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Survey Methods to Optimize Response Rate in the National Dental Practice–Based Research Network

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Abstract

Surveys of health professionals typically have low response rates, and these rates have been decreasing in the recent years. We report on the methods used in a successful survey of dentist members of the National Dental Practice–Based Research Network. The objectives were to quantify the (1) increase in response rate associated with successive survey methods, (2) time to completion with each successive step, (3) contribution from the final method and personal contact, and (4) differences in response rate and mode of response by practice/practitioner characteristics. Dentist members of the network were mailed an invitation describing the study. Subsequently, up to six recruitment steps were followed: initial e-mail, two e-mail reminders at 2-week intervals, a third e-mail reminder with postal mailing a paper questionnaire, a second postal mailing of paper questionnaire, and staff follow-up. Of the 1,876 invited, 160 were deemed ineligible and 1,488 (87% of 1,716 eligible) completed the survey. Completion by step: initial e-mail, 35%; second e-mail, 15%; third e-mail, 7%; fourth e-mail/first paper, 11%; second paper, 15%; and staff follow-up, 16%. Overall, 76% completed the survey online and 24% on paper. Completion rates increased in absolute numbers and proportionally with later methods of recruitment. Participation rates varied little by practice/practitioner characteristics. Completion on paper was more likely by older dentists. Multiple methods of recruitment resulted in a high participation rate: Each step and method produced incremental increases with the final step producing the largest increase.

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Declaration of Conflicting Interests

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Keywords

survey methods; participation rates; response rates; online surveys; health professions; dentists

Introduction

Surveys of health-care professionals are a valuable tool in health services and policy research because they are a cost-effective method to assess knowledge, attitudes, and practices in delivery of health care (VanGeest, Johnson, & Welch, 2007). Response rate, a measure of the representativeness of the sample, is the most common statistic cited to indicate the quality of a survey (Baruch & Holtom, 2008; Rogelberg & Staton, 2007). These rates, historically and currently, have been lower for health professionals than the general public (Asch, Jedrzejewski, & Christakis, 1997; Cummings, Savitz, & Konrad, 2001; Sudman, 1985). From Sudman's seminal article in 1985, reasons for lower response rates from physician surveys include lack of time, saliency, or perceived lack of importance, concerns about confidentiality, and concern about bias of the survey, either in general or for specific questions, including not allowing a full range of responses to questions. The presence of "gate keepers," office personnel who in effect screen mail and e-mail requests of the health-care professionals for whom they work, has been cited recently as a major reason for low response among health professionals (Klabunde et al., 2012).

In addition to lower response rates historically among health-care professionals, most reviews find that response rates have been declining (Cho, Johnson, & VanGeest, 2013; Cull, O'Connor, Sharp, & Tang, 2005; McLeod, Klabunde, Willis, & Stark, 2013). In a review of 50 surveys of pediatricians from 1994 to 2002, Cull, O'Connor, Sharp, and Tang (2005) found that response rates decreased from 70% to 63%, for time periods of 1994–1998 to 1999–2002. Cho, Johnson, and VanGeest (2013), in a meta-analysis of 48 surveys of health professionals from 1948 to 2012, found that response rates decreased from over 80% before 1960 to around 50% in 2000 and then to 42% in 2012. In a review of surveys of health-care providers between 2000 and 2010, using a 60% response rate as a benchmark, the percentage of surveys that met this benchmark decreased from 61% in 1998–2000 to 36% in 2005–2008 (McLeod et al., 2013). Possible reasons for declining response rates for health-care professionals are increased requests to complete such surveys and increased workloads, both in number of patients and administrative obligations, although this has not been explicitly demonstrated (Klabunde et al., 2012).

Response rates are not the only measure of quality. Response bias, or nonresponse bias, occurs when those who respond differ from those who don't on the outcome of interest; this bias has grown in importance as a measure of survey quality (Johnson & Wislar, 2012; Shelley, Brunton, & Horner, 2012). Assessing nonresponse bias can be done in a number of ways. The most common way is comparing characteristics of those who respond with those who do not, preferably on the outcome measure. As this information is rarely available for nonresponders, a surrogate or correlate of the outcome measure may be used. Other ways of assessing nonresponse bias involve comparing early and late responders or following-up more extensively on initial nonresponders. The latter provides only a limited assessment of

nonresponse bias because late responders and responders to more extensive follow-up are still responders and thus may not reflect characteristics of true nonresponders. Few studies report on potential response bias (Asch et al., 1997; Cummings et al., 2001). Cummings, Savitz, and Konrad (2001), in a review of 27 mailed physician surveys published between 1986 and 1995, reported that only 18% estimated any type of response bias. Studies that have assessed potential response bias in physician surveys have found little (Field et al., 2002; Kellerman & Herold, 2001; McFarlane, Olmsted, Murphy, & Hill, 2006).

The review by Cho et al. (2013) found minimal response bias; specifically, response was slightly higher for younger professionals, females, and nonspecialty professionals. Higher response rates were reported for (1) mail (57%) than online (38%) or mixed mode (49%), (2) monetary (60%) than nonmonetary (48%) or no incentive (48%), (3) physicians (55%) than nurses (51%) or other health professionals (46%), (4) one (57%) or two follow-up reminders (66%) than none (43%) or three (49%), (5) non-U.S. (57%) than U.S. (43%) setting, and (6) non-RCT (57%) than Randomized Controlled Trial (RCT) (50%) study designs.

Monetary incentives have consistently been found to increase response rates (Asch, Christakis, & Ubel, 1998; Halpern, Ubel, Berlin, & Asch, 2002; Kasprzyk, Montano, St. Lawrence, & Phillips, 2001; Keating, Zaslavsky, Goldstein, West, & Ayanian, 2008; Leung, Ho, Chan, Johnston, & Wong, 2002; Robertson, Walkom, & McGettigan, 2005). Even small amounts, for example, US\$1, US\$2, and US\$5, increase participation (VanGeest et al., 2007). Prepaid incentives are more effective than promised incentives (Delnevo, Abatamarco, & Steinberg, 2004; Leung et al., 2004). In general, most studies have found that the larger the incentive, the larger the effect (Asch et al., 1998; Halpern et al., 2002; Kasprzyk et al., 2001; Keating et al., 2008) but not all (Burt & Woodwell, 2005; VanGeest, Wynia, Cummins, & Wilson, 2001). An optimal amount has not been determined (Klabunde et al., 2012). Few nonmonetary incentives increase participation (Burt & Woodwell, 2005; Halpern et al., 2002).

Studies of factors affecting response rates among nonphysician health-care providers have been few, compared to those among physicians, and most were primarily done by mail (Guisse, Chambers, Valimaki, & Makkonen, 2010; Hawley, Cook, & Jensen-Doss, 2009; Hill, Fahrney, Wheelless, & Carson, 2006; Paul, Walsh, & Tzelepis, 2005; Ulrich et al., 2005; VanGeest & Johnson, 2011). In general, findings among nonphysician providers are consistent with those among physicians, namely, that monetary incentives, even small amounts, increase response rates compared to no incentives, nonmonetary, or a lottery. Hawley, Cook, and Jensen-Doss (2009), in a study including both physician and nonphysician providers, found a lower response rate among psychiatrists than therapists, psychologists, counselors, or social workers. This is in contrast to the across-studies comparison by Cho et al. (2013), who found that physicians typically responded at higher rate than did nonphysician providers. VanGeest and Johnson (2011), in their review of studies among nurses, found that nurses responded well to telephone strategies, in contrast to surveys among physicians (Cho et al., 2013) who typically respond very poorly to telephone surveys.

Use of online (also referred to as web based or electronic) methodology to conduct surveys has become increasingly popular. Online methodology has many advantages compared to postal mail or telephone methods, such as being quicker, less expensive, and typically having higher rates of item completeness. The majority of online surveys costs are due to programming and enabling e-mail delivery. Because these largely are initial costs, the cost efficiency of online surveys increases as the sample size increases. Often-cited limitations of online surveys are low response rates and difficulty in specifying the sampling base (Braithwaite, Emery, de Lusignan, & Sutton, 2003; de Leeuw, 2012; van Selm & Jankowski, 2006). The latter occurs when there is an incomplete or outdated list of e-mail addresses for the target population. Beebe, Locke, Barnes, Davern, and Anderson (2007) conducted a randomized mixed-mode study of 500 physicians. One group was contacted by e-mail first and asked to complete the survey online. The other group was sent an invitation and questionnaire via postal mail. One week after initial notification and request for participation, each nonrespondent was sent a reminder, in the same mode (online or paper) as the original request. After another week, each nonrespondent was sent another reminder and request, this time in the “other” mode. The response rate, completed/eligible, was calculated for each arm, web/mail and mail/web, completion/eligible, significance of difference determined. The results were web/mail 62.9% and mail/web 70.2%, $p=.07$. They concluded that mail then web results in a slightly higher response; however, if time is a factor, they recommended using web then mail. Schleyer and Forrest (2000) presented a cost–benefit analysis comparing postal and electronic mail. If basic assumptions of availability of valid e-mails for study population are met, using electronic is more cost effective at sample sizes of 348 or more; furthermore, the cost–benefit is larger with larger study sizes.

For more than two decades, access to the Internet has seldom been an issue when surveying health-care professionals. The challenge has been, and remains, how to catch professionals’ attention sufficiently to elicit a questionnaire response. This is especially challenging in the current era of information overload. As stated above, few surveys of health-care providers have obtained response rates above 70% (reviews: Flanigan, McFarlane, & Cook, 2008; McLeod et al., 2013; Shelley et al., 2012; VanGeest et al., 2007). The Medical Expenditure Provider surveys, Medical Provider Component, have achieved 80–95% response depending on provider type from the 2006 survey (Stagnitti, Beauregard, & Solis, 2008); however, these are follow-up surveys to providers of patients who participated, conducted primarily by telephone. Therefore, these may not be directly comparable to a typical or stand-alone survey. Virtually, all surveys of dentists with response rates over 80% have been by postal mail and outside of the United States: Swedish orthodontists, 87% ($n = 157$; Bjerklin & Bondemark, 2008); British general dentists, 86% ($n = 75$; Sutton, Ellituv, & Seed, 2005); Ugandan dentists, 82% (Mutwabule & Whaites, 2002); and British periodontists, 82% ($n = 459$; McCrea, 2008).

Shelley, Brunton, and Horner (2012) reviewed 53 surveys of dental radiology published between 1983 and 2010 to develop recommendations to assist future researchers. They argued that study characteristics other than response rates should be considered. One example is the specification of the sampling base. In their review, Shelley et al. (2012) reported a mean response rate of 74%; however, they included in their review surveys that

were conducted at meetings in which there is a 100% response rate. As they noted, these surveys are not comparable to a typical survey; response rates from these contexts are of lesser value as a quality indicator.

To our knowledge, no large survey of health-care providers, which we define as having more than 1,000 potential respondents in the sampling frame, with an online component has reported a response rate of over 70%. Using methods described by Schleyer and Forrest (2000), the modified tailored approach of Dillman (2007), and the recommendations from Klabunde et al. (2012), the proceedings from a 2010 National Cancer Institute (NCI) workshop surveying health-care providers, we report our experience using a large online component in obtaining excellent response to a survey of dentists in the National Dental Practice–Based Research Network.

The objectives of this report are to quantify the (1) increase in response rate associated with successive survey methods in a questionnaire completed by dentists and by three sequential categories of recruitment (electronic, paper, and personal follow-up), (2) time to completion with each successive step, (3) contribution from the final method (follow-up by study staff [regional coordinator]), and (4) differences in response rate and mode of response by practice/practitioner characteristics.

Method

The National Dental Practice–Based Research Network (“network”) is a consortium of dentists and dental organizations focusing on improving the scientific basis for clinical decision making (Gilbert et al., 2013). Its mission is “To improve oral health by conducting dental practice-based research and by serving dental professionals through education and collegiality.” It is committed to maximizing the practicality of conducting research about clinical practice across geographically dispersed regions and diverse practice types. The network comprises six geographic regions, each with a regional director and coordinator for administrative purposes. Many details about the network are available at its website, www.nationaldentalpbrn.org. This study was approved by the respective institutional review board(s) of each of the network’s regions.

Enrollment Questionnaire

As part of the network enrollment process, practitioners complete an Enrollment Questionnaire that describes themselves, their practice(s), and their patient population. A copy of the questionnaire is publicly available (National Dental Practice-Based Research Network [PBRN] Study Results Page). Questionnaire items from the Enrollment Questionnaire, which had documented test/retest reliability, were taken from our previous work in a practice-based study of dental care and a PBRN that ultimately led to the National Dental PBRN (Florida Dental Care Study, 2015; Gilbert et al., 2011). The typical enrollee completes the questionnaire online, although a paper option is available. Invitations to enroll are typically done by mass mailings or by face-to-face request during a dental professional meeting. These invitations are one time only; they are not followed up by any further mail, e-mail, or personal contact.

Content of the Isolation Techniques Questionnaire

After confirming on the questionnaire itself that the respondent was a general dentist and that he or she does at least one root canal treatment each month (as compared to the “do at least some” criterion taken from the Enrollment Questionnaire), respondents were asked for the number of root canal treatments performed each month and the frequency and type of isolation methods used. The questionnaire was comprised of 57 questions printed on eight pages. A copy of the full questionnaire is publicly available (National Dental PBRN Study Results Page). There is no overlap of information requested between the enrollment and isolation techniques questionnaire.

Electronic Development and Testing of Online Isolation Techniques Questionnaire

An online web survey system was used for primary data collection and management. The system tracked all activity for each of the participating dentists. Each component was tested and a full system test was executed to ensure that it was functional as expected; functional testing included screen review, navigation assessment, and data entry. The web survey system was tested on Microsoft Internet Explorer, Google Chrome, Mozilla Firefox, and Apple’s Safari browsers. The web survey was rendered as a series of hypertext markup language pages. Users advanced through the pages by selecting a “Next” button. The content on each page was limited to help minimize the scrolling required. Respondents could skip questions with the exception of the eligibility question but were prompted when they tried to advance to a different screen or submit a page with an omitted question and were asked to confirm if they wanted to leave the screen without answering the question. The system timed out after 30 min of no use. When they logged back in, the system would take them to the screen where they left off. Respondents were allowed to save their responses and continue at a later time. User acceptance testing of the web-based survey was performed by various members at each of the network administrative regions. The user testing evaluated the readability, feasibility, and Internet browser compatibility of the electronic survey to ensure that the system functioned as expected and was consistent with all protocol requirements.

Administration of the Isolation Techniques Questionnaire

By January 31, 2014, more than 5,000 persons had completed an Enrollment Questionnaire; 1,876 of these persons were invited to participate in the Isolation Techniques questionnaire because they met four criteria: (1) general dentist, (2) currently practicing/seeing patients, (3) reported performing at least some root canal treatment, and (4) selected the “limited” or “full” participation levels, as compared to the “information only” level of participation in the network. Preprinted invitation letters were postal mailed to eligible practitioners, inviting them to participate and informing them that they would receive an e-mail with a link to the electronic version of the questionnaire. At the time of the e-mail, the practitioners were given the option to request a paper version of the survey; none did. Practitioners were asked to complete the questionnaire within 2 weeks. Two reminder e-mails were sent at 2-week intervals to those who had not completed the questionnaire. A postal reminder was sent with the third e-mail reminder, again 2 weeks after prior reminder, 6 weeks after the initial e-mail request; a printed version of the questionnaire was included with the postal reminder offering the practitioners the option of completing the questionnaire on paper. After an

additional 2 weeks, another postal reminder with a printed questionnaire was sent. If a response was not received within 2 weeks, regional coordinators followed up to ensure that the network communications had been received and ascertain whether the dentist was interested in participating. There was not a specific protocol regarding mode and order of contacting by the regional coordinators. They followed up with telephone calls, fax, and personal e-mails (from themselves as opposed to being from the network Coordinating Center); some started with telephone calls, while others focused on e-mails. Additionally, each region holds annual meetings for practitioners to inform them about current and planned network studies and elicit their input. Practitioners in regions (South Central, Midwest, and Northeast) who held an annual practitioner meetings between February and April 2014 and who had received at least the initial e-mail invitation, but had not completed the survey, were offered the opportunity to complete a paper survey at the meeting.

Data collection was closed 12 weeks after the original e-mail invitation. Practitioners or their business entities were remunerated US\$50 for completing the questionnaire because monetary incentives have consistently shown that these incentives increase participation (VanGeest et al., 2007); if they confirmed at the end of the survey that they would like remuneration (86% did so). Survey data were collected from January 31, 2014, to July 15, 2014; completion of the isolation techniques questionnaire was not linked in any way to when the enrollment questionnaire had been completed. After survey collection, regional coordinators' follow-up logs were reviewed to ascertain whether the network communications e-mail links and postal questionnaires had been received and whether the practitioner had moved locations as well as the number of contact attempts made.

To document test/retest reliability, 43 respondents completed the same questionnaire twice online. The mean (*SD*) time between test and retest was 15.5 (3.0) days. The agreement between Time 1 and Time 2 for individual questionnaire items was quantified using a mean weighted κ score, which was 0.62, with an interquartile range of 0.46–0.79.

Of the 1,876 dentists invited, 24 were deemed ineligible before beginning the questionnaire (4 had died, 15 were no longer practicing, and 5 no longer provided root canal treatment) and 136 were determined ineligible after completing the questionnaire (3 no longer a general dentist and 133 reported not doing at least one root canal treatment each month), leaving 1,716 eligible dentists; 22 were active refusals and 194 were nonrespondents. Overall, 1,500 responded: 1,488 (87%) completed the entire survey, 6 only answered the first question, 3 erroneously checked that they were not a general dentist and consequently were electronically skipped to end of survey, and 3 completed varying parts of the first half of the questionnaire. The average time to complete the survey was 15 min.

Analysis

Participation at each stage was calculated two ways: (1) incremental: of remaining eligible, the proportion participating; and (2) proportional: of those participating, the proportion accrued at each stage. Participation was also categorized into three groups: (1) after initial postal notification letter, recruited, and completed electronically, that is, online; (2) recruited with e-mail and postal, completed on paper; and (3) required follow-up of regional coordinators, completed online or on paper. Significance of differences in the proportion of

eligible dentists who participated according to practice/practitioner characteristics was ascertained in bivariate analysis using χ^2 tests. We also tested differences between those for whom regional coordinators followed up with whether or not they participated, and also among those who participated, in whether the survey was completed online or on paper. Independent associations with participation were assessed using logistic regression. Where indicated, some categories were collapsed (e.g., region and practice type), bivariate analyses rerun, and dichotomous grouping entered in the model. Characteristics with $p < .20$ in bivariate analysis were entered into the model; next, stepwise regression was used, removing variables until only those with $p < .05$ remained. Odds ratios (*OR*) and 95% confidence intervals (*CI*s) were calculated from the models. All analyses were performed using SAS (see <https://www.sas.com/presscenter/guidelines.pdf>) 9.4 (SAS Institute). Of the 1,488 completed surveys, 21 were completed at annual practitioner meetings. To enhance generalizability, the analysis described below excludes the 21 practitioners who completed the survey at an annual meeting.

Results

Completion Rates and Type

As shown in Table 1, 30% of practitioners completed the survey after the initial e-mail, 19% and 11% after the second and third e-mail reminder, respectively, 19% and 32% after the fourth e-mail/first postal and second postal reminder, respectively, and of the remaining practitioners 52% completed the survey either more than 2 weeks after the second postal reminder but before regional coordinators followed up or after regional coordinators followed up. Proportionally, 35% of practitioners responded within 2 weeks of the first e-mail, an additional 22% within 2 weeks of the second and third e-mails, another 26% within 2 weeks of the fourth e-mail/first postal and second postal reminder, and 4% within 2 weeks of the second postal reminder but before being contacted by regional coordinator and 13% as a result of regional coordinator follow-up. Overall, 66% were recruited electronically, 21% with postal follow-up and completion on paper, and the final 13% with follow-up by regional coordinators and completed online or paper. A total of 24% (353/1,470) were completed on paper.

Time to Completion

The median time to completion was 2 days after the initial e-mail, for those completing prior to the reminder e-mail sent 2 weeks later. Similarly, there were spikes at 2 days after the second and third e-mail reminders, with diminishing gain in recruitment described above. Spikes after a postal reminder had been sent were longer at 12 and 6 days, respectively; these represent greater recruitment gains than the simple e-mail reminders. The recruitment time involving follow-up by regional coordinators was longer, peaking at 25 days, but nonetheless accompanied by a substantial gain in response.

Contribution by Regional Coordinators

There were 469 eligible practitioners from whom surveys had not been received 2 weeks after the second postal mail request and for whom regional coordinators followed up to ascertain if they had received study information. A total of 55 were completed prior to

regional coordinators attempting follow-up (28 online and 27 on paper). Of the 411 practitioners whom regional coordinators contacted or attempted to contact, 189 (46%) were completed. The median number of times a regional coordinator contacted or attempted to contact a practitioner was three (Interquartile range: 2–3; range: 1–11); fewer for when surveys were completed than when not (medians: 2 vs. 3, $p < .001$). Of the 189 completed surveys, 77 (41%) involved only one contact attempt.

Thirty practitioners were no longer at the practice of record; new practice information was obtained for 27, of whom 10 completed the survey. Only seven practitioners or their offices reported not receiving survey information, and when resent, either by e-mail or fax, all seven were completed. Offices of three practitioners refused information (hung-up) when regional coordinators tried to ascertain if information was received. Overall, completed surveys were obtained from 46% ($n = 189$ of the 411) of practitioners after follow-up by regional coordinators. Of these, 127 (67%) were completed online and 62 (33%) on paper.

Associations With Overall Participation and by Type

In bivariate (Table 2) and adjusted analysis, higher proportions of practitioners from the Western region participated, as did those who were members of at least one dental association and those who either worked in large group (managed care) practices or were owners of private practices compared to their counterparts. Among the 411 practitioners whom regional coordinators contacted or attempted to, there were no significant differences in practice/practitioner characteristics between those who ultimately participated and those who did not, based on bivariate analyses (Table 2). In adjusted analyses, however, there were significant differences. Male practitioners were more likely to ultimately participate after follow-up by regional coordinators than were females ($OR = 2.1$; 95% CI = [1.2, 3.5], $p = .006$). Likelihood of ultimately participating decreased with years since dental degree (per 10 years, $OR = 0.78$, 95% CI = [0.66, 0.93], $p = .004$).

Among participating practitioners, completion on paper was more common among practitioners who were male, older, had more years since graduated from dental school, did not have any additional training, were owners of private practice, or from the south central region (Table 2). In adjusted analyses, all the associations remained significant except years since graduated from dental school.

Discussion

An exceptionally high participation rate (87%) was obtained. Each step produced incremental gains in response: diminishing gains with the two reminder e-mails, 19% and 10%, respectively; increasing gains with postal reminders accompanied with a printed questionnaire, 19% and 32%, respectively; and the largest gain with the final step of personal contact, 52%. Response peaked at 2 days after e-mail reminders were sent, 12 and 6 days for postal reminders, and 25 days for personal contact. Practice/practitioner characteristics differed by mode of response, paper vs. electronic, but not by whether or not response was obtained only after Regional Coordinator personal contact.

In conducting any survey, regardless of mode (postal, telephone, electronic, or combination), reminders are needed to obtain acceptable response rates. Four reminders have been advocated as an appropriate number (Dillman, 2000, 2007). Typically, there is decreasing gain with successive reminders; however, most studies that report gain by reminder do so using the same mode of reminder, primarily either electronic or postal. For example, Toledo and colleagues (2015) in an online survey of 5,433 primary health-care professionals in Spain used four e-mail reminders; overall response was only 36%. Reminders were sent at 10-day intervals. A 7% response was obtained in the 24 hr after initial e-mail. Steady but diminishing responses of 1–2% per day were observed until the first e-mail reminder sent after 10 days, after which a 4% response was observed in the next 24 hr. The pattern repeated with smaller daily increases of 0.5–1% and smaller peaks of 2% then 1%, following second through the fourth reminders. When staying within the same mode, electronic (e-mail), we also found diminishing gains with successive reminders for the two e-mail reminders. In contrast, we found increasing response when the mode of reminder was changed from e-mail to postal with a printed copy of the questionnaire included, and even more so, when the reminder mode was changed from postal to personal contact. This was most notable for the last step, personal contact by regional coordinators. Excluding practitioners who responded before regional coordinators attempted to contact, nearly half (46%) responded after being contacted; this was the highest proportional response of any step and the absolute number responding ($n = 189$) was comparable to the prior two steps.

The 2008 National Sample Survey of Registered Nurses (U.S. Department of Health and Human Services, 2010) used a multimodal approach similar to ours. Its protocol differed in that the nurses had to enter a web address, while our participants only had to click on a link provided in an e-mail. Also, in the last step, the nursing survey could be completed over the telephone, which was not an option provided for our survey. Their overall response rate was 62%; 27% paper, 24% online, and 10% telephone. Stepwise response rates were not presented. A study of physicians that is the most comparable to the current dental study is the study by Kroth and colleagues (2009) who examined clinicians' response rate across three medical PBRNs. Their survey was of active network members with valid e-mail addresses, as was ours. Their initial invitation was via e-mail, with five rounds of electronic solicitation for an online-based questionnaire and two rounds of a paper-based version mailed to nonresponders. The electronic solicitations (e-mails) were personalized, came from the physician's local practice-based network, and had a customized link to the online survey that provided automatic log-in. They had no final telephone follow-up. As with ours, the greatest response was within 2 days of initial e-mail (12%), diminishing responses occurred with the second through fourth e-mails; the paper option sent with third e-mail had a modest response, with no discernible response to either the fifth e-mail or a second paper option. Their overall response rate was 61%: 46% online and 15% on paper. There were two primary differences in their recruitment methods and ours: (1) their initial invitation was via e-mail, while ours was postal mail followed immediately by e-mail with embedded link; and (2) we had a last step of personal/staff outreach. From their graph, an estimated response within 2 weeks of initial e-mail invitation is 15% (120/805); ours was 31%. While it is doubtful that a change in mode of initial invitation would account for a doubling of response rate, it is conceivable that it could account for a 5–10% difference in response rates. There

are no studies that we could find that assessed difference in response rates by mode of initial invitation in a “defined” population, that is, a nonrandom group such as practice-based networks. Our response rate, excluding the last step, was 76% $([1,470 - 244 + 55]/1,695)$, which would make the response rates in the studies comparable.

There can be many obstacles when surveying health professionals. The importance of these surveys and their possible difficulties is why the NCI convened a workshop in November 2010 to discuss the challenges (Klabunde et al., 2012). The first topic area identified for improvement was identification of an appropriate sampling frame (the NCI workshop focused on physicians). Ideally, a sampling frame should be complete, current, include no duplications, and have no ineligible persons; such a sampling frame is very rare. Our sampling frame of network dentists meets these criteria except that it had some ineligibles, which were screened out via the first questions on the survey. The underlying question regarding the sampling frame in our study is whether they are representative of U.S. dentists. Network members are not recruited randomly, so factors associated with network participation (e.g., an interest in clinical research) may make network dentists unrepresentative of dentists at large. While it cannot be asserted that network dentists are entirely representative, we can state that they have much in common with dentists at large, while also offering substantial diversity in these characteristics. This assertion is warranted because (1) substantial percentages of network dentists are represented in the various response categories of the characteristics listed in Table 1, (2) findings from several network studies document that network dentists report patterns of diagnosis and treatment that are similar to patterns determined from nonnetwork general dentists (Gordan et al., 2009; Norton et al., 2014), and (3) the similarity of network dentists to nonnetwork dentists using the best available national source, the 2010 American Dental Association Survey of Dental Practice (American Dental Association, 2012; Makhija et al., 2009). Although not stated as an objective in the NCI workshop, Shelley et al. (2012), in their review of dental studies, expanded on the concept about properties of a sampling frame. In an appropriate sampling frame, every member should have an equal chance of being selected and random sampling should be used. If the sampling frame is large, an appropriate sample size estimate should be made so as to avoid having to survey the entire sampling frame. Sampling the entire frame is a waste of resources (Dillman, Smyth, & Christian, 2009). We estimated that we needed a sample of 1,000. As we were unsure of what the participation rate would be, and wanted to assess the yield of having staff follow-up with nonresponders as a last step, we decided to survey the entire group.

A second topic from the NCI workshop had to do with how to optimize a mixed-mode approach, namely, an approach that uses both postal and electronic mail. Response rates are usually higher for mail than telephone or electronic, with telephone being extraordinarily difficult, and the realization that electronic will become even more pervasive than it already is. We had no randomization component to make direct comparisons, but our design was intended to optimize response. We started with mail notification, as studies using electronic notification (e-mail) had poor response. We did follow mail notification with e-mail because this allowed embedding a link which the practitioner could simply click on to begin the survey. We had two e-mail notifications at 2-week intervals. Other studies have found that gain from more reminders decreases markedly after two. Also, from our prior work, we

found that practitioners who completed paper forms differed from those who completed electronically (Funkhouser et al., 2014); thus, we knew that we wanted to include a mail component as well.

The third topic area from the NCI workshop had to do with the role of gatekeepers. Our “last step,” having network staff follow-up with nonresponders, addressed that challenge. Of practitioners who completed the survey, almost half (44%) required only one call, in essence getting past a gatekeeper, yet there were others who, even after 10–11 attempts, calls, e-mails, or fax, were not responsive.

Regarding the issue of personal outreach, we believe that this study demonstrates for other organizations the potential utility of personal outreach. Not only did outreach increase the number of practitioners who responded, it also identified practitioners who were no longer eligible, thereby reducing the denominator. Because organizations will have contact information on their sampling frame or might be able to access public information to identify additional contact information (which our research assistants sometimes used), these organizations can make their own assessment of the utility of this approach for their sample or some targeted subset of it (based on the subset’s projected potential for a higher response rate). We estimate that to follow up with the 441 practitioners who had not responded after e-mail contacts required approximately 15 work-days of staff time. The majority of practitioners in our study had not participated in other studies nor had they had previous contact with our research assistants. It is typically only after network enrollees have done an in-office clinical study or attended a regional meeting of network practitioners do they begin to develop a professional relationship with the network’s research assistants.

A limitation of the study may be the relatively uncommon sampled population, specifically, the National Dental PBRN. As this was the first survey of the new national network, recruitment into the network began April 2012 and the survey was conducted in early 2014; the practitioners may have been even more likely to respond. We think this largely explains the high response, 31%, to our initial invitation. The incremental increases with second and third e-mail reminders, and the two postal reminders, should be applicable to other researchers and populations where there is some type of existing relationship. The comparability of response rates and initial reminders between our study and those of Kroth et al. (2009) support this. The large proportional and absolute gain with the final step, personal contact, surprised us. We do not know if others will find it similarly beneficial; we present it so that others may try. The gain from personal outreach comprised 13% of our respondents, which is not much larger than the 10% completed by telephone for the 2008 National Sample Survey of Registered Nurses (U.S. Department of Health and Human Services, 2010). Although the nurses’ survey was completed on the telephone and ours was via personal contact, they both used personal contact, which can be expensive and may not be as fruitful in other populations. In their review of surveys of nurses, VanGeest and Johnson (2011) found that nurses responded to telephone strategies comparable to those of mail. This differs markedly from studies conducted among physicians, which find poor response to telephone strategies (Cho et al., 2013). “Gatekeepers” in medical offices may make personal contact by telephone extremely difficult. In our study, personal contact did not necessarily mean with the dentist himself or herself and usually was not; it entailed

reaching a person in the office and verifying that the dentist had received the materials. There have been no comparable studies of surveys among dentists to evaluate telephone strategies in obtaining response to surveys. We speculate that trying to get a dentist to complete a survey on the telephone would have had a very poor response, as it has with physicians.

In summary, we believe that other organizations, such as other PBRNs (of which there are many), membership associations (such as health-care professional organizations), or large cohorts from ongoing studies, may be able to use our methods in a cost-efficient manner to maximize their response rates. Using a multimodal protocol, it is possible to obtain a high participation rate with a large online component. Although response steps were not randomized, we believe that it is unlikely that additional e-mail reminders, without postal and/or telephone follow-up, would have meaningfully increased the response from 57%. Also, as we have reported previously from an earlier survey, there appears to be a difference between practitioners who respond on paper and those who do so online (Funkhouser et al., 2014). Of note, the late responders (those who did not participate until after follow-up by regional coordinators) did not differ from early responders in any characteristic assessed including mode of completion. Also, the high absolute and proportional response (52%) to the last step (personal follow-up) is noteworthy. Although this step adds to the cost, the yield is large.

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Table 1

Participation Rates by Recruitment Step.

Recruitment Step	<i>n</i> ^a Eligible	<i>n</i> ^b	Participated		No. of Days From Initial E-mail to Participation		Median No. of Days From Prior Step to Participation
			Percentage of Remaining Eligible	Median	Interquartile Range		
1. Initial e-mail	1,695	519	31	2	1–4		2
2. First e-mail reminder	1,176	222	19	16	15–19		2
3. Second e-mail reminder	954	97	10	30	29–33.5		12
4. Third e-mail/First postal reminder	857	165	19	54	46–57		6
5. Second postal reminder	692	223	32	62	61–67		25
6. Regional coordinator follow-up ^c	469	244	52	81 ^d	75–91		
Total	1,695	1,470	87				

^aExcludes 21 completed at regional meetings.^bWithin 2 weeks of steps No. 1–5.^cOf 244, 55 were completed before regional coordinator contact.^dMedian No. of days for 55 was 75; for remaining 189, median of 83 days.

Table 2

Participation Rate, by Practitioner/Practice Characteristics.

Practitioner/Practice Characteristics	Overall			Participated			Of Followed-Up by Regional Coordinators (n = 411)			Of Participated On Paper		
	n	%		n	%		n	%		n	%	
Gender												
Female	389	23	331	85	40	39	62	19				
Male	1,292	77	1,130	87	48	149	290	26				
			<i>p</i> = .2			<i>p</i> = .15						<i>p</i> = .01
Race ethnicity ^a												
White	1,321	79	1,156	88	47	145	292	25				
Black/African American	82	5	65	79	35	9	16	25				
Asian/Pacific Islander	163	10	145	89	54	21	24	17				
Other	12	1	9	75	25	1	1	11				
Hispanic/Latino	91	5	78	86	46	12	18	23				
			<i>p</i> = .14			<i>p</i> = .5						<i>p</i> = .2
Age (years)												
<35	186	11	157	84	44	23	14	9				
35–44	367	22	328	89	55	46	64	20				
45–54	350	21	305	87	51	46	90	30				
55–64	592	35	520	88	44	59	136	26				
65 and older	186	11	154	83	31	14	48	31				
			<i>p</i> = .2			<i>p</i> = .10						<i>p</i> < .001
Years since dental school graduation												
<10	318	19	274	86	50	43	38	14				
10–19	334	20	296	89	54	44	66	22				
20–29	382	23	334	87	46	43	96	29				
30+	655	39	563	86	39	57	153	27				
			<i>p</i> = .6			<i>p</i> = .10						<i>p</i> < .001
Additional formal training after dental school												
No	1,009	60	865	86	43	108	228	26				

Practitioner/Practice Characteristics	Overall						Of Followed-Up by Regional Coordinators (n = 411)						Of Participated On Paper	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Yes	686	41	605	88	81	51	125	21	<i>p</i> = .02					
Membership in any dental organizations														
No	228	13	184	81	24	36	43	23	<i>p</i> = .13					
Yes	1,467	87	1,286	88	165	48	310	24	<i>p</i> = .8					
Practice														
Practice type														
Owner of private practice	1,239	74	1,082	87	134	46	299	28	<i>p</i> = .007					
Associate of small group private practice	215	13	174	81	27	40	29	17	<i>p</i> = .3					
Member large group practice (HP/PDA) ^b	103	6	98	95	11	69	8	8	<i>p</i> = .14					
Public, community, and publicly funded	70	4	62	89	9	53	11	18	<i>p</i> = .004					
Federal government, academic, and other managed care	59	4	49	83	8	42	5	10	<i>p</i> = .09					
More than one practice location														
No	1,428	84	1,239	87	154	45	307	25	<i>p</i> = .8					
Yes	263	16	230	87	35	53	46	20	<i>p</i> = .2					
Locale of practice														
Urban—inner city	184	11	156	85	28	49	39	25	<i>p</i> = .12					
Urban—not inner city	449	27	400	89	51	50	101	25	<i>p</i> = .3					
Suburban	760	45	660	87	76	44	144	22	<i>p</i> = .5					
Rural	289	17	251	87	33	47	68	27	<i>p</i> = .8					
Patient population														
Percent patients with private insurance														
<40	244	15	202	83	35	45	48	24	<i>p</i> = .09					
40–79	987	60	865	88	103	46	224	26	<i>p</i> = .9					

Practitioner/Practice Characteristics	Overall						Of Followed-Up by Regional Coordinators (n = 411)				Of Participated On Paper	
	Participated		Participated		Participated		Participated		Participated		On Paper	
	n	%	n	%	n	%	n	%	n	%	n	%
Percent patients who come in regularly												
< 50	310	19	265	85	42	49	63	24				
50-79	995	60	868	87	106	46	212	24				
80+	351	21	311	89	35	45	69	22				
			<i>p</i> = .5								<i>p</i> = .7	
Region ^c												
Western	186	11	173	93	21	64	25	14				
Midwest	162	10	135	83	16	38	25	19				
South Central	390	23	344	88	51	53	112	33				
South Atlantic	288	17	252	88	20	36	63	25				
Northeast	360	21	310	86	32	39	72	23				
			<i>p</i> = .02								<i>p</i> < .001	

^a Although race and Hispanic/Latino ethnicity are separate questions in the Enrollment Questionnaire, some Hispanic/Latino participants did not provide a race or indicated “Hispanic/Latino” as their race, thus race and ethnicity were combined.

^b Either HealthPartners Dental Group in greater Minneapolis, MN, or Permanente Dental Associates in greater Portland, OR.

^c Reported on Enrollment Questionnaire as the state, subsequently categorized into one of the six regions of the network.