

A Systematic Literature Review of the Information-Seeking Behavior of Dentists in Developed Countries

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Abstract: Understanding the information-seeking behavior of dentists may inform ways to increase the dentist uptake of evidence-based research for clinical decision making and the practice of evidence-based dentistry, but no systematic review of dentist information-seeking behavior has been conducted. This review aimed to synthesize the best available evidence on where and how dentists seek information. A literature search of Web of Science, Scopus, PubMed, and reference lists of English language studies from the Organization for Economic Cooperation and Development countries of dentists' information-seeking behavior published between 2002 and 2014 was conducted. Selected articles were assessed using mixed methods analysis, and the data extracted were thematically synthesized. Nine studies met the inclusion criteria, and four main themes were identified: dentists' difficulty translating evidence-based resources into clinical practice; dentists' preference for face-to-face meetings, collegial discussion, and print materials over evidence-based resources; dentists' perceptions of the validity of evidence-based resources and the role of specialist and experienced dentists as information sources for general and less experienced dentists; and differences between early and late adopters of research evidence. Dentists in these studies tended to adopt new materials/techniques after discussion with a colleague, a dental specialist, or a respected dental expert. These dentists also reported lacking time, experience, skills, and confidence to find and use evidence-based resources. Many of the dentists studied were cautious about making decisions based on documentary sources like literature reviews and preferred to seek advice from an experienced or specialist colleague or to participate in face-to-face meetings.

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“Information-seeking” is defined as a process of inquiry in which people purposefully engage to change their state of knowledge.¹ Many models have attempted to map the process of information-seeking since 1993 when Ellis established one of the first models of information-seeking, expanded in research by Kulthau and Wilson into a more comprehensive model.²⁻⁴ These models have varied in their ability to explore the various variables of information source selection, levels of information need, and cycles of feedback and review and determine whether the information need has been satisfied by a search.⁵ The activity of information-seeking consists of question formulation, refining a search, and the resources or sources used, which can be people or documentary. One study also explored

the barriers to information-seeking by specific groups to develop ways to overcome these barriers.⁶

The Australian Dental Association defines evidence-based dentistry (EBD) as “an approach to health care that requires the judicious integration of systematic assessments of the best clinically relevant scientific evidence” and contends that the implementation of critically assessed data is ideally performed in partnership between dentist and patient.⁷ Both EBD and information-seeking relate to an individual's interaction with information for a specific purpose, and both incorporate feedback loops to assess the information's suitability for the information need. However, information-seeking encompasses a broader range of behavior and includes more sources than EBD, which generally refers to

the synthesis of scholarly peer-reviewed information rather than consultation with people sources.⁸⁻¹¹ As evidence-based medicine and dentistry are seen as a method of increasing the uptake of up-to-date best evidence in clinical practice, information-seeking as a distinct part of this process can offer insights into the capabilities, perceptions, and needs of dentists.

There has not been a comprehensive review of the literature on the information-seeking behavior of dentists; the articles that are available are from fields such as library and information science, dentistry, and the evidence-based movement. Although similarities exist between the information-seeking literature and EBD in regard to searching for and assessing the information, EBD includes patient feedback in that process.⁴ Overall, little is known about information-seeking behaviors of dentists.

A better understanding of the information-seeking behaviors of dentists will assist education providers, such as dental schools, in designing tertiary education programs and dental associations in developing continuing education (CE) and professional development programs. It will also help policymakers, decision support system designers, and creators of new knowledge understand the best methods of supplying accessible information that will encourage EBD. The aim of this review was to synthesize the best available recent evidence on where and how dentists seek information.

Methods

The review considered both qualitative and quantitative studies, written in English, and published between 2004 and 2014.¹² This review focused on studies in which dentists were the only group of participants and excluded studies that included dentists

as one of a larger group of practitioners. The review also sought to assess the information-seeking behavior of dentists for the purpose of making clinical decisions, not for other purposes. However, no articles were excluded on that basis that were not already excluded for other reasons. The inclusion and exclusion criteria are shown in Table 1, and categories of articles included and excluded are shown in Figure 1.

The PubMed, Scopus, and Web of Science databases were searched using Boolean operators and the following keywords: information-seeking, dentists, clinical decisions, and evidence-based. Inclusion and exclusion criteria were applied at title and abstract search levels, followed by full text analysis of those articles that met the inclusion criteria. The detailed process of applying the inclusion and exclusion criteria is shown in Figure 1. Snowballing techniques were then applied whereby the reference lists of retrieved articles were searched for other relevant citations. One reviewer conducted the search of full text articles against the inclusion and exclusion criteria, and the other reviewers assisted in the assessment of methodological quality, data extraction, and data synthesis. The quality of the articles selected for review was assessed by two authors for methodological validity using the Mixed Methods Appraisal Tool developed at McGill University in Canada.¹³ Any disagreements that arose between the reviewers were resolved through discussion or with a third reviewer.

Selected studies were classified by type of research (qualitative or quantitative study) and then assessed according to six criteria designed to assist with evaluating the methodological quality. An overall quality score for each study was calculated by dividing the number of criteria met by the total number of criteria as per the appropriate methodological quality criteria for quantitative and qualitative studies.¹⁴

Table 1. Inclusion and exclusion criteria for studies

Criterion	Inclusion	Exclusion
Time period	2004-14	Before 2004
Language	English	Non-English
Place of study	OECD countries	Developing countries
Study participants	Dentists	Dental hygienists, dental therapists, dental laboratory technicians, oral health therapists, other health care professionals
Purpose of information-seeking	Clinical decisions	Nonclinical decisions, clinical decision making without reference to information-seeking, treatment patterns, procedures, non-primary research, information retrieval; practice management, administration, or staff management or recruitment

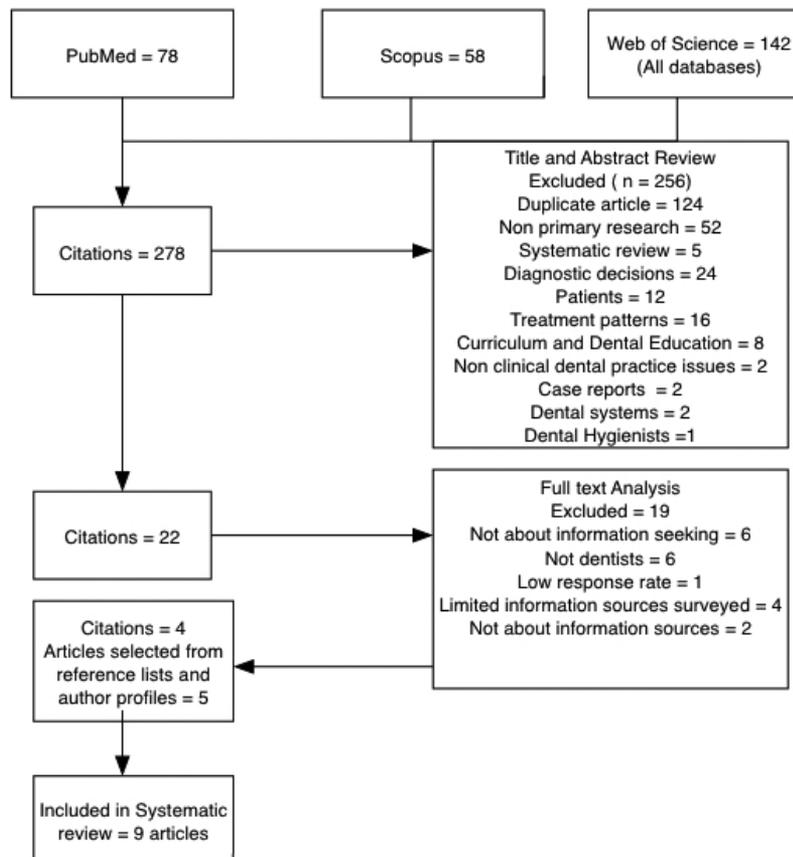


Figure 1. Search strategy for systematic review

Data extracted from the reviewed articles were the study populations, study methods, and main outcomes. The text about where and how dentists seek information was coded and concepts identified. Two authors performed the thematic analysis. For each article, all the participant quotations (qualitative studies) and text in the results and/or discussion/conclusion sections (quantitative studies) were extracted. The two authors independently coded the extracted data, categorized the codes, and generated themes. The results were compared and discussed at regular meetings involving all authors until consensus was reached.

Results

From an initial pool of 278 published articles, nine met the inclusion criteria (Table 1). The result of the review process is shown in Figure 1. The articles

were assessed for methodological quality (Table 2 and Table 3). An overview of characteristics of the studies included in the review is shown in Table 4.

Of the nine studies, six were conducted in the U.S., one was a collaboration between researchers in Denmark and the U.S., one was conducted in the U.K., and one was conducted in Turkey. Six were quantitative studies using self-administered survey questionnaires. Three studies were qualitative using focus groups, vignettes, or semi-structured interviews. Four major themes were identified (Table 5).

Translating Evidence-Based Resources into Clinical Practice

Both qualitative and quantitative studies reviewed indicated that these dentists had difficulty applying information from peer-reviewed journals, literature searches, and other evidence-based resources such as practice guidelines in their clinical

Table 2. Qualitative critical review form analysis of three studies

Critical Appraisal Checklist	Hopper et al., 2011	Landry, 2006	Song et al., 2010
1. Are there clear qualitative research questions (objectives)?	Yes	Yes	Yes
2. Are the sources of qualitative data (archives, documents, informants, observations) relevant to address the research question?	Yes	Yes	Yes
3. Is the process for analyzing the data relevant to address the research question (objective)?	Yes	Yes	Yes
4. Is appropriate consideration given to how findings relate to the context? (e.g., setting in which data were collected)	Yes	Yes	Yes
5. Is appropriate consideration given to how findings relate to the context? (e.g., setting in which data were collected)	Yes	Yes	Yes
6. Is appropriate consideration given to how findings relate to researcher's influence?	Yes	No	No
Overall quality score	1	0.83	0.83

Sources: Hopper L, Morris L, Tickle M. How primary care dentists perceive and are influenced by research. *Community Dent Oral Epidemiol* 2011;39:97-104; Landry C. Work roles, tasks, and the information behavior of dentists. *J Assoc Inf Sci Technol* 2006;57(14):1806-908; and Song M, Spallek H, Polk D. How information systems should support the information needs of general dentists in clinical settings: suggestions from a qualitative study. *BMC Med Inform Decis Making* 2010. At: www.biomedcentral.com/content/pdf/1472-6947-10-7.pdf. Accessed 16 Apr. 2015.

Table 3. Quantitative critical review form analysis of six studies

Critical Appraisal Checklist	Selvi and Ozerkan, 2002	Spallek et al., 2010	Funkhouser et al., 2012	Haj-Ali et al., 2005	Botello-Harbaum et al., 2013	Straub-Morarend et al., 2011
1. Are there clear quantitative research questions (objectives)?	Yes	Yes	Yes	Yes	Yes	Yes
2. Do the collected data address the research question?	Yes	Yes	Yes	Yes	Yes	Yes
3. Is the sampling strategy relevant to address the quantitative research question?	Yes	Yes	Yes	Yes	Yes	Yes
4. Is the sample representative of the population under study?	Yes	Yes	Yes	Yes	Yes	Yes
5. Are the measurements appropriate (standard instrument)?	Yes	Yes	Yes	Yes	Yes	Yes
6. Is there an acceptable response rate?	Unclear	Yes	Yes	Yes	Yes	No
Overall quality score	0.83	1	1	1	1	0.83

Sources: Selvi F, Ozerkan A. Information-seeking patterns of dentists in Istanbul, Turkey. *J Dent Educ* 2002;66(8):977-80; Spallek H, Song M, Polk D, et al. Barriers to implementing evidence-based clinical guidelines: a survey of early adopters. *J Evid Based Dent Pract* 2010;10(4):195-206; Funkhouser E, Agee B, Gordan E, et al. Use of online sources of information by dental practitioners: findings from the dental practice-based research network. *J Public Health Dent* 2012;74:71-9; Haj-Ali R, Walker M, Petrie A, et al. Utilization of evidence-based information resources for clinical decisions related to posterior composite restorations. *J Dent Educ* 2005;69(11):1251-6; Botello-Harbaum M, Denko C, Curro C, et al. Information-seeking behaviors of dental practitioners in three practice-based research networks. *J Dent Educ* 2013;77(2):152-60; and Straub-Morarend C, Marshall T, Holmes D, et al. Information resources utilized in clinical decision making: common practices in dentistry. *J Dent Educ* 2011;75(4):441-51.

practice.^{8,9,11,15-19} Spallek et al. found that the dentists complained that available resources usually lacked statistics about the longevity of materials, other key statistics, or detailed clinical practice guidelines, which made them difficult to use in practice.¹⁸ Dentist

participants commented that “[we need] more really proven evidence out there, simple tools for staff to use chairside”; “[peer-reviewed scientific journals are] a little bit obscure”; and “I wouldn’t have time to look at whether the right stats were being used.”^{18,19}

Table 4. Characteristics of selected studies of clinical information-seeking behaviors of dentists

First Author, Date	Information-Seeking Language Used	Setting, Number, and Type of Participants	Study Design and Analysis	Summary of Main Results/Conclusion
Botello-Harbaum, 2013	Information-seeking, information behavior, information sources	3 dental practice-based research networks (PBRNs) (U.S.); 950 dentists from various PBRNs	Quantitative study with self-reported core questionnaire; chi-square statistics	More influential information sources were face-to-face or collegial discussion. However, more frequent sources used were printed peer-reviewed journals. New information dissemination strategies need to incorporate these findings.
Funkhouser, 2012	Use of online sources of information	The dental-based practice network (U.S. and Scandinavian); 657 general dental practitioners in the network	Survey questionnaire; logistic regression models	A relatively small proportion of dentists used information online for practice guidance. Preference for face-to-face discussion about clinical topics.
Haj-Ali, 2005	Informational resource use	699 general dentists from the Academy of General Dentistry (U.S.)	Quantitative postal questionnaire; descriptive and inferential statistics	Low reliance on evidence-based information sources in clinical practice among newer graduates contrasted with greater use of evidence-based resources by more experienced clinicians.
Hopper, 2011	Use of research	Northwest of England, 24 dentists	Qualitative study with focus groups and interviews; constant comparison analysis	Evidence-based dentistry perceived as less relevant than empirical evidence. Dentists wanted concise, timely evidence-based guidance. Further research about how to develop an evidence-based research culture among primary care dentists is needed.
Landry, 2006	Information behavior, information needs	12 private practice dentists from metropolitan Tacoma and Seattle (U.S.)	Qualitative study with vignette-based interviews and follow-up interviews; thematic analysis	Dentists continued to rely on traditional sources for their authority and accessibility, but the internet's convenience and accessibility were important to dentists. Personal contact still significant factor in perceived information-seeking success.
Song, 2010	Information needs, met or unmet needs, resource use patterns	18 general dentists from Pittsburgh (U.S.)	Qualitative study; semi-structured interviews; thematic analysis with constant comparative method	Dentists' need for better visual representation and patient-specific, evidence-based information was mostly unmet. Future decision support systems should integrate up-to-date clinical evidence that is accessible and supportive of dentists' resource use patterns.
Selvi, 2002	Information-seeking patterns	133 private practice dentists in Istanbul (Turkey)	Quantitative study with self-administered questionnaire; descriptive and inferential statistics analysis	Private practice dentists preferred discussion with colleagues, print journals, and textbooks. Time constraints created difficulties in information retrieval. Turkish dentists in private practice could improve their computer literacy to resolve their professional isolation issues.
Straub-Morarend, 2011	Utilization of scientific information	518 general dental practitioners who graduated from the University of Iowa (U.S.)	Quantitative study with survey questionnaire; descriptive statistics	Dentists utilized a variety of information sources for clinical decision support, some evidence-based and others not. Newer graduates and generalists differed from specialists and experienced dentists.
Spallek, 2010	Information constraints, information for clinical decisions	43 early adopting dentists from 2008 Evidence-Based Dentistry Champion Conference (U.S.)	Qualitative survey, descriptive statistics analysis	Early adopters of EBD resources experienced barriers to clinical implementation in ways such as criticism from colleagues and difficulty in changing practice models. Issues of currency and reliability of scientific literature affected decision making.

Note: See Tables 2 and 3 for full source information on these studies.

Table 5. Number of studies in each theme

Theme	Number of Studies
Difficulty translating evidence	5
Preference for print and face-to-face	6
Validity concerns of research	5
Information diffusion between generalist and specialist/experienced dentists	6

Authors speculated that low use of some online sources related to a lack of critical ability to analyze and use evidence-based information in their practices.^{9,15,16,18} Some experienced dentists themselves found a lot of clinical guidelines relevant but lengthy to read and therefore difficult to use in their practice due to lack of time.¹⁸ The dentists also reported feeling that a lot of research was not relevant to their practice.¹⁹ Those dentists who were aware of the availability of research made comments such as “[I] need to develop a critical eye,” referring to their ability to synthesize and utilize the information they retrieved so that they could apply it in their practice.¹⁴

Preference for Meetings, Discussion, and Print Materials

Due to the difficulty of translating new research into practice, these dentists were found to have a higher preference for print textbooks, subscription journals, face-to-face discussion, meetings, and local CE than for databases and other online sources of the literature.^{1,9,11,15,16} Colleagues were often considered a better resource than the scientific literature as the practical application of knowledge could be explained in a way that was personalized.^{14,19}

Studies also found greater use of face-to-face association meetings, specific single subscription journals, and discussion with colleagues than the use of Medline or PubMed.^{1,11,15,18,19} Straub-Morarend et al. observed that reliance on other professionals, although limited, was “arguably economical and readily accessible” for dentists who have time constraints.⁹ A lack of computer literacy among dentists from both metropolitan and rural areas was noted, and some authors recommended increased literacy to resolve their isolation issues.^{1,11} In contrast to the use of people and older print resources, one study reported a low uptake of clinical decision making software by dentists.¹⁵

Validity of Evidence-Based Resources and Use of Specialists

The studies reviewed suggested that the dentists were skeptical about the authority, validity, and relevance of many evidence-based resources.^{1,9,14,15,18,19} Dentists place a high value on source validity and authority, and these studies suggested dentist mistrust of the scientific and peer-reviewed literature.^{1,9,15,18,19} Although scientific caution is possibly an aspect of dentists’ clinical process, Spallek et al. found this mistrust in scientific information to be a new finding not previously mentioned.¹⁸

In a quantitative study, Funkhouser et al. tried to distinguish between the frequency of use of an information source and its influence on the dentist’s practice and were surprised that newer graduates, whom they assumed would be more active online than their counterparts who graduated earlier, rated face-to-face CE and association meetings as more influential than online courses.¹⁶ Hopper et al. found that this mistrust of evidence-based guidelines came from the need for an outside assessment of the data, so that the dentists could be advised since, as one said, “I wouldn’t have time to look at whether the right stats were being used.”¹⁹ Botello-Harbaum et al. acknowledged that this suspicion about whether a source was reliable or authoritative explained why the dentists preferred to attend face-to-face CE meetings since “speakers are often recognized as authorities in their field, prompting a greater level of trust in their information.”²¹

Early Versus Late Adopters

Five studies noted a distinction between early adopters of newer research evidence published in peer-reviewed databases and journals and late adopters who tended to consult experts and preferred to read trade and local journals regularly for their clinical practice decisions.^{1,14,15,18,19} Late adopters waited for a “large body of evidence” to compel them to change their clinical practice methods, especially if they perceived their current methods as effective.¹⁹ Subjects commented that research did not always yield the clinical results they promised, possibly due to time constraints in general practice.¹⁹ The combination of reliable and easily used data was difficult to find, even by the expert dentists, since often detailed and valid statistics were available yet were considered too complex. This could explain the need

for further consultation with a dentist perceived as experienced and authoritative for decision making.¹⁸

Hopper et al. described the group of later adopters as “not reflective,” meaning that although they read journals, they were reluctant to apply what they read to their practice.¹⁹ Some general dentists in that study noted that they would ask for help from dentists who were interested in research or were early adopters, who would then feed the information to the other dentists. One specialist dentist in a different study mentioned that he was “someone that people would go to for information” and that he often contacted other specialists for information.¹⁴ Specialists, due to their greater experience and training, often showed a preference for seeking their clinical practice information in scientific peer-reviewed sources over general dentists who preferred to seek it from specialists. Hopper et al. noted that the difference between early adopters and later adopters was that the early adopters operated as information diffusers of the latest, most valid, and most reliable information, often in the face of criticism and resistance from other more cautious dentists or practice managers.¹⁹

Discussion

This systematic literature review found that the way in which dentists are urged to search for information differs from the way they actually search. The NHMRC hierarchy of evidence pyramid recommends that dentists consult first systematic reviews and randomized controlled trials, followed by pseudo-randomized controlled trials, cohort studies, and case controlled studies, and lastly comparative studies and case studies. Expert opinion does not feature in the pyramid, but if it were at the bottom and the pyramid were turned upside down, it would match more accurately the way in which these dentists actually searched for information.²⁰

Our findings about the dentists’ difficulty in utilizing and applying best quality up-to-date evidence need to be further investigated to better understand their causes. If these causes could be identified, they would contribute to education designs that could improve the uptake of EBD. This would particularly benefit solo, isolated, and rural dentists who have less frequent access to training and collegial support for their information-seeking. The studies reviewed suggested that the participating dentists either lacked the computer or critical literacy to discern the appro-

priate information or lacked the ability to synthesize it for clinical application.^{1,9,14,15,18,19} These issues of knowledge translation, skepticism about source validity, and alternate source-seeking could be resolved through more strategic dissemination strategies to reach dentists in clinical practice.

Lack of appropriate dissemination systems and networks could also contribute to these dentists’ preference for face-to-face communication despite the availability of large quantities of quality information. The evidence of dentists’ frequent use of collegial communication could suggest that formalized networks be developed to take advantage of this information-seeking behavior. Formalized networks such as these could increase uptake of evidence-based information and allow specialists to serve as experts on specific procedures to the benefit of less experienced dentists in the profession.

Leckie et al.’s model of information-seeking proposed that all professionals look for relevance, reliability, and accessibility in an information source, but that accessibility was the most significant factor.⁶ Given that many dentists work alone or have high patient quotas, the importance of accessibility for information source selection may influence their preferences for print journals and textbooks, visual resources, and face-to-face consultation with a colleague. When translating information sources into practice, some dentists complained that the information they required was not yet available, took too long to read, or that they preferred a verbal interchange with a well-known expert.^{1,9,14,15,18,19} These issues relate to Leckie et al.’s concept of relevance.⁶ A perception of prior success with an information source created a sense of reliability and accessibility related to how usable the information was. The question of reliability and accessibility begs the question as to whether there are issues with the dentist’s skill or training or shortcomings with the data available.

The situation of experienced or specialist dentists who provide a dissemination service to less experienced and general dentists requires further examination. Hertzum, an information scientist, studied the act of “expert-seeking” among professionals from many fields, exploring the context in which professionals seek people as information sources over documentary sources such as databases.²¹ He posited a theory of high and low information needs in which high information needs were related to “process, opinion, and decision making” and people sources were more appropriate for those higher needs. This

theory is consistent with Kulthau's theory of high and low information needs.³ It is possible that dentists seek information from people sources when their information needs are higher than on other occasions when they access documentary sources. Hertzum's review could inform a future study in which the reasons for dentists' seeking information from more experienced people sources are explored.

The correlation between the number of years since dentists' graduation and their use of non-evidence-based print, face-to-face training, and discussion with colleagues was a surprising result.^{14,18} One would expect newer graduates, being more computer-savvy, to be greater users of evidence-based information such as peer-reviewed materials in electronic databases than dentists who graduated earlier. This correlation between earlier dental school graduation date and information and critical literacies requires further research to ascertain why apparently older dentists seek information more easily than more recent graduates.

Also important are the critical literacies to interpret and assess relevance for an information need. Levine et al. documented an interdisciplinary course about information resource use in conjunction with EBD and performed a review of the literature that revealed a lot of dental schools failed to teach the ability to conduct critical appraisals of the best available evidence.¹⁰ However, Hopper et al.'s study stressed the importance of clinical experience and "pattern recognition" for effective clinical outcomes, which is a separate skill to finding and analyzing the best evidence for clinical use.¹⁹ There is a need for further research aimed at understanding the preferred source selection and information-seeking habits of dentists in order to assist dental practitioners and education providers such as dental schools and dental associations in providing CE training and continuing professional development in a fashion that is most suitable for dental practitioners.

To further explore the concept of information diffusion channels, McGlone et al. noted that the method of information diffusion in dental education was critical, particularly if the desired outcome of the education was to result in changed clinical practice.²² The education of dentists in the use of new materials was more effective when the form of education dentists received was hands-on although further research is required to ascertain what kinds of education lead to changes in clinical practice.

There are three essential areas for further research: explore the computer, critical, and information literacy of dentists; explore the design, relevance, and accessibility of evidence-based documentary sources such as systematic reviews or procedural guidelines; and explore the efficacy of the dissemination of new research through formal tertiary and CE in comparison with informal information-seeking between dental colleagues. A study could be conducted on these aspects of information-seeking, surveying a broad range of dentists across rural and metropolitan areas, public and private practice, and primary and specialist care.

Limitations of this study were that the grey literature was not included and that no distinction could be drawn in several of the studies between clinical information-seeking and non-clinical information-seeking, as some of the quantitative studies did not incorporate it into the survey design. Grey literature refers to unpublished research or research that has been published in non-commercial form, such as government reports, conference proceedings, news and bulletins, and research reports. Some useful information on our topic may have been available in these sources.

Conclusion

Many of the dentists studied in the reviewed articles were cautious about making clinical decisions based on documentary sources like literature reviews and preferred to seek an experienced colleague or attend face-to-face meetings. The reasons for this could relate to the quality of evidence-based information available for dentists; time constraints in a busy dental practice; abilities or lack thereof regarding critical thinking, information-seeking, and synthesization among dentists in different contexts; or current dissemination strategies used to distribute current best evidence recommended for dental practice.

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