Effectiveness of interventions to promote continuing professional development for dentists

Helen A. Best and Louise Brearley Messer

[1]*Eastman Dental Institute, University College, London UK;* [2]*School of Dental Science, University of Melbourne, Australia*

Background: Continuing education is incumbent upon dentists as health professionals, but its promotion may be required, particularly in order to ensure regular professional updating. Continuing professional development may be delivered in a variety of ways, and new strategies and techniques must be evaluated for effectiveness.

Aim: To evaluate the effectiveness of two interventions utilizing the philosophies and techniques of the discipline of Quality Improvement.

Method: A self-assessment instrument (a manual) for quality dental practice was developed using the Delphi technique. A randomized, controlled trial of the interventions was conducted under field conditions for dental practice in Victoria, Australia. Dentists in Test Groups 1 and 2 completed the self-assessment manual, and received relevant references and their own scores for the manual in comparison with empirical standards. Dentists in Test Group 1 also attended a continuing education course on Quality Improvement. Dentists in Control Group 1 completed the manual only and received feedback of their scores. Dentists in Test Groups 1 and 2, and in Control Group 1 completed the manual again after 1 year as a post-intervention follow-up. Dentists in Control Group 2 completed the manual only at 1 year.

Results: The intervention involving self-assessment, receipt of scores and references for the manual resulted in modest improvements in total scores for dentists after 1 year, although a response bias was apparent.

Conclusion: An effective method of facilitating change in quality dental practice was identified. Assessment of strategies and techniques for professional development of dentists should include observation of patterns of participation.

Key words: dentists; self-assessment; continuing professional development; quality improvement.

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NEW emphases on evidence-based dentistry indicate the need to investigate the types of interventions that are effective in changing health care practices (1). Continuous improvement in dentists' performance may be fostered by several approaches, such as broad-based public health promotions (2), continuing education strategies (3) and quality improvement initiatives (4). The quality improvement philosophy recognizes the dynamism of the quality of care and that quality can be improved when the current care is satisfactory. This approach for updating and improving care involves problem solving based on education and consultation and is not dependent on regulatory or punitive structures (5). The applications of quality improvement philosophies in the medical field have been reported widely (6–8). They suggest a similar use of these philosophies for dental practice.

The aim of the present study was to evaluate the role of interventions addressing quality improvement in dental practice by dentists delivered by continuing professional education. The specific objectives were (1) to examine the effectiveness of two interventions that included completion of a self-assessment manual with relevant references provided, with or without an associated continuing education course; and (2) to compare 1-year post-intervention observations for these two forms of the intervention with those for two control groups.

Methods and materials

Protocol

Design of the intervention study

Dentists were assigned randomly to four groups: two test groups and two control groups (Table 1). At baseline, dentists in Test Groups 1 and 2 completed a self-assessment manual for quality dental practice, received relevant reference material, and received their own scores in comparison with empirical standard scores. Dentists in Test Group 1 also attended a continuing education course on quality improvement as a discipline. Dentists in Control Group 1 completed the manual and received feedback of their scores. Dentists in Test

TABLE 1. *Study design for the determination of effective methods of facilitating change in dentists' practice patterns*

Development of the self assessment manual

- Three stage Delphi process
- Test–retest reliability survey for the proposed manual

The intervention study

Study group	Quality assessment baseline	Intervention conducted	Post-intervention follow-up at 1 year
Test Group 1	Yes[1]	Received scores on manual Received references for manual Attended continuing education course on Quality Improvement	Recompleted self-assessment manual
Test Group 2	Yes	Received scores on manual Received references for manual	Recompleted self-assessment manual
Control Group 1	Yes	Received scores on manual	Recompleted self-assessment manual
Control Group 2	None	None	Completed self- assessment manual

[1]Self-assessment manual on quality improvement.

Groups 1 and 2, and in Control Group 1 completed the manual again 1 year later. Dentists in Control Group 2 completed the manual once only, at 1 year.

The study was conducted in 1997–98 as follows: the completion of baseline self-assessment manuals commenced in February 1997 and the follow-up was undertaken 1 year later, in February 1998. The feedback to the dentists was provided in May 1997. The quality improvement continuing education course was conducted in late May 1997 following the provision of the feedback to Test Group 1.

The quality assessment instrument

The quality assessment instrument was a manual (copies available from author HB) which served as the measuring instrument and allowed comparisons of baseline and post-intervention data. The educative nature of the manual may have contributed to changes in the participants' knowledge and behaviour during the study. The manual contained 21 sections addressing clinical issues, administrative and process issues for dental practice (e.g. legal aspects, ethics, waste management), assessment of oral health, and a patient questionnaire.

The domains, standards and criteria of quality dental practice addressed in the manual pertained to structural, process and outcome aspects of dental practice or to dentists' knowledge and behaviours. These parameters were established in a preliminary study using a Delphi technique with three iterations. A panel of 77 dentists (who did not participate in the intervention study) was selected and invited to participate in the Delphi technique on the basis of their expertise and awareness of current dental literature. All were acknowledged experts within general and specialist dental fields. The third Delphi iteration included questions ranking the importance of topics for inclusion in the self-assessment manual, the number of questions, and allocation of points (weighting process (9)). After the third iteration and analysis of responses, scoring of the manual was addressed. In particular, negative marking was not used in order to discourage guessing.

A criterion-referenced approach was used in setting acceptable ranges of scores (standards) for answers. Standards were based on descriptive statistics (mean, mode, median) generated from pilot tests and instrument content, recognizing the opportunity for improvement by the participant while completing the manual. Two sets of total scores were established: raw (unweighted) scores, and scores weighted according to the relative importance of items as established previously by the Delphi participants (9). Facility and Discrimination Indices (10) for each item were considered, in addition to test–retest reliability statistics and validity assessments (9). It was not considered appropriate to utilize Cronbach's alpha reliability coefficients to judge the suitability of components of the quality assessment instrument because the items utilized within the manual could be operationally defined as a knowledge or behaviour in type. Item deletion methods to improve the coefficients would have resulted in removal of items defined as important by the Delphi participants and questions for inclusion in, for example, the infection control section, necessarily changed for the final self-assessment manual, based on changes to guidelines for dental practice established by authorities during the period of the study.

Typically, one point was assigned for each correct response per item. For a few items, fractional points were assigned, according to the standard attained for the item by the participant. One point was assigned for

completing each Bleeding on Probing Index for a patient, for each caries status assessment performed, and for each completed patient questionnaire irrespective of the responses to questions.

The quality improvement continuing education course

Provided as a learning format, the course included 4.5 h of lectures and 1 h of interactive workshop. Lectures (supplemented by written summaries for participants) were given by several speakers with relevant expertise (including HB) on the following topics pertinent to the discipline of Quality Improvement: Overview of Quality Concepts, Total Quality Management, Continuous Quality Improvement and Quality Assurance, Development of a Quality Plan, The Tools of Quality, Clinical Dental Applications of Quality Concepts, Patient Monitoring with Specific Reference to Periodontics and Caries; and Quality Indicators including Patient Knowledge, Attitudes and Behaviours. The workshop addressed quality improvement methods such as force field analysis and flow charts (11–13).

Sampling and selection of participants

The register of dentists of the Dental Board of Victoria (1996) was used as the sampling frame (registration is compulsory for dentists undertaking practice in Victoria). A systematic sampling method was utilized. The study was sited within field conditions for dental practice in Victoria. The formula of Armitage and Berry (14) was used to calculate group sample sizes, taking values of 80% and 0.05, respectively, for power and significance level. A standard deviation of 11 was used, which was the value for the total weighted scores for participants derived from data collected in the first test of the test–retest reliability surveys.

Based on the response rate of participants in the test–retest surveys, the estimated response rate for the proposed study was 30% for each of Test Group 2, Control Group 1 and Control Group 2. Because attendance at a continuing education course was required, a lower response rate of 20% was estimated for Test Group 1. Based on previous studies by the investigators (15) and recognizing the number of specialists registered with the Dental Board of Victoria, the number of ineligible dentists for the study was estimated to be 22%. The target group included general dental practitioners, but the study list was not limited exclusively to these dentists. Thus, a total of 1471 dentists were selected initially from the register for random assignment to study groups as follows: Test Group 1, (469); Test Group 2, (334); Control Group 1, (334); Control Group 2, (334).

Conduct of the study

Recruitment of participants was undertaken to minimize bias. Approximately 2 months ahead of starting, dentists assigned to Test Group 1, Test Group 2 and Control Group 1 each received an introductory letter explaining the study. Dentists in Test Group 1 were then invited individually to participate by telephone and/or letter. The recruitment process continued until the number of dentists agreeing to attend the continuing education course satisfied the statistical power requirement for the study (recognizing also practical limitations in running the course, such as the venue). Dentists assigned to Test Group 2 and Control Group 1 received additional introductory information in a letter included in the mailout of the self-assessment manual. Dentists in Control Group 2 were invited to participate in the study by an introductory letter included in the mailout package of the self-assessment manual that occurred at the 1-year follow up for the other three groups.

All study participants were provided with a socio-demographic questionnaire addressing gender, age, country of birth, year of graduation, institution where the dental qualification was attained, attainment of a post graduate qualification, membership of the Australian Dental Association and employment issues.

Data management

Data were entered into spreadsheets and analysed using SPSS software systems. Logistic regression and distribution free, non-parametric tests (Kruskall–Wallis and Mann–Whitney U-tests) were used. The critical level of alpha for all tests was set at $P \leq 0.05$. The Null hypotheses were that group scores (total unweighted and total weighted) at baseline did not differ from group scores at the post-intervention follow-up administered 1 year later.

Assignment

A computer based method was utilized (by a statistician physically and administratively separate from the study investigators) to assign individual dentists randomly to one of the groups within the study. Random assignation was used so as to minimize bias between the groups with respect to uncontrolled extraneous variables.

Results

Response rates for Delphi and the test–retest processes

The response rates for completed questionnaires by the 77 participants in each iteration of the Delphi technique

TABLE 2. *Distribution of responses for the two tests in the test-retest procedure used in developing the self-assessment manual on quality improvement*

	Test 1	Test 2
Initial sample of dentists	50	50
Number of manuals mailed out	39	25
Total number of ineligible dentists	18[1]	18[1]
Number of responses	20	14
Overall response rate	20/32 = 62.5%	14/32 = 43.8%
Response rate for completed manuals	14/32 = 43.8%	10/32 = 31.3%

[1]Ineligible because of an address for a location outside of Victoria, address unknown, employment status, Delphi survey participant.

were 52.8, 59.7 and 56.9%, respectively. The responses for participants in Tests 1 and 2 of the test–retest surveys are shown in Table 2. The paired differences for the total unweighted scores achieved by the participants did not differ with statistical significance (Student's *t*-statistic = −0.30, $P > 0.05$).

Response issues for the intervention study: participant flow

The sociodemographic characteristics of dentists who returned completed manuals at baseline did not show practical differences from those received from dentists in the overall sampling frame. The data was inappropriate for formal statistical examination because of the differences in the criteria used for reporting subgroup survey data and the dental register. The baseline response profiles for each of the three study groups and the response profiles for each of these

groups at 1-year follow up and Control Group 2 are presented in Table 3. The response rate for Control Group 2 (30%) was similar to the response rate for Test Group 2 (28%) but greater than that for Control Group 1 (23%) at baseline. Data sets were available for samples of 8, 29 and 25 private general dental practitioners who had completed each aspect of the project at 1-year follow up, for Test Groups 1 and 2 and Control Group 1, respectively.

The decline in response rate at follow-up was of potential practical significance. Logistic regression analyses (with *completion of the study* as the dependent variable) were undertaken. The final Backward Likelihood model showed that dentists in Test Group 1 were significantly more likely to withdraw from the study than dentists in Control Group 1. Also, dentists who attained lower total raw scores at baseline were significantly less likely to complete the study than

TABLE 3. *Response profiles for the intervention study*

	Test Group 1 439	Test Group 2 334	Control Group 1 334	Control Group 2 334
Agreed to attend continuing education course and self-assessment manuals mailed out	71	na[1]	na	na
Completed self-assessment manuals[3]	38 (53%)[2]	na	na	na
Attended continuing education course on Quality Improvement[4]	24 (34%)	na	na	na
Identified non-participants[5]	na	78	86	77
Self-assessment manuals mailed out	na	256	248	na
Further non participants identified after mail out[6]	na	13	16	na
Completed self-assessment manuals	na	69 (28%)[5]	54 (23%)[5]	na
One-year follow-up from baseline				
Self-assessment manuals mailed out	38	69	54	257
Identified non-participants[6]	2	3	2	24
Completed self-assessment manual				
• Eligible sample	16 (44%)	32 (48%)	26 (50%)	70 (30%)
• Course participants	8 (36%)	na	na	na

[1]na = Not applicable.
[2]Percent responses of dentists agreeing to attend continuing education course on quality improvement.
[3]Non-response issues – unavailable because – going on holidays, child minding issues, attending a different course.
[4]Non-attendance at course because – attending a different course/function, work commitments.
[5]Identified non-participants – ineligible because of prior participation in phases of this project, e.g. Delphi processes, reliability analysis; or address outside Victoria (an earlier introductory leaflet mailout identified, for example, some retirees and incorrect addresses).
[6]Identified non-participants following mailout – because of incorrect address, altered status or retirement.

TABLE 4. *Descriptive statistics for the total unweighted and weighted scores for private general dental practitioners within the study groups at the 1-year follow-up*

Study group	Sample size	Unweighted scores		Weighted scores	
		Mean (SD)	Percent of total possible score	Mean (SD)	Percent of total possible score
Test Group 1	8	202.8 (20.7)	71.4	142.9 (10.3)	71.7
Test Group 2	29	208.2 (23.6)	73.3	141.9 (14.4)	71.2
Control Group 1	25	190.9 (29.9)	67.2	128.9 (17.1)	64.6
Control Group 2	59	189.8 (28.9)	66.9	127.8 (17.1)	64.1

dentists who had attained higher scores at baseline. Sociodemographic characteristics of the dentists were not identified as useful predictors of study completion for the model.

Descriptive and analytical statistics for the total scores for the quality assessment manual

At baseline, the total unweighted scores and the total weighted scores for participants did not differ significantly between the groups. The descriptive statistics for the post-test total unweighted scores and the post-test total weighted scores for the four study groups are presented in Table 4.

The distribution of unweighted scores was 73.3% for Test Group 2 and 66.9% for Control Group 2. The Kruskall–Wallis test results revealed statistically significant differences in post-test scores between the groups ($\chi^2 = 10.63$, df $= 3$, $P \leq 0.05$). Multiple comparison statistics utilizing the Mann–Whitney's *U*-test for the groups revealed that Test Group 2 exhibited significantly higher scores as compared to Control Groups 1 and 2 ($P \leq 0.05$). Other group comparisons for total unweighted scores were not statistically significant.

The distribution of weighted scores was 71.2% for Test Group 2 and 64.1% for Control Group 2. The Kruskall–Wallis test results revealed statistically significant differences in post-test scores between the groups ($\chi^2 = 19.94$, df $= 3$, $P = 0.05$). Multiple comparison statistics utilizing the Mann–Whitney's *U*-test for the groups revealed that Test Groups 1 and 2 exhibited significantly higher scores as compared to Control Groups 1 and 2 ($P \leq 0.05$). Other group comparisons for total weighted scores were not statistically significant.

Discussion

Study design and limitations

In designing the study, consideration was given to whether an experimental or quasi-experimental design (eliminating controls on the basis of legal, ethical or practical issues) should be used. A randomized con-

trolled trial design was selected, based on the concept that this is the 'gold standard' for evidence-based dentistry (16). In addition, this design best controls for extraneous variables that threaten the internal and external validity of an experimental study. Consideration was also given to designing a study that best represented the field conditions (such as sample, setting, resources) under which dentists usually pursue continuing professional education and that would represent the conditions under which the programme would be implemented. Given that dentists in private practice constitute the largest proportion of the dental workforce in Victoria, Australia, this study was conducted within this environment. Expected fiscal constraints for continuing education activities were also taken into consideration.

The selection of a self-assessment approach was based on the role of needs assessment for change processes and learning, as discussed by Knowles (17). Dentists can be quite self-critical and self-reported behaviours correlate well with externally validated behaviours (18). It should be noted that third party evaluation of dentists' practices was not a current procedure in Australia at the time of the study.

Characteristics of the measuring instrument

Use of the Delphi technique to establish the content of the self-assessment manual for this study gave it high face validity and content validity. The Delphi technique has been used in dental research by others in developing measurement tools for similar purposes (19). For example, it has been used in the development of standardized measures to assess dimensions of managed care plan performance (20).

The quality assessment scores in the present study may have been augmented or lowered by social desirability influences (either negative or positive). The manual contained both knowledge and behavioural components that could be influenced by social desirability effects. For example, the expected (correct) response to many of the behavioural items was apparent. However, the practical significance of these issues depends on the use made of the scores, and in this

instance the scores were provided as confidential feedback to each participant for their own benefit.

Sampling issues

Although participants were assigned randomly to study groups, some bias was nevertheless introduced into the study as voluntary participation was involved thereafter. The sociodemographic characteristics of dentists who commenced this study were similar to those characteristics of the dentists in the sampling frame. However, the results of the study are not generalizable to the population of private general dental practitioners in Victoria, because of the differential response rates. Given the selective withdrawal of participants from the paired components of the study, statistical comparisons of scores for both Test Groups with Control Group 2 need qualification as the magnitudes of any differences in scores are likely to have been overestimated. Of dentists assigned to Test Group 1, very few (only 8) actually completed all parts of the intervention, thereby substantially reducing the power of the statistical analysis. Therefore, it should not be concluded that an intervention of this type could not lead to greater improvements in self-assessment scores.

It should be emphasized however, that the overall value of the study is influenced by the relevance of the design to implementation in field conditions; the sampling process and location of this study provide such insights. In a critique of randomized controlled trials, Thomas (21) considered that it is a challenge to develop appropriate and relevant research to capture the complexity of field circumstances. As standards for reporting research conducted under field conditions increase, investigators should also report on difficulties encountered in executing such studies.

Substantive issues

The findings indicate that a quality improvement intervention with a broad-based approach (involving completion of a self-assessment manual, receipt of relevant references and individual scores), resulted in significantly better scores in the target population than the two control groups in the study. These differences were apparent for the total unweighted and total weighted scores for the manual.

Comparisons of this study with other related studies can only be made with caution based on differing societal issues, study objectives and methodologies. Others have reported that participation in a self-administered quality assessment programme (involving peer evaluation of the validity and reliability of the self-assessment instrument) led to changes in perceptions of practice quality by participating dentists.

Although the response rate for the study was only 6.25%, almost all (94%) respondents indicated they discovered deficiencies in their practices (22).

Important changes pertinent to a quality improvement or continuing education intervention may occur external to the evaluation process, or even as a result of that process. For example, on later reflection, a participant may decide to implement changes even though these were not considered at the time of the evaluation. The intervention itself may effect experiential learning in a positive but immeasurable fashion, leading to the development of non-specific skills. Assessing the overall value of quality improvement interventions is therefore multifaceted.

The differing rates of study completion for those dentists achieving lower scores as compared to higher scores is of concern in the present study. Such response patterns could provide support for mandatory continuing professional education and has been noted by other authors (23). However, the selective withdrawal of some dentists from the study may indicate that they were working in non-ideal circumstances that did not allow their ongoing involvement. The loss of participants from Test Group 1 may also indicate that the topic and intensity of the intervention may not have matched their needs or learning styles. Attributes of health care professionals that may constitute barriers to the implementation of quality management principles, such as professional autonomy and independent working patterns, have been described (24, 25). Medical practitioners may be more inclined to embrace the philosophies of quality improvement than dentists, because of their attachments to institutions such as hospitals where these concepts are implemented on an institutional basis (25) and are linked frequently to external accreditation of the institution.

Conclusions and recommendations

An effective method of facilitating change in quality dental practice involving self-assessment by participating dentists, feedback of scores and provision of reference material was identified. Response bias was apparent in the study. Assessment of strategies and techniques for professional development of dentists should include observation of patterns of participation.

Acknowledgements

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Address:
Dr Helen A. Best
10 Edencourt Road
Streatham
London SW16 6QP, UK