

Change in stated clinical practice associated with participation in the Dental Practice-Based Research Network

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Clinical researchers have attempted many methods to translate scientific evidence into routine clinical practice, with varying success. Practice-based research networks (PBRNs) provide an important, practitioner-friendly venue to test these methods.

Dentist practitioner-investigators from the Dental Practice-Based Research Network (DPBRN) completed a detailed questionnaire about how they diagnose and treat dental caries. Next, they received a customized report that compared their answers to those from all other practitioner-investigators. Then, 126 of them attended the DPBRN's first network-wide meeting of practitioner-investigators from all five of its regions. During that meeting, certain questions were repeated and new ones were asked about the dentist's intention to change the way that he or she diagnosed or treated dental caries.

Less than one-third of practitioner-investigators intended to change how they diagnosed or treated caries as a result of receiving the customized report. However, as a result of the meeting, the majority of these same practitioner-investigators stated an intention to change toward a more conservative, less surgically invasive approach.

These findings are consistent with the idea that a highly interactive meeting with fellow practitioner-investigators may be an effective means to translate scientific findings into clinical practice. Practitioner-investigators are open to changing how they treat patients as a result of engaging fellow practitioner-investigators in the scientific process.

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It can take many years before clinically relevant scientific evidence is incorporated into routine clinical practice; as a result, a substantial percentage of patients receive health care that is unnecessary, inconsistent with current scientific evidence, and even potentially harmful.¹⁻⁴ It is important to determine the best way to move recent evidence into regular practice, to ensure that this information quickly reaches the patients for whom it is intended. According to the literature, the most effective methods for disseminating this information have been educational outreach (performed in the practice), reminder systems, financial incentives, and interactive educational meetings that encourage discussion and practice.⁵⁻⁹ Generally, passive dissemination of materials, the development of

clinical guidelines, or attendance at didactic meetings have not been effective, and using opinion leaders and audit and feedback approaches have demonstrated varying levels of effectiveness.^{10,11} For patients to receive high-quality care, the dental community must determine the best method(s) for moving research results into widespread practice.

The practice-based research network (PBRN) is an important venue for testing these methods.¹² PBRNs have continued to grow in number because of their unique advantages in terms of research and quality improvement, their ability to bring practice-relevant topics to the research agenda, and the potential they offer for reducing the amount of time that it takes for scientific advances to become part of daily practice.¹³⁻¹⁵

One such PBRN is the Dental Practice-Based Research Network (DPBRN).¹⁶ Many details about the DPBRN are available publicly at its website.¹⁷ In brief, the DPBRN consists predominantly of practitioner-investigators and staff in outpatient dental practices from five regions: Alabama/Mississippi (AL/MS), Florida/Georgia (FL/GA), dentists employed by HealthPartners Dental Group and other practitioners in Minnesota (MN), Permanente Dental Associates (PDA) in Oregon and Washington, and the Scandinavian countries of Denmark, Norway, and Sweden (SK). The DPBRN offers a wide representation of practice types, treatment philosophies, and patient populations, including diversity in terms of the race, ethnicity, geography, and rural/urban area of residence

of its practitioner-investigators and their patients. Analyses of these characteristics confirm that DPBRN dentists have much in common with dentists at large, while still offering substantial diversity with regard to these characteristics.^{18,19}

The DPBRN emphasizes practical science about, in, and for the benefit of “real world” clinical practice. The practitioner-investigators themselves actively participate in developing ideas for studies and in designing, conducting, and communicating this research—all for the purpose of having a direct, practical impact on clinical practice in non-academic settings.

The DPBRN holds annual regional meetings for its practitioner-investigators and has held one network-wide meeting. These meetings provide opportunities to learn about and discuss the latest results from DPBRN studies and how they might impact regular clinical practice. Additionally, practitioner-investigators design future studies, network with colleagues, and obtain continuing education credit. Most presentations are given by the practitioner-investigators themselves (as opposed to academic faculty), who have reported that they are more influenced by the study results and the value of DPBRN participation when they hear presentations from fellow practitioner-investigators.¹⁶

Academic faculty typically are held up as experts, and a tension might exist between wanting to learn from an expert but also not wanting to be told what to do, especially when there is concern that the expert does not understand the specific dentist’s patients or practice. In addition, academic faculty may be seen as less credible than fellow practitioner-investigators

when it comes to commenting on results from studies performed in non-academic settings. When data from a large number of fellow practitioner-investigators, their practices, and their patients are collected in a scientific manner (as is done in DPBRN studies), practitioner-investigators have reported informally that they are more likely to use this information and change their clinical practice.²⁰

Instead of relying on informal and anecdotal reports, the DPBRN sought to formally collect data from dentists on their stated clinical practice and intentions to change those methods of practice. This decision was based on the role that intention has in improving clinical practice. For example, in a 2006 study of dental radiographs, the authors concluded that intention may be a worthy proxy for actual clinical behavior, making intention a useful concept for evaluating an intervention before conducting a full-scale experimental trial of that intervention.²¹ This study sought to test the hypothesis that participation in DPBRN activities is associated with significant changes in practitioner-investigators’ stated clinical practice and intentions to make those changes.

Materials and methods

This study engaged DPBRN dentist practitioner-investigators on five key occasions: an enrollment questionnaire; a baseline questionnaire entitled “Assessment of Caries Diagnosis and Treatment”; a mailing before the DPBRN’s first network-wide meeting, in which results from the baseline questionnaire were reported; a questionnaire completed at the meeting’s registration desk; and a questionnaire completed upon leaving the meeting.

DPBRN enrollment questionnaire

As part of DPBRN enrollment, all practitioner-investigators complete a 101-item questionnaire about themselves and their practice characteristics. The distribution of these characteristics for DPBRN dentists has been reported previously.^{18,19} As of December 2008, a total of 1,204 dentists had enrolled.

Baseline questionnaire

All DPBRN dentist practitioner-investigators who indicated on their enrollment questionnaire that they do at least some restorative dentistry ($n = 998$) were invited to participate in this baseline questionnaire; 565 did so. Methodologic particulars—such as sample selection, the recruitment process, length of the field phase, the data collection process, and procedures used during a pilot study and pre-testing of the questionnaire—have been reported previously.²² The full questionnaire—the DPBRN’s first study to involve all five DPBRN regions—is available publicly.²³ A subset of these questions was repeated at the network-wide meeting.

The mailing before the DPBRN’s first network-wide meeting

Each practitioner-investigator who had registered for the network-wide meeting ($n = 133$) was mailed a summary of the results of the baseline questionnaire 45 days before the meeting. This summary included results from all five DPBRN regions as well as the responses that this particular practitioner-investigator provided for each item, so that each summary was unique to that practitioner-investigator, allowing each practitioner-investigator to compare his or her individual responses with

Table 1. Summary of responses provided at the meeting registration desk, overall and by DPBRN region. Column values do not add to 100% in all instances due to rounding.

	Overall	DPBRN region					Statistical significance of the association between the response and region
		AL/MS	FL/GA	MN	PDA	SK	
Number of attendees	126	42	26	15	21	22	
Before the meeting, did you receive a packet that contained your results?							
Yes	97%	95%	96%	100%	95%	100%	Not significant
Approximately how much time did you spend reviewing this packet?							
Less than 15 minutes	10%	11%	13%	0%	1%	5%	Not significant
15–30 minutes	44%	51%	50%	57%	47%	11%	
30 minutes to one hour	32%	27%	29%	36%	21%	53%	
More than one hour	14%	11%	8%	7%	16%	32%	
Did you discuss these results with any other practitioner-investigators?							
Yes	35%	11%	20%	36%	50%	89%	$p < 0.001$
No	65%	89%	80%	64%	50%	11%	
As a result of considering these results, how much did you change how you <i>diagnose</i> dental caries?							
A large amount	2%	0%	4%	7%	0%	0%	Not significant
A small amount	28%	28%	38%	29%	20%	20%	
None	71%	73%	58%	64%	80%	80%	
As a result of considering these results, how much did you change how you <i>treat</i> (prevent and restore) dental caries?							
A large amount	0%	0%	0%	0%	0%	0%	$p = 0.038$
A small amount	27%	18%	46%	43%	25%	14%	
None	73%	82%	54%	57%	75%	86%	

those of others in the same region and with those of all practitioner-investigators in the network. An accompanying letter reminded the recipient of the specific aims of the questionnaire, a request to bring the packet to the meeting, and an explanation about how these results would be discussed at the meeting during breakout sessions (groups consisting of 8–10 attendees). The full report and its accompanying letter are available publicly.²³

Invitations to the meeting were mailed in batches, according to practitioner-investigators' level of engagement in DPBRN activities to date, including participation in the baseline questionnaire, the first

network-wide clinical study, and other DPBRN activities to that date.

Meeting context

The full agenda for this network-wide meeting is available publicly.²³ The key objectives of the meeting were to provide an organized venue for collegial interaction—including discussion with colleagues from all DPBRN regions about results from the baseline questionnaire—with the goal of improving clinical practice to more closely follow the latest scientific evidence; to present the latest results from two DPBRN studies (both of which related to caries diagnosis and treatment) that were intentionally related to

the questionnaires provided at the completion of the meeting; and to present the latest evidence from the literature about caries diagnosis, prevention, and treatment. Discussions with colleagues included not only panel discussions with question-and-answer sessions but also informal gatherings and formal breakout sessions in which groups of 8–10 practitioner-investigators discussed pre-assigned topics at assigned tables. Groups were arranged to ensure that each group would have at least one practitioner-investigator from each DPBRN region. These round-table discussions lasted approximately two hours. Each group was responsible

Table 2. Summary of responses provided after the meeting, overall and by DPBRN region (in %).
Column values do not add to 100% in all instances due to rounding.

	Overall	DPBRN region					Statistical significance of the association between the response and region ($p < 0.05$)
		AL/MS	FL/GA	MN	PDA	SK	
As a result of this meeting, how much do you think that you will change how you <i>diagnose</i> dental caries?							
A large amount	10	8	13	7	17	4	0.016
A small amount	49	61	46	57	61	17	
None	42	31	42	36	22	78	
As a result of this meeting, how much do you think that you will change how you <i>treat</i> (prevention and restoration) dental caries?							
A large amount	14	12	26	14	11	5	0.022
A small amount	68	74	70	71	74	48	
None	19	15	4	14	16	48	
I liked meeting with fellow DPBRN practitioner-investigators at this meeting							
Strongly agree	94	97	83	93	100	96	Not significant
Agree	6	3	17	7	0	4	
Neither agree nor disagree	0	0	0	0	0	0	
Disagree	0	0	0	0	0	0	
Strongly disagree	0	0	0	0	0	0	
Overall, the meeting was useful to my clinical practice							
Strongly agree	57	55	63	57	70	43	Not significant
Agree	40	45	33	43	30	48	
Neither agree nor disagree	3	0	4	0	0	9	
Disagree	0	0	0	0	0	0	
Strongly disagree	0	0	0	0	0	0	
Attending this meeting increased my interest in participating in future DPBRN studies							
Strongly agree	82	84	83	64	90	83	Not significant
Agree	15	13	13	29	10	17	
Neither agree nor disagree	3	3	4	7	0	0	
Disagree	0	0	0	0	0	0	
Strongly disagree	0	0	0	0	0	0	

for formally presenting its findings and conclusions to all attendees during a plenary session.

Questionnaire completed at the meeting's registration desk

Attendees were asked to complete a five-item questionnaire upon checking in for the meeting at the registration desk (see Table 1). The full questionnaire is available publicly.²³

Questionnaire completed upon leaving the meeting

Attendees were also asked to complete a questionnaire after the meeting ended. The content of some questions is evident in Tables 2 and 3, but certain questions require more detail because they related to clinical situations. These clinical questions fell into two categories:

diagnostic methods used by that practitioner-investigator and treatment scenarios in which practitioner-investigators stated how they would treat these hypothetical patients who appeared in their practices. All questions were excerpted from the baseline "Assessment of caries diagnosis and treatment" questionnaire and are available publicly, which

Table 3. Comparison of individual baseline responses to responses after the meeting to the same clinical questions (%).

	Response was more conservative after the meeting	Response was the same after the meeting	Response was less conservative after the meeting	Statistical significance (<i>p</i> value)
Diagnostic methods				
When you examine patients to determine if they have a primary occlusal caries lesion, on what percentage of these patients do you use a <i>dental explorer</i> to help diagnose the lesion?	39	48	13	0.002
Treatment scenarios				
Defective composite restoration with cementum-dentin margins	35	56	9	<0.001
Defective composite restoration with enamel margins	30	61	9	0.006
Defective amalgam restoration	29	63	8	0.001
Occlusal caries scenario 1	11	88	1	0.002
Occlusal caries scenario 2	34	65	1	<0.001
Occlusal caries scenario 3	38	51	11	0.001
Proximal caries scenario	24	68	8	0.079

made it possible to compare how these practitioner-investigators responded at baseline to how they responded at the end of the meeting. The mean number of months (\pm SD) between baseline and the questionnaire completed after the meeting was 20.3 (4.4), with a range of 6.1–26.3. The wide range in the number of months occurred because there was substantial variation in terms of the dates when each practitioner-investigator completed the baseline questionnaire. Some practitioner-investigators enrolled in the DPBRN early, while others enrolled in the network as late as six months before the network-wide meeting.

Questions about diagnostic methods

The first five questions pertained to the frequency with which dentists reported using several diagnostic methods on the patients in their practices—specifically, the dental explorer for primary occlusal

caries, laser fluorescence for primary occlusal caries, air-drying for primary caries, fiber-optic transillumination for proximal caries, and magnification. The next question asked if the practitioner-investigator assessed caries risk for individual patients in any way; those who responded “yes” were subsequently asked whether a special form was used.

Other questions about diagnostic methods included the following: “When you examine patients to determine if they have a primary caries lesion on the occlusal surface, on what percentage of these patients do you use laser fluorescence (for example, DIAGNODent)?”; “When you examine patients to determine if they have a primary caries lesion, on what percentage of these patients do you use air-drying to help diagnose the lesion?”; “When you examine patients to determine if they have a caries lesion on a proximal (mesial or distal) surface

of an anterior tooth, on what percentage of these patients do you use fiber-optic transillumination to help diagnose the lesion?”; “When you examine patients to determine if they have a caries lesion, on what percentage of these patients do you use some sort of magnification to help diagnose the lesion?”; and “Do you assess caries risk for individual patients in any way?” The differences in reported usage between baseline and after the meeting for these five questions were not statistically significant ($p > 0.05$).

Response categories were as follows: never (0%); 1–24%; 25–49%; 50–74%; 75–99%; and every time (100%). A “more conservative” response meant moving to a category with a lower number after having provided a response of a higher category at baseline. A “less conservative” response meant moving to a category with a higher number after having provided a response of a lower category at baseline.

Questions about treatment scenarios

The next three questions were based on high-resolution photographs of various defective restorations accompanied by case descriptions. The first case involved a defective composite restoration with cementum-dentin margins and the description of a patient who had been a regular dental patient and had existing dental restorations. The second case had a defective composite restoration with enamel margins and a description of a patient at low risk for caries. The third case had a defective amalgam restoration and a description of the same hypothetical patient, except that in this scenario, the patient was at low risk for caries.

Attendees were asked what type of treatment they would recommend to the patient if that patient appeared in their practice; treatment options ranged from no treatment to replacement of the entire restoration. These nine treatment options were separated into three categories: no treatment or preventive treatment only; polish, re-surface, or repair the restoration; and replace the entire restoration. A “more conservative” response meant moving to a category with a lower number after having provided a category with a higher number at baseline. A “less conservative” response meant moving to a category with a higher number after having provided a category with a lower number at baseline.

The next question involved clinical images of increasingly severe occlusal caries. Responses were again divided into three ordinal categories, in terms of highest degree of clinical intervention recommended: no treatment or preventive treatment only, minimal intervention, and complete restoration. The options for minimal

intervention included minimal drilling with a sealant, minimal drilling with a preventive resin restoration, air abrasion with a sealant, and air abrasion with a preventive resin restoration. The options for complete restoration were an amalgam restoration, a composite restoration, and an indirect restoration. A “more conservative” response meant moving to a category with a lower number after having provided a category with a higher number at baseline. A “less conservative” response meant moving to a category with a higher number after having provided a category with a lower number at baseline.

The next question involved five radiographic images of the same caries lesion of increasing depth located in the interproximal surface of a mandibular premolar (outer half of enamel; inner half of enamel; outer one-third of dentin; middle one-third of dentin; inner one-third of dentin). Attendees were asked to indicate which image corresponded to the lesion depth at which they would recommend performing a permanent restoration, rather than performing preventive therapy only. A “more conservative” response meant moving to a category with a lower number after having provided a category with a higher number at baseline. A “less conservative” response meant moving to a category with a higher number after having provided a category with a lower number at baseline.

Statistical methods

All analyses used a statistical analysis system (version 9.1, SAS Institute). In addition to quantifying frequency distributions (that is, the percentages in each category), responses by DPBRN region were cross-tabulated to test for significant differences. For responses on

a binary scale, chi-square tests were used; for responses on an ordinal scale, Mantel-Haenszel chi-square trend tests were utilized. Table 3 features responses to the clinical questions from the baseline questionnaire cross-tabulated with responses to the same questions repeated after the meeting had ended. McNemar’s test and Bowker’s test of symmetry were used to determine whether patterns of change in response were statistically significant for dichotomous and ordinal responses, respectively.²⁴ Tests used extended ordinal categories rather than the more conservative-to-less conservative scale that summarizes the responses in Table 3. Statistical significance was assumed for a *p* value of less than 0.05.

It is important to note that these statistics do not depend on the proportion of respondents whose answers changed. Instead, the statistics quantify whether their responses are more likely to change in one direction than another. Bowker’s statistic generalizes McNemar’s in cases where there are more than two response choices. Among those whose answers changed, Bowker’s statistic tests whether the direction of change was symmetrical. For example, did the respondent’s answer change from category 2 to category 3 as often as it did from category 3 to category 2?

Results

Responses provided at the meeting registration desk

All 126 practitioner-investigators who attended the network-wide meeting completed this questionnaire (see Table 1). At least 95% of the attendees from each region acknowledged having received the report that compared their individual responses from the baseline

questionnaire to those of other DPBRN dentists. The time these dentists spent reviewing the report varied widely. There was also considerable variability by DPBRN region among those dentists who reported having discussed this individualized report before the meeting with their colleagues.

A total of 30% of respondents said that they had changed how they diagnose dental caries as a result of considering these individualized results; this percentage did not vary significantly by DPBRN region. A similar percentage (27%) said that they would change how they treat dental caries, but this percentage varied significantly by region, with practitioner-investigators from the FL/GA and MN regions reporting the highest percentages (see Table 1).

Post-meeting responses

Table 2 shows responses to the post-meeting questionnaire. Most practitioner-investigators (59%) said that they would change how they diagnose dental caries as a result of the meeting. The percentage who said that they would change how they treat caries was even higher (82%). The responses to both questions varied significantly by DPBRN region.

Table 2 also shows responses to three questions that were used to evaluate the effectiveness of the meeting. All practitioner-investigators liked meeting with fellow DPBRN practitioner-investigators. A total of 97% either agreed or strongly agreed with the statement that the meeting was useful to clinical practice, while 97% also felt that the meeting increased their interest in participating in future DPBRN studies. None of the responses to these three questions varied significantly by DPBRN region.

Comparison of baseline and post-meeting responses to clinical questions

Diagnostic methods

Table 3 compares responses to clinical questions at baseline to those reported after the meeting. Of the six questions about diagnostic methods, responses concerning use of a dental explorer produced significantly different responses, leading toward a more-conservative approach—in other words, these dentists would use the explorer on a smaller percentage of patients.

Treatment scenarios

Table 3 also shows the results of comparing responses to the seven treatment scenarios at baseline to those reported after the meeting. A statistically significant change toward a more conservative approach was evident in six of the seven scenarios.

Discussion

The findings of the present study are consistent with the informal reports that DPBRN practitioner-investigators had provided concerning the effectiveness of collegial interaction in changing approaches in clinical practice. The responses provided at the meeting registration desk suggest that less than one-third of respondents had any intention of changing diagnosis or treatment approaches as a result of comparing how they and other practitioner-investigators diagnose and treat dental caries. However, after the meeting, the majority of these same practitioner-investigators stated their intention to change both their methods of diagnosis and treatment in some manner, thus taking the next step toward implementing change and translating the latest scientific evidence into regular clinical practice. This movement

from no stated intention to a stated intention is consistent with the health change theory, which suggests that this step is a prelude to the subsequent “next step” of actually implementing change.^{25,26}

These findings are consistent with both implementation theory and with the literature concerning implementation methods used by other health care professionals. According to Rohrbach *et al*, a change in knowledge about the latest evidence is necessary but not sufficient for change.²⁷ For this reason, passive dissemination of materials, the development of clinical guidelines, and attendance at didactic meetings generally have not been effective.¹⁰ Interventions that target other barriers to change, such as the context of the individual practice, have a larger impact. These barriers can include a practice’s patients and the constraints and incentives created by its particular financial and health care system circumstances.^{9,28}

For this reason, PBRN research might be especially useful, because practitioner-investigators must consider data from their own practices and listen to views about these data from other practitioner-investigators who share many of the same constraints, incentives, and motivations. In other words, participating in PBRN activities may create an openness to change, and practitioner-investigators themselves can act as agents of change.

In the context of the DPBRN meeting, those practitioner-investigators who were most eligible to act as agents of change were those who had already incorporated the more conservative approaches to caries diagnosis and treatment—the approaches supported by the scientific evidence. In addition, these meetings encourage collegial

interaction among peers and generate ideas for new studies, which may help to speed the transition of evidence into regular practice. Further systematic investigations are warranted to determine which methods work best and do so in the most practical manner.

Study designs exist on a continuum of inferential power.²⁹ At the highest end of the spectrum is the study design with the greatest inferential power and scientific rigor, the well-done double-masked randomized clinical trial. By comparison, the present study increased scientific inferential power by moving from informal anecdotal reports to the collection of data (in a standardized manner) from many practitioner-investigators. Although the authors would have liked all DPBRN practitioner-investigators (not just those who attended the meeting) to answer the questionnaire about diagnostic and treatment scenarios, the study did benefit by having a “before/after” design in which responses from before the meeting were compared to those from the same individuals after the meeting.

Furthermore, the changes observed were leading toward a more conservative approach (that is, providing minimal, preventive, or no intervention, as opposed to doing a surgical/restorative intervention), the approach that is supported by the latest scientific evidence. Therefore, it can be said that if a highly interactive meeting that encourages frank discussion in a collegial setting (like the one held in the present study) is effective for moving evidence into regular clinical practice, then the results that were observed are those that *should* be observed if highly interactive meetings are effective, although these results are not conclusive evidence of their effectiveness.

The fact that this change in intention was also associated with a change in stated clinical practice (that is, the questions about how one would diagnose and treat patients in practice) is also consistent with the conclusion that this method is effective. Appropriate follow-up would include querying all DPBRN practitioner-investigators (as opposed to only those who attended the meeting), followed by a single-masked randomized trial to test the effectiveness of this translation-to-practice strategy.

Conclusion

This study tested whether dentist practitioner-investigators in the DPBRN would be open to changing the way they diagnose and treat dental caries as a result of receiving the latest scientific information on the topic and interacting with fellow practitioner-investigators during a professional meeting that was designed to foster this interaction. The results suggest that this process was effective at fostering a change in both diagnosis and treatment.

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Disclaimer

Opinions and assertions contained herein are those of the authors and are not to be construed as necessarily representing the views of the respective organizations or the NIH.

The informed consent of all human subjects who participated in this investigation was obtained after the nature of the procedures had been explained fully.

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