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Preparing practicing dentists to engage in practice-based research

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Abstract

Background—The authors describe an educational program designed to prepare practicing dentists to engage in practice-based research in their practices—a trend receiving more emphasis and funding from the National Institute of Dental and Craniofacial Research (NIDCR).

Methods—The Northwest Practice-based REsearch Collaborative in Evidence-based DENTistry (PRECEDENT), an NIDCR-funded network of which the authors are members, developed a one-day educational program to educate practitioners in principles of good clinical research. The program has four components built around the following questions: “What is the question?”;

“What are the options?”; “How do you evaluate the evidence?”; and “How do you conduct a study?”

Results—The intensive one-day program initially offered in early 2006, which concluded with applications of research principles to research topics of interest to practitioners, was well-received. Despite their admission that the research methodology by itself was not of great interest, the dentists recognized the importance of the background material in equipping them to conduct quality studies in their practices.

Conclusions—Dentists interested in participating in practice-based research view training in research methodology as helpful to becoming better practitioner-investigators. The PRECEDENT training program seemed to reinforce their interest.

Practice Implications—As dentistry evolves to become more evidence-based, more and more of the evidence will come from practice-based research. This training program prepares practicing dentists to become engaged in this trend.

Keywords

Practice-based research; clinical research; training; research methodology

In the past, much, if not most, clinical research in dentistry and medicine was conducted in academic health centers. One of the criticisms made of such clinical research has been that it is conducted in an artificial “ivory tower” environment that is very different from the environment of a full-time clinical practice. It often is lamented that the transfer of knowledge from clinical research findings into changes in clinical practice is extremely slow or nonexistent. This may be because of the perception that the results found in an academic environment would not translate into a full-time practice environment—or it may be because they really have not translated (see, for example, conflicting findings on longevity of restorations from academic-based clinical trials and practice-based cross-sectional studies¹). The Agency for Health-care Research and Quality (part of the U.S. Department of Health and Human Services) indicated that the time from introduction of a new concept in health care to its use in practice may be as much as two decades.² To address that issue, the National Institutes of Health (NIH) developed Roadmap Initiatives in part to speed up the technology transfer process by encouraging clinical research to be conducted in the practices of physicians and dentists so that the results can be seen as directly applicable—and, thereby, have a greater and quicker effect on clinical practice. (The NIH established the Roadmap in 2002 to guide medical research in the 21st century.)

In April 2005, in response to the Roadmap Initiatives, the National Institute of Dental and Craniofacial Research (NIDCR) funded three practice-based research networks to encourage the conduct of clinical research in dental practices. The three are widely distributed across the United States: the Northwest Practice-based REsearch Collaborative in Evidence-based DENTistry (PRECEDENT), administered through schools of dentistry at the University of Washington (UW), Seattle, and Oregon Health and Science University (OHSU), Portland³; the Practitioners Engaged in Applied Research and Learning (PEARL) Network, administered by the New York University College of Dentistry⁴; and the Dental Practice-Based Research Network (DPBRN), administered by the University of Alabama at Birmingham.⁵ This article will focus on the network to which we belong, the Northwest PRECEDENT.

THE NORTHWEST PRECEDENT NETWORK

The practitioner-investigators in the Northwest PRECEDENT network are practicing dentists in Idaho, Montana, Oregon, Utah and Washington. We recruited the practitioner-

investigators as a result of an aggressive year-long campaign that involved mass mailings, as well as presentations at state and local dental society meetings.

The demographics of our members vary but generally mirror the demographics of dentists in each state. Of the 163 “active” PRECEDENT members (those who have completed or are in the process of completing training), 83 percent are men and 17 percent are women; 13 percent are of minority background (including Asian-American); 28 percent are younger than 40 years, 22 percent are in their 40s, and 50 percent are 50 years and older. The slight skew toward participants 50 years and older likely is related to the reasons given for participating. The most frequent reason cited was the desire to “give back” to a profession in which they had enjoyed success; those 50 years and older likely are more secure (financially and otherwise) than younger dentists, therefore allowing them to participate as a service to the profession. Members’ median length of time in practice is 20 years.

The proportion of active members who practice in rural settings (31 percent) is considerably higher than the 7.2 percent estimated for the overall population of dentists in the five-state region (M.H. Anderson, DDS, MS, Dental Director, Washington Dental Service, oral communication, May 2004), and it likely reflects a higher level of interest among those in rural areas in connecting with colleagues. It is not expected that those who choose to participate in practice-based networks represent a truly random sample of practicing dentists, since they likely are more motivated by and interested in principles of evidence-based dentistry, but it is reassuring that they do not constitute a group that is demographically different from the rest of the population of dentists.

In initiating the Northwest PRECEDENT network, we developed a training program to prepare practicing dentists to conduct research in their practices, for which we offer continuing dental education credit. The purpose of this article is to describe the content of that training program, discuss its rationale and summarize the practitioners’ responses to the program.

THE TRAINING PROGRAM

Dentists as research subjects

Before any discussion of training can take place, there needs to be some differentiation between the kinds of research done in collaboration with practicing dentists. Some research may involve merely asking practicing dentists to complete a questionnaire, answering questions about the way they practice without requesting specific information about their patients. For this kind of survey, the dentists technically are research subjects in a study. They need to give consent to participate, and they may be given specific directions on how to interpret or answer the questions, but this typically does not require any additional training.

Dentists as investigators

On the other hand, if practicing dentists are being asked to enroll their patients in a study being conducted in their offices, then they become investigators in the study, and they likely need training in topics not usually covered in the clinical practice of dentistry or in traditional dental education.

Research training

We ask dentists to undertake three kinds of training before participating in Northwest PRECEDENT studies.

- First, although most dental offices are certified as following confidentiality requirements of the Health Insurance Portability and Accountability Act (HIPAA) of 1996, we present some additional HIPAA issues related to the conduct of clinical research in a brief handout or through a short Web-based program that participants must read and acknowledge that they have completed.
- Second, once they become active investigators in clinical research, they must undergo training in the responsible conduct of research, most notably in ethical issues surrounding the conduct of research involving humans. This is an important subject that raises issues often not addressed in clinical practice. For example, the dentist often is the person who obtains patients' consent for participation in a study. Informed consent is a process in which the patient is educated about the study and asked if he or she wishes to participate. The idea of obtaining informed consent from a patient regarding a clinical procedure—when the decision ordinarily would be left to the dentist's clinical judgment—may sound foreign. The dentist must be able to separate his or her role as a clinician from that of a researcher. At the same time, he or she must take care not to coerce patients into participation. The dentist, as the patient's primary dental care provider, easily can behave in a manner that might be unintentionally coercive if he or she strongly recommends to a patient that he or she participate in a study. To understand the ethical issues involved in research involving human subjects, we require members of our network to complete a Web-based course in this topic through either UW or OHSU.
- The third area of training required to become a member of our network is the principles underlying the conduct of good clinical research in dentistry. The training is designed to help the clinician become involved actively in the formulation of the research hypothesis and in the development of the research design. To educate our members in these principles of sound research, we have developed a one-day course, which is described below.

THE COURSE

We divide the course into four components to address the following fundamental issues:

- What is the question?
- What are the options?
- How do you evaluate the evidence?
- How do you conduct a study?

What is the question?

One of the most fundamental issues in conducting good clinical research is understanding how to frame the research question of interest appropriately, and how then to translate it into a testable hypothesis. To aid the practicing dentist in this endeavor, we introduce the use of the PICO method. This terminology emphasizes identifying the patient's or population's (P) characteristics of interest, the intervention (I), the control or comparison (C) group and the outcome (O) on which comparisons will be based.

The PICO method is particularly helpful in framing questions that involve treatment interventions. For example, a clinician might suggest the following as a potential topic for a clinical research project: does regular use of chlorhexidine rinse prevent tooth loss in patients with periodontitis who are 65 years and older? Examination of the question using the PICO terminology reveals that the patient's or population's (P) characteristics of interest are specified (patients with periodontitis 65 years and older), the intervention (I) is specified

(regular use of chlorhexidine rinse) and the outcome (O) is specified (tooth loss). However, there is nothing in the suggested research topic that specifies the control or comparison (C) group. The control group could be rinsing with fluoride, a placebo rinse with a taste similar to that of chlorhexidine or an antiseptic mouthrinse; alternatively, it could be using no rinse at all. Specification of what is intended for a control group is important in the design and analysis of the clinical questions, and using the PICO guidelines forces the clinician to be specific in the phrasing of the clinical question. This suggests that to frame the research question properly, one also must specify a control or comparison group with which to compare patients who use chlorhexidine regularly.

A second topic discussed under this first category is the role that behavior often plays in many oral health research questions. A patient is not merely a mouth full of teeth, and the practitioner-investigator is not merely treating or studying a biological event. Rather, a patient or participant is subject to many psychosocial and cultural influences that may affect his or her oral health. Acknowledging that cognition, emotion, temperament and motivation play roles in a person's behavior that, in turn, affect his or her oral health is important in identifying the exact nature of the most relevant question. Distinguishing between disease as a biological event and illness as a subjective experience also may help in framing the appropriate question. Furthermore, psychosocial issues may be confounding risk factors or outcome variables. As practitioner-investigators may choose to include psychosocial variables in their study designs, we provide training in the selection and use of reliable and valid measures for their use in research studies.

What are the options?

During this section of the program, we discuss the different kinds of clinical research study designs and the levels of evidence produced by each. In a given situation, it is desirable to identify the study design that produces the highest level of evidence and also is feasible to conduct. The hierarchy of evidence from study designs proceeds thus, from lowest to highest level of evidence: single case reports, case series, case-control studies, cohort studies, randomized controlled trials (RCTs). The study design that produces the highest level of evidence, the RCT, may not always be feasible. For example, if one is interested in testing whether the efficacy of a specific type of periodontal treatment is affected by smoking, an RCT in which patients are randomized to smoke or not smoke is not feasible or ethical. One has to select from among the study designs that are feasible the kind that will yield the most and highest level of information.

How do you evaluate the evidence?

While practitioner-investigators in practice-based research networks do not have to function as bio-statisticians for their studies, they must understand the basic terminology and principles used in designing and analyzing studies so they can understand and help interpret the results. Thus, we try to ensure that they understand the basic concepts of confidence intervals and tests of hypotheses. We use inherent variability in disease measures as the underpinning for developing a confidence interval that expresses the amount of precision surrounding an estimated value. To explain statistical hypothesis testing, we draw an analogy between it and the legal system. In statistical hypothesis testing, a stated null hypothesis is assumed to be true, and the evidence from the study is evaluated by calculating the probability of achieving a result like that observed under that assumption. Similarly, in the legal system, a defendant is assumed to be innocent and the surrounding evidence is evaluated as to whether it contradicts that assumption beyond a reasonable doubt.⁶ We also use this analogy to introduce the concepts of type I error (convicting an innocent person) and type II error (letting a guilty person go free), as well as power (the probability of convicting a guilty person). Translated into hypothesis-testing terminology, this allows a discussion of

how the sample size for a given study is determined by the size of the treatment effect one is trying to detect, the power one wishes to have for detecting that effect, the inherent variability in the measure one is using and the significance level (or type I error rate—the probability of incorrectly concluding that there is a treatment effect) one uses in the hypothesis test. Thus, the practitioners gain an appreciation of how all of these factors can influence the sample size required for a study. It also provides a basis for how the analysis of the data results in a conclusion, the underlying certainty of that conclusion and the difference between a conclusion that is statistically significant and one that implies clinical significance.

How do you conduct a study?

The final didactic section of the training program consists of practical discussions of several topics that can influence the quality of a study and that, therefore, deserve special emphasis. These important topics include bias (what it is and what causes it), enrollment (which often is overlooked in importance and effect), methods of treatment assignment, patients' adherence to the treatment protocol, measurement of the outcome of interest, attrition of participants as the study progresses, and the principles and process of obtaining informed consent. For each of these topics, we provide examples of how studies can become biased through a lack of attention to some of these details. A summary of how to perform a study and avoid introduction of bias includes the following advice:

- follow the enrollment protocol;
- establish a careful informed consent process;
- randomize treatment assignments (if appropriate);
- maximize patients' adherence to assigned treatments;
- increase the accuracy of the outcome assessment;
- mask the treatment assignments when feasible;
- minimize attrition of patients.

After these discussions, we hold a general brainstorming session concerning topics for studies that practitioners have suggested when they signed up on our Web site. We address topics that were mentioned most often. We also encourage the practitioner-investigators to use PICO terminology to frame the appropriate question and to suggest an appropriate study design to address the question. This discussion reinforces the topics just covered and allows the practitioner-investigators to provide input on priorities for studies to be conducted in the network.

ASSESSING THE COURSE

We presented the course twice as day-long conferences in early 2006, with a total of 98 dentists in attendance. During the second presentation of the course, the lectures were recorded, and the slides were incorporated into handouts. Now, as new members of the PRECEDENT network are identified, they receive a DVD version of the lectures (approximately 4.5 hours long) as well as a notebook with copies of all slides, and we ask them to view the lectures while reviewing the handouts. After they complete the training session, we ask them to attend a two-hour meeting with network investigators so they can ask any questions about the material and provide input on study topics, much as in the brainstorming sessions we hold at the end of the daylong conferences.

Rationale for the training program

It is reasonable to ask if this kind of training is really necessary to involve practicing dentists in practice-based research. One argument is that a one-day training program such as this will not provide adequate background for the practitioners to function as independent clinical researchers, and all that is needed for a specific protocol is to provide explicit instructions to practitioners regarding how to carry it out. It is our belief, however, that no protocol ever can be explicit enough to cover every scenario that might arise in carrying out a study, and at some point a practitioner will face a dilemma regarding what to do in a study for a situation not addressed in the manual of operations. When that occurs, we believe that someone who has been exposed to and understands the general underlying principles on which the research project is based, will not approach the dilemma as an automaton but, rather, will have improved judgment and be less likely to do something that threatens the integrity of the study.

An additional argument for requiring this kind of training before participation in practice-based research is that for a network to be successful, its members should feel a certain amount of ownership. If members understand the underlying principles being used to identify research topics, design the studies and analyze and interpret the results, then they are more capable of playing an active role in making decisions regarding network activities. By not simply treating practitioners as technicians, we reinforce a more collaborative role for them and, we hope, ensure increased satisfaction among, and future participation by, practitioner-investigators.

Practitioners also need to identify and appreciate any kind of adaptations they may need to make to incorporate research activities into their daily practice routines with minimal disruption. Understanding the principles covered in this training will help them do this in advance.

Finally, exposure to these research principles should encourage practitioners to use evidence-based principles routinely in their practice, even when they are not involved in a specific research project.

Evaluation of the program by practitioners

As stated earlier, we have presented this training program twice as one-day conferences, and several times using the DVD format with follow-up discussion meetings. At the conclusion of each of the conferences or meetings, we asked participants to evaluate the content of the training program by indicating whether they agreed or disagreed with four statements that suggest the potential impact of the course on future practice-based research. The table provides a summary of the responses from all of those who participated in either conference or DVD/meeting format.

Nearly all practitioners who participated in the training program felt that it would improve their performance in future research studies and that it increased their desire to participate in future studies. They indicated a commitment to participate in future training conferences as needed and to recommend the program to their colleagues.

Neither mode of presentation (in-person versus DVD) of the program was clearly superior to the other, as evidenced by the responses given. While we expected the in-person presentations to be more engaging, we found that several of those who used the DVD presentation expressed appreciation for the ability to return to and review some topics that were more challenging. In our discussions with practitioners at the completion of the two types of program, we found no discernible differences in their understanding and application of the research principles.

In the evaluations provided after completion of the in-person and self-paced DVD training, we asked participants for additional comments. Aside from specific comments and suggestions for individual speakers, practitioners' general comments indicated that although the material could be somewhat foreign to them, they understood and appreciated the necessity of this training in enabling them to conduct research in their offices. Some typical comments were as follows:

- "Well done for a topic that can be dry, although I find it very interesting."
- "The course was worthwhile and necessary. Good overview of not that interesting a subject."

In addition, many commented on how acquiring this new knowledge has increased their enthusiasm for creating evidence for the practice of evidence-based dentistry:

- "I feel very excited to participate in this type of research group."
- "Looks like a fun and satisfying new challenge [for] a 25-year wet-fingered dentist looking to return something to the profession, with a possible benefit to others in real life and in research."

CONCLUSIONS

Practicing dentists who are interested in engaging in practice-based research appreciate the value of receiving training in research methodology that will better prepare them to conduct clinical research studies in their own offices. While listening to lectures about research methodology may not be as exciting as a hands-on clinical procedure course, these dentists generally see the need for this kind of orientation to help them conduct quality studies in their practices. A full one-day program focusing on research principles, followed by a discussion of how those principles apply to relevant studies, seems to solidify their interest in practice-based research.

Providing this background training already has paid dividends as far as obtaining practitioners' input into identifying relevant clinical research topics and designing studies to address them. Investigators at the UW and OSHU proposed the first PRECEDENT study, a survey of the oral health status of a random sample of 20 patients from each participating practice, to help in future study planning. However, most subsequently identified study topics have been initiated by the practitioner members, and all have benefited from assessments by PRECEDENT practitioners, who rated them for relevance and made suggestions as to appropriate study designs. These studies (either under way, under development or approved for future development) include the evaluation of salivary characteristics to identify patients at high risk of experiencing caries, the treatments for and outcomes of cracked teeth, the comparison of mineral trioxide aggregate with calcium hydroxide in long-term outcomes of direct pulp caps, outcomes of and risk of complications resulting from third-molar extractions, and prevalence and treatment of chronic tooth sensitivity.

As we develop new studies, we will offer the opportunity for additional protocol-specific technical training to implement them. However, our emphasis is on developing studies that are simple to design and conduct, which should minimize the need for additional training and calibration. The mode of delivering additional protocol-specific training likely will vary with different studies; it could include Web-based videos as well as brochures with color illustrations. We have used the PRECEDENT annual meeting to introduce new studies and provide technical training in the use of the Web-based data-capture system, and we likely will continue to use that forum for additional study-specific training.

The training done so far has resulted in the collection of high-quality data in the first survey of dental patients. As of Jan. 15, 2008, we had collected data regarding approximately 1,432 patients from 75 dental practices, with few indications of missing, incomplete or invalid data. The high acceptance rate and overall positive evaluation of the training program by the member practitioner-investigators in conference and DVD format suggest that we should be able to continue using it for future members as they join the network. All indications are that the investment of our time in developing this course and of the members' time in taking this training will continue to pay dividends in future years.

Acknowledgments

The authors acknowledge the contributions of the 119 practitioner-investigator members of Northwest Practice-based REsearch Collaborative in Evidence-based DENTistry (PRECEDENT) who have completed the training program on principles of good clinical research, either in the live conference format or in the DVD/meeting version, and who have provided feedback to us on the program.

The authors encourage all practitioners who are interested in learning more about the networks funded by the National Institute of Dental and Craniofacial Research, and in inquiring about how they might participate, to visit the Web sites given in the reference citations below for the Northwest Practice-based REsearch Collaborative in Evidence-based DENTistry (PRECEDENT),³ the Practitioners Engaged in Applied Research and Learning (PEARL) Network⁴ and the Dental Practice-Based Research Network (DPBRN).⁵

ABBREVIATION KEY

HIPAA	Health Insurance Portability and Accountability Act of 1996
NIDCR	National Institute of Dental and Craniofacial Research
NIH	National Institutes of Health
OHSU	Oregon Health and Science University
PICO	Patient's or population's (P) characteristics of interest, intervention (I), control or comparison (C) group, outcome (O)
PRECEDENT	Practice-based REsearch Collaborative in Evidence-based DENTistry
RCT	Randomized controlled trial
UW	University of Washington

References

1. Manhart J, Chen H, Hamm G, Hickel R. Buonocore Memorial Lecture: review of the clinical survival of direct and indirect restorations in posterior teeth of the permanent dentition. *Oper Dent*. 2004; 29(5):481–508. [PubMed: 15470871]
2. U.S. Department of Health and Human Services, Agency for Healthcare Research and Quality. [Accessed Jan. 5, 2008.] Translating research into practice (TRIP)-II: fact sheet. "www.ahrq.gov/RESEARCH/trip2fac.htm#Background/"
3. Northwest Practice-based REsearch Collaborative on Evidence-based DENTistry. [Accessed Jan. 5, 2008.] Northwest PRECEDENT Web site. "<http://clinicaltrialsworkbench.axioremsearch.com/nwprecedent/>"
4. [Accessed Jan. 5, 2008.] Practitioners Engaged in Applied Research and Learning. PEARL Network Web site. "<http://web.emmes.com/study/pearl/index.htm>"
5. Dental Practice-Based Research Network. [Accessed Jan. 5, 2008] Dental Practice-Based Research Network Web site. "www.dpbrn.org/home.asp"
6. Motulsky, H. Intuitive biostatistics. New York: Oxford University Press; 1995.

TABLE
Attendees' evaluation of practice-based research continuing education program (N = 98).

EVALUATION STATEMENT	ATTENDEES' RESPONSE (% OF ATTENDEES)				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The information conveyed during this conference will improve my performance when participating in future research studies.	73	27	0	0	0
This conference increased my desire to participate in future research studies.	55	43	2	0	0
I will make every effort to attend related conferences in the future.	65	35	0	0	0
I will recommend this conference to other dentists.	59	36	5	0	0