Knowledge, Attitudes and Practices of Dental Hygienists Regarding Caries Management by Risk Assessment

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Abstract

Purpose: The purpose of this study was to survey dental hygienists to determine their knowledge, attitudes and practices regarding the implementation of caries risk assessment, particularly caries management by risk assessment (CAMBRA), in private dental practices.

Methods: A 17 item survey was developed to evaluate dental hygienists' knowledge, attitudes and practices related to CAMBRA and perceived barriers to CAMBRA implementation in private dental practice. Surveys were mailed to a randomized sample of 1,000 dental hygienists licensed to practice in California. Responses were tabulated for each respondent, and the response frequency for each survey item was calculated. Respondents' comments to the open-ended question were compiled, according to themes.

Results: The response rate was 18%. Only 66% of the respondents were familiar with the term CAMBRA, although 89% agreed with its underlying principles of risk assessment. CAMBRA protocol had been implemented in 40% of the respondents' employment sites. Respondents disagreed that time (45%) and cost of products (68%) were barriers to implementation. Many did not know their employers' knowledge or attitudes about CAMBRA and its implementation, as evidenced by a "don't know" response range of 29 to 48% for the 4 relevant statements. Respondents' comments included both successes and barriers implementing CAMBRA.

Conclusion: CAMBRA protocol has not been widely implemented in private practice, although the current data do not indicate insurmountable barriers. Broader dissemination may be feasible if dental hygienists would obtain more comprehensive knowledge of evidence-based risk assessment protocols and would assume a leadership role in implementing CAMBRA protocols and procedures in private dental practices.

Keywords: caries management by risk assessment, dental caries prevention and control, dental hygienist, risk assessment

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Introduction

Dental caries is still one of the most prevalent chronic diseases in the U.S.[1] According to the National Health and Nutrition Examination Survey 2004, 92% of adults age 20 to 64 have experienced dental caries in their permanent teeth.[2] The Centers for Disease Control and Prevention currently report that over 19% of children ages 2 through 19 years have untreated dental caries.[3] Dental caries continue to pose a substantial problem despite the continual development of new means to prevent and treat the caries process.

The most recent attempt to control dental disease is to assess caries risk factors and manage caries, based on preventive and curative clinical procedures. One protocol, termed Caries Management by Risk Assessment (CAMBRA), is an evidence-based approach to preventing, reversing and, when necessary, repairing early damage to teeth.[4-7] The practice of CAMBRA involves calculating the patient's risk factors for caries development, and prescribing preventive treatment based on risk levels categorized as low, moderate, high or extreme caries risk.[8,9] The protocol includes obtaining information about the patient by means of a questionnaire, intraoral examination, dental radiographs and other tests, that can be performed by a licensed oral health care provider such as the dental hygienist. As a preventive oral health care specialist, the dental hygienist is the ideal provider to perform much of CAMBRA protocol.[7,10-13]

CAMBRA has been shown to reduce caries risk, as was suggested in a 2 year clinical trial of anticaries, therapies targeted according to risk assessment.[14] Furthermore, it has been suggested that CAMBRA would be economically viable in private practice.[13,15]

While following CAMBRA protocol in clinical dental care has shown promise in reducing caries risk, implementation in private practice has met resistance.[16-18] Performing some type of caries risk as-

sessment has been more widely adopted than implementing CAMBRA protocol that includes using a special form, documenting the outcomes and providing an individualized caries management plan, based on the patient's caries risk status.[18-20]

Reasons for this lack of CAMBRA implementation have not been well documented. However, discussions in current literature and anecdotal comments suggest the involvement of multiple barriers.[21,22] Dental hygienists are in a good position to recognize these barriers, as they are usually the dental personnel who implement preventive protocols. Their perceptions may shed light on why CAMBRA has not been more widely adopted in private practice.

The purpose of this study is to survey dental hygienists to determine their knowledge, attitudes and practices regarding the implementation of caries risk assessment, particularly CAMBRA, in private dental practices.

Methods and Materials

This prospective, cross-sectional study was approved by the institutional review board of the University of California, San Francisco. The study population consisted of dental hygienists licensed, and in good standing, to practice in California from 1972 to present. A randomized sample of 1,000 subjects was selected from a population of 15,320 by a computerized randomization process performed by R&D Data Corporation. This private company brokers files of names, license numbers and addresses of individuals licensed through the California Department of Consumer Affairs. Assuming a 40% response rate, a sample size of 400 respondents was statistically determined, based on the expectation that 50% of the dental hygienists would not have familiarity with CAMBRA, and using a confidence level of 95% with a total width of 0.10 (+0.05). For recruitment mailing addresses of the subjects were also obtained from the R&D Data Corporation.

The 17 item survey, evaluating dental hygienists' knowledge, attitudes and practices related to CAMBRA, was composed of 1 item on CAMBRA familiarity (yes/no response option), 11 items on CAMBRA concepts and implementation (4 point Likert-type response options ranging from strongly agree to strongly disagree, plus don't know), 1 open-ended item about barriers/facilitators related to CAMBRA implementation in the respondents' practice settings and 4 demographic items. The survey was pretested on a convenience sample of 5 practicing dental hygienists for clarity of content. Modifications were made to improve comprehension of questions.

After survey pretesting and refinement, the survey was mailed to the 1,000 randomly selected California-licensed dental hygienists along with a recruitment cover letter, a letter of consent explaining the study purpose, risks and benefits, and a self-addressed, postage-paid return envelope. Return of the survey indicated consent to participate in the study. Surveys were coded to ensure subject confidentiality, while permitting follow-up of non-respondents. Follow-up mailings were sent to non-respondents 3 weeks following the initial mailing.

Responses to the surveys were tabulated for each respondent, using Microsoft Excel, and the response frequency for each survey item was calculated. Some items were examined in terms of the respondents' familiarity with CAMBRA. Comments from respondents to the open-ended question were compiled, according to themes.

Results

Two mailings of the survey resulted in a response rate of 18% (178 respondents). Of the 178 respondents, 173 completed the survey and only their responses were included in the analysis.

Demographic Characteristics

Most of the respondents reported that they were employed in general practice, but over half were employed $\leq$30 hours per week (Table I). A small percentage was not practicing, and 35% were members of the American Dental Hygienists' Association (ADHA). The respondents' years of graduation were distributed similarly in intervals from 1972 to present.

Of the 173 respondents, 66% reported that they were familiar with the term CAMBRA. Examining the demographic characteristics of the respondents on the basis of their familiarity with CAMBRA provided additional information (Table II). The majority of ADHA members, those currently working, and those having graduated within the past 20 years, were familiar with CAMBRA.

Knowledge, Attitudes and Implementation

Respondents rated their level of agreement with statements addressing various aspects of caries risk assessment and CAMBRA (Table III). Most of the respondents agreed that "assessment of caries risk for a patient can predict whether or not that

Table I: Demographic Characteristics of Respondents (n=173)

	Percent
Practice Characteristic*	
General dental practice	91%
Pediatric dental practice	7%
Other specialty practice	14%
Public health dental hygiene	4%
Year of Graduation from Dental Hygiene Program**	
2005 or later	23%
1994-2004	27%
1983-1993	20%
1972-1982	29%
Hours practicing dental hygiene per week**	
Greater than 30 hours	36%
Less than or equal to 30 hours	57%
Currently not practicing	8%
ADHA Member	
Yes	35%
No	65%

*Respondents allowed to select more than one response
**Percentages may not equal 100 due to rounding of numbers

Table II: Familiarity with CAMBRA Based on Demographic Characteristics

Demographic Characteristic	Total number of respondents (n)	Respondents familiar with CAMBRA (n) (Percent*)
All Respondents	173	114 (66%)
ADHA Member	59	47 (80%)
Full time (>30 hours/ week)	13	5 (38%)
Part time (<30 hours/ week)	98	62 (63%)
Not currently working	62	47 (76%)
Graduated from dental hygiene program: 2005 or later	40	32 (80%)
Graduated from dental hygiene program: 1994 to 2004	46	33 (72%)
Graduated from dental hygiene program: 1983 to 1993	35	19 (54%)
Graduated from dental hygiene program: 1972 to 1982	49	28 (57%)

*Percentage of the "CAMBRA-familiar" respondents, based on the total number of respondents for the specific demographic characteristic.

patient develops caries in the future," but only 70% agreed that "CAMBRA improves caries prevention in clinical dental practice." Among the respondents who reported familiarity with the term CAMBRA, the percentage that agreed with the above statement was higher (81%). Very few of the respondents disagreed that "the dental hygienist would be an ideal candidate for implementation of CAMBRA."

Respondents rated their level of agreement with statements describing the extent of implementation of CAMBRA or other caries risk assessment in the practice in which they worked the greatest amount of time (Table IV). Fewer than half reported that the office followed CAMBRA protocol. Two-thirds of all respondents reported that they assess caries risk, but in a form other than that of CAMBRA.

Barriers to CAMBRA Implementation

More respondents disagreed than agreed with the barriers to CAMBRA implementation, which were listed in the survey (Table III). Less than one-third of the total respondents agreed that there was not enough time during a dental hygiene appointment to include CAMBRA. Of those familiar with CAMBRA, 36% agreed and 51% disagreed that CAMBRA would pose a time barrier. Nearly one-quarter of all respondents did not know whether CAMBRA protocol would pose a time barrier. Only 25% of the total respondents agreed with the statement that: "most patients would not accept the cost of prescription dentifrices or other out-of-pocket expenses."

Most respondents disagreed with the listed barriers that were related to their employers' opinions (Table III). Few respondents agreed with the statements that their employer was not familiar with CAMBRA, was interested in CAMBRA but did not know how to implement it, and was not convinced that CAMBRA would reduce risk of caries. Also, very few reported that their employer believed that "CAMBRA will reduce profitability of restorative work". To note, 29 to 48% of all the respondents reported that they did not know their employers' knowledge or attitudes regarding CAMBRA. Respondents familiar with CAMBRA reported lower percentages (21% to 36%) of not knowing their

Table III: Respondents' Attitudes Rregarding CAMBRA

Dental hygienists' attitudes regarding CAMBRA	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
Assessment of caries risk for a patient can predict whether or not that patient develops caries in the future (n=171)	34%	55%	6%	0%	5%
CAMBRA improves caries prevention in clinical dental practice (n=171)	30%	40%	3%	0%	27%
The dental hygienist would be an ideal candidate for implementation of CAMBRA (n=171)	40%	43%	5%	<1%	12%
There is not enough time during a dental hygiene appointment to include CAMBRA (n=161)	7%	22%	34%	11%	26%
Most patients would not accept the costs of prescription dentifrices or other out-of-pocket expenses (n=166)	4%	21%	55%	13%	8%
My employer is not familiar with CAMBRA (n=165)	8%	15%	32%	16%	29%
My employer is interested in CAMBRA but does not know how to implement it (n=164)	1%	9%	34%	14%	42%
My employer is not convinced that following CAMBRA protocol is effective at reducing risk of caries (n=166)	2%	7%	27%	14%	48%
My employer believes that CAMBRA will reduce profitability of restorative work (n=165)	3%	4%	34%	20%	39%

Percentages may not equal 100 due to rounding of numbers.

employer's knowledge and attitudes (i.e., more respondents knew their employer's knowledge and attitudes).

Respondents' Comments on Successes and Barriers

In this study, 39% of the total respondents answered the open-ended question: "Please explain or include additional information about any barriers or successes you have encountered practicing or implementing CAMBRA." Twenty respondents reported success with CAMBRA. Following are representative examples of their responses:

- "…patients have really embraced our caries-prevention program and do not seem deterred by the out-of-pocket expense for products."
- "Education and communication with my patients has been a key component of CAMBRA success."
- "I had great success implementing CAMBRA into my practice. It was well received by all my patients."

The respondents' expressions of challenges to CAMBRA implementation have been organized according to 5 themes. The numbers of respondents with responses related to that theme and representative responses are listed below:

1. Lack of internal support (n=19): "Getting the whole team on board has been a barrier…I'm trying to change that." "Mainly there is… a team-work barrier."
2. Lack of communication with employer/dentist (n=11): "Never worked (34 years) in an office that mentioned CAMBRA." "We have not discussed CAMBRA in our office, I really don't know if the dentist is familiar with it or if he feels it is not effective."
3. Lack of patient acceptance or compliance and confusion with products (n=10): "We have purchased products and weren't very successful with compliance from our patients." "Barriers are patient compliance and follow-through."
4. Time (n=8): "Time is our biggest challenge." "Having the time during the already busy hygiene schedule."
5. Cost (n=8): "The cost was a big deterrent." "The biggest issue for our patients are cost and compliance." "The only barrier that I encountered was the price…It was not affordable for every patient to use and see the benefit."

Discussion

This study surveyed dental hygienists to determine their knowledge, attitudes and practices regarding the implementation of caries risk assessment, particularly CAMBRA, in private dental

Table IV: Caries Risk Assessment Practices In Private Dental Offices of Respondent

	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
Our office follows CAMBRA protocol (n=168)	12%	30%	36%	6%	16%
Our office assesses caries risk, but in a form other than that of CAMBRA (n=165)	10%	57%	21%	5%	7%

practices. The results indicated that only two-thirds of the respondents were familiar with the term CAMBRA, although most agreed with its underlying principles of caries risk assessment. CAMBRA protocol had been implemented in only 40% of the respondents' dental offices. Most respondents did not agree that time and cost of products were barriers to implementation, and many were not aware of their employers' knowledge or attitudes about CAMBRA and its implementation.

CAMBRA protocol was not widely known among the respondents, as approximately one-third of them reported no familiarity with the term CAMBRA. However, most of the respondents, who were ADHA members, were familiar with CAMBRA. The authors speculate that these ADHA members may be more likely to perceive dental hygiene in terms of the professional model, which was described by Darby and Walsh.[23] Relevant examples of this model are that dental hygiene actions are knowledge based, and the dental hygienist implements self-generated preventive care regimens. Accordingly, these dental hygienists would be interested in furthering their knowledge of evidence-based preventive care, such as CAMBRA. Furthermore, as ADHA members, they may have greater opportunities to attend ADHA component and national meetings, to read the Journal of Dental Hygiene and Access, and to receive information about continuing education courses. Most of the respondents who had graduated in recent years were also familiar with CAMBRA. They probably would have been introduced to CAMBRA or some other form of caries risk assessment in their dental hygiene educational programs.

CAMBRA is one of several recognized caries risk assessments. Other caries risk assessment systems include the Caries Risk Assessment Tool (CAT), proposed by the American Academy of Pediatric Dentistry (AAPD)[24] and designed for infants, children and adolescents; the American Dental Association (ADA) caries risk assessment forms;[25] and the Cariogram™, which uses computer software to display a graphical representation of an individual's caries risk.[26]

In this study, more than half of the respondents reported that their office is assessing caries risk in a form other than that of CAMBRA. It is unknown whether they are using one of the previously described protocols or informal judgment, based on clinical expertise and experience. One might also speculate that they may be using an abbreviated form of CAMBRA, or some, but not all, of CAMBRA protocol. According to the findings of the U.S. Dental Practice-Based Research Network, 69% of the surveyed dentists assess caries risk for individual patients in some way, but of those 69%, only 17% use a special form.[19] Another U.S. survey found that 72% of the responding dentists performed some type of caries-risk assessment, but only 27% documented the outcome and only 51% provided a management plan based on the patient's risk status.[20] These studies illustrate how dental practices are using elements, but not all aspects, of the CAMBRA protocol. Reports of CAMBRA demonstration projects have stated that CAMBRA protocol had to be modified to meet the specific needs of the practices.[21] These modifications to CAMBRA have been aimed at reducing cost to patients, enhancing patient compliance and improving efficiency of procedures.[13,20]

Respondents may have had varied interpretations of the phrase, following CAMBRA protocol. Reports in the literature have described a variety of instructional guidelines for implementing CAMBRA procedures in clinical dental practice.[5-12,16] The original practice of CAMBRA requires the oral health practitioner to follow a prescribed form, which allows the practitioner to categorize a patient's caries risk status based on disease indicators, risk factors and protective factors.[8,9] These formalized assessment tools assure that caries risk assessment is not subjective and dependent on possibly limited knowledge and skill level of the practitioner.[22] Prescribed guidelines have been used by predoctoral students, as they were being taught the protocols of the CAMBRA-based risk assessment in order to standardize patients' caries risk in an educational setting.[16,20,27,28]

Practical barriers to CAMBRA implementation, which have been suggested in the literature, include time to complete the multiple steps of CAMBRA protocol, and cost to the patient of caries-prevention products.[17,21,22] Agreement was mixed among respondents in this study regarding whether CAMBRA poses a time barrier in dental prac-

tice. The percentage of respondents, familiar with CAMBRA, who agreed there was a time barrier, was more than the percentage of the total respondents. However, it was surprising that approximately half of those familiar seemed to disagree. Perhaps, for these respondents, some tasks, such as administering the questionnaire or testing salivary bacterial challenge, were performed by other staff members. More likely, the respondents may have been using an abbreviated form of CAMBRA protocol.

More than half of the respondents felt that cost to the patient was not a barrier to CAMBRA implementation. Comments of several respondents supported these data. On the other hand, almost one-third did agree that the expense of the products would affect implementation. The details of the dental practices, where respondents are employed, are unknown; this latter group of respondents may be serving patients of lower economic status. In general, lower socio-economic individuals have the highest caries risk and incidence, and would benefit greatly from CAMBRA. However, they would most likely experience a financial burden with this protocol. A limitation of this study is the failure to include in the survey questions regarding the economic status of the respondents' patient population, such as the percentage of Medicaid-covered patients. These data may have offered interesting insight into the feasibility of CAMBRA implementation.

The products are expensive, relative to the traditional oral care products. Fluoride dentifrices that contain 1.1% fluoride cost 3 to 4 times greater than over-the-counter dentifrices. Xylitol-containing lozenges or gums, when used at the recommended dose of 6 grams per day,[29] would cost approximately 1 to 3 dollars per day. Chlorhexidine rinse, prescribed for daily use 1 week per month,[29] is sold in pharmacies for 3-times the cost of traditional mouth rinses. The authors speculate another reason why the preventive products may impede CAMBRA implementation might be patients' confusion by the number of products and associated instructions.

The majority of respondents did not consider their employers to be substantial barriers due to the employers' lack of knowledge of CAMBRA and acceptance of its effectiveness, or due to the financial impact on the practice. However, a surprising percentage of respondents did not know their employer's knowledge and attitudes about CAMBRA. This suggests a lack of communication about preventive treatment philosophies between the dental hygienists and the dentist(s) with whom they work. Respondents who were familiar with CAMBRA appeared to know more about their employers' knowledge and attitudes than those unfamiliar. This finding may reflect better communication in general between this group of respondents and their employers.

In spite of the respondents' limited knowledge of employer's opinions, the majority of them disagreed that their employers believed that following CAMBRA protocol would reduce the profitability of restorative work. This finding seems to indicate that these respondents have confidence in their employers' rationale regarding the patients' needs for restorative care. Reduction in profitability of restorative work might not necessarily be considered a negative aspect. Preventive procedures and minimally invasive restorative techniques could generate profit in private dental practice, as well as develop a large base of patients, who are satisfied with their preventive care.[13,15,16] Recent developments in insurance codes for CAMBRA-associated procedures may provide the practitioner with reasonable financial impetus for this increased focus on preventive care.[30]

The most frequent barriers reported in open-ended questions were the lack of communication with and support from their employers and other staff members. Many of these respondents indicated that they were challenged with lack of support and collaboration when attempting to adopt more proactive preventive protocols. This perceived lack of support may be another reason why implementation of CAMBRA into private dental practices is limited. In order to implement such a protocol into an already busy and established routine, complete understanding and strong support of CAMBRA and the prevention-oriented treatment model by all team members are essential.[16]

While these results provide useful information about dental hygienists' knowledge, attitudes and practices regarding CAMBRA, there are limitations to this study. A low (18%) response rate was obtained, and inherent with a low response rate is the lack of knowledge of the non-respondents. In this study the non-respondents may have been those dental hygienists who were not familiar with CAMBRA or other caries risk assessments. They may have chosen not to participate because of their lack of knowledge or interest. Thus, the number of dental hygienists familiar with CAMBRA in this study may have been greater than in the general population of dental hygienists, thereby creating a response bias.

Another limitation to the results may be the unforeseen ambiguity of terminology. The interpre-

tation of the phrase and familiarity with CAMBRA may have varied among the respondents, from recognition of the phrase to knowing all aspects of CAMBRA procedures. Also, the phrase and extent of CAMBRA implementation may have had differing meanings to respondents, from simply recommending patients to use preventive products, to performing all details of CAMBRA protocol. While these data create a challenge for the investigators to interpret, comments to the open-ended question often clarified the respondents' interpretation of these terms.

Conclusion

Results of this study indicate that CAMBRA was not widely known among respondents. To provide optimal oral preventive care, dental hygienists need to have comprehensive knowledge about evidence-based risk assessment protocols, such as CAMBRA. They could obtain this information by attending continuing education courses or meetings of the dental hygiene association or by reading journal articles on the topic. Many dental hygiene educational programs are incorporating CAMBRA theory and protocols into their curriculum so future dental hygiene graduates hopefully will be better informed.

The reasons why more dental offices have not implemented CAMBRA into their practices are still unclear. Most respondents did not agree that time, cost of products, and their employers' knowledge and attitudes about CAMBRA and its implementation were barriers. Without significant barriers, implementing CAMBRA would be feasible but a leader would be needed to develop and establish protocols and procedures. Dental hygienists need to assume this leadership role. As indicated by the majority of our respondents, the dental hygienist would be the ideal candidate to implement CAMBRA protocols and procedures in private dental practices.

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