaxis prevents infection in the following patient populations? (4 items)	0.33-0.55	0.52-0.79
7. To what extent do **YOU** agree that each of the following dental procedures put some patients at risk for infective endocarditis? (5 items)	0.19-0.44	0.35-0.65
8. Do **YOU** ever prescribe, or request prescription, for antibiotic prophylaxis prior to invasive dental procedures in your office for patients with? (5 items)	0.30-0.52	0.25-0.41

Footnote: The 8 five points Likert scale questions (and sub-questions) presented, covered knowledge and perception of AHA guidelines, decision criteria to implement or change AP practices, and perception of risk/benefit ratio and associated comorbidities. Questions on eligibility/consent and survey closing questions were excluded. Item choices (not shown) were two to seven per question/sub-question.

FIGURE LEGENDS

Figure I. AP survey study design

Legend. Summary of key steps of the AP survey study design consisting of a 9-months development phase and a 9-month implementation phase. The think aloud process is designed to improve the readability and accessibility of the survey. REDCap = Research Electronic Data Capture; IRB = Institutional Review Board; DMP = Data Management Plan

Figure II. Screening and selection process of AP survey eligibility

Legend. A total of 3584 network members were sent emails to inform them about the AP survey. Among them, 2169 were eligible as they did consent and have an active license.

Figure III. AP Survey distributions of weighted Kappa and percentage of agreement

IIIa.

IIIb.

Legend. (**a**) The weighted kappa distribution is slightly right-skewed. IQR (interquartile range) for weighted kappa: 0.42-0.64. (**b**) The median of percentage agreement is 55%, with an IQR of 46%-64%.

Figure IV. Responders' distributions across age, gender and network region

IVa.

IVb.

Legend. Responder age (**a**) and (**b**) geographic distributions of the AP survey DPBRN responders' proportions, *i.e.*, eligible practicing members with an active license who

consented to the study, are compared to the data in the 2018 census data of the 2019 ADA HPI Masterfile.[25] ADA records pertained to dentists with one of the following occupations: private practice (full- or part-time), dental school/faculty staff member, armed forces, other federal services (*i.e.*, Veterans' Affairs, Public Health Service), state or local government employee, hospital staff dentist, graduate student/intern/resident, or other health/dental organization staff member.