

Caries Management by Risk Assessment vs. Traditional Preventive Strategies:

Effect on Oral Health Behaviors and Caries Diagnoses

A study to determine whether a caries management by risk assessment tool vs. traditional oral health education improves oral health behaviors, reduces caries risk and results in less caries diagnoses over time.

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ABSTRACT

Objective: To determine whether a caries management by risk assessment (CAMBRA) tool improves oral self-care behaviors and decreases caries diagnoses as compared to traditional oral health education strategies.

Methods: Patient records using inclusion/exclusion parameters were queried in the School of Dentistry's (SOD) electronic health record database. Records from patient visits to the dental hygiene clinic during 2010-2011 comprised the control group, as CAMBRA was not in use at this time. The test group was comprised of patient records from 2012-2016, as CAMBRA protocols were implemented in 2012. Plaque index scores and caries diagnoses across visits were compared between test and control groups. Changes in protective factors and risk factors as noted in CAMBRA were recorded for the test group.

Results: One hundred subjects were in the control group and 107 were in the test group. In both groups, at least 50% of the patients presented with active caries at visit one. Patients in the test group had statistically significant lower plaque scores and improved their oral self-care behaviors. Differences in new caries diagnoses at the last visit were not statistically significant between groups.

Conclusion: Patients with a CAMBRA lowered their caries risk as evidenced by lower plaque index scores and an increase in oral self-care behaviors favoring health. The percentage of patients with a new caries diagnosis at the last visit was lower for the test group, but not at a level of statistical significance. Caries management by risk assessment was more effective in lowering caries risk and changing oral self-care behaviors than traditional caries preventive strategies.

Keywords

Dental caries, caries management by risk assessment, oral health education

Introduction

Dental caries is a multifactorial disease that begins with microbiological shifts within the complex biofilm and is affected by salivary flow and composition, exposure to fluoride, consumption of dietary sugars, as well as preventive oral behaviors¹⁻⁵. Traditionally, caries preventive strategies have focused on providing oral health education and brushing and flossing demonstrations⁶. Assessment of caries risk has not been part of this traditional strategy of prevention. Current scientific evidence has shown the success to caries prevention and management lies with altering the complex dental biofilm and modifying oral factors to improve health. A validated tool that was created to represent the multifactorial nature of dental caries disease is caries management by risk assessment (CAMBRA), as it emphasizes the balance between pathological and protective factors in the caries process^{3,5,7-9}. CAMBRA identifies pathological factors as poor oral self-care practices, frequency of carbohydrate intake suboptimal fluoride exposure, cariogenic bacteria, and a history of caries⁸. Protective factors include optimal fluoride exposure, dietary control of sucrose and good oral hygiene habits⁸. A growing body of evidence suggests CAMBRA can lower caries risk by altering the balance between protective and pathological factors^{7,10}.

Using CAMBRA, a dental provider gathers specific oral health and behavioral information from a patient, evaluates the balance of pathological and protective factors and categorizes a patient's risk for future disease⁸. CAMBRA results serve as a springboard for a discussion between a provider and patient about caries risk, modification of protective and pathological factors, as well as the patient's motivation to change behavior¹¹⁻¹⁸.

In recent years, several studies have shown the use of CAMBRA results in lowering a patient's caries risk category over time^{8,13,18}. In a retrospective experimental study by Featherstone, et al., the investigators compared three groups of high caries risk patients that either: 1) never received the anticaries products, 2) took the products once and never returned for refills and, 3) took the anticaries products and returned for at least one more refill. After 18 months, statistical significance in caries increments between groups was demonstrated⁸. Findings from this study suggest using a CAMBRA tool, which includes the preventive regimen may lower caries risk over time. Findings from a practice-based clinical setting showed similar evidence that CAMBRA lowers caries risk by addressing protective and pathological factors¹⁸. To date, there is insufficient evidence to conclusively state that the use of CAMBRA reduces caries risk or lowers number of caries diagnoses vs. traditional oral health education strategies. More evidence is needed about the efficacy of the CAMBRA tool to modify caries risk factors to favor health and reduce caries diagnoses. Therefore, the purpose of this study was to determine if using a caries risk assessment tool reduces caries risk and lower caries diagnoses vs. using traditional oral health education.

Research Questions:

1. For a patient with active caries, does the use of caries management by risk assessment (CAMBRA), as compared to traditional oral health education result in a decrease of new caries lesions?
2. For a patient with active caries, does the use of a caries management by risk assessment (CAMBRA) tool when compared to traditional oral health education improve oral health behaviors as measured by plaque scores?

Hypotheses:

1. There is no difference in new caries diagnosis for patients that have undergone caries management by risk assessment vs. patients who have not undergone risk assessment.
2. There is no difference in oral health behaviors for patients that have undergone caries management by risk assessment vs. patients who have not undergone risk assessment.

Study population and methodology

This study used a retrospective, experimental design. A sample consisting of 207 patient records from the SOD dental hygiene clinic were screened for inclusion and exclusion criteria. Inclusion criteria for the test group included patients eighteen years of age or older with their first visit to the SOD's dental hygiene clinic between 2012-2016, two or more dental hygiene clinic visits and two or more completions of CAMBRA. Inclusion criteria for the control group included patients eighteen years of age or older with their first visit to SOD dental hygiene clinic between years 2010-2011, no record of CAMBRA completion, and two or more dental hygiene clinic visits. Exclusion criteria included patient's age less than eighteen years old, less than two dental hygiene visits total or less than two dental hygiene visits with recorded CAMBRA scores, or less than two recorded plaque scores. Prior to the implementation of CAMBRA in 2012, students provided traditional oral health education including brushing and flossing demonstration. In 2012, CAMBRA protocols were implemented in the dental hygiene clinic.

Patient records using inclusion/exclusion criteria were queried in the SOD's electronic health record database. Using the CAMBRA form, the blinded primary investigator recorded any change in the following protective and/or pathological risk factors for the test group at the first, second and last patient visits of the study period: visible heavy plaque on teeth, drinks fluorinated water from municipal supply, fluoride toothpaste at least once a day, fluoride toothpaste at least 2xday, fluoride mouth rinse (0.05%NaF) daily, 5000 ppm F fluoride toothpaste daily, and chlorhexidine prescribed/used one week each of last 6 months. Additionally, plaque scores using the Silness and Loe plaque index(PI) were obtained and recorded as low, moderate or high¹⁹. The literature supports the use of the PI as an outcome measure to assess oral self-care behaviors^{5,7,20}. Changes in caries status, new caries diagnoses and

plaque score for both the test and control groups were recorded using a standard form. Additionally, patient's gender, age and dental insurance type were recorded for both the test and control groups (see appendix A). To ensure consistency in recording, only the primary investigator performed the data collection. The study took place at the University of Minnesota School of Dentistry (SOD) during October 2017 and January 2018.

Fisher's exact tests were used to compare new caries diagnoses, caries status, oral health behaviors, and plaque score outcomes between the two groups at the first, second and last patient visits. In addition, generalized estimating equations (GEE) models for binary or ordinal data were used to compare the outcomes between the groups across all visits. These models were adjusted for age, gender, insurance status, and time from first visit. GEE models were used because the number of visits an individual patient has are potentially correlated. P-values less than 0.05 were considered significant. SAS V9.3 (SAS Institute Inc., Cary, NC) was used for the analysis. This study was approved by the University of Minnesota and was determined by the IRB to be exempt (IRB #00000159).

Operational Definitions

Traditional oral health education: providing a patient with information about dental disease processes, toothbrushing and/or flossing demonstrations and recommendations for changing behaviors.

Results

A total of 207 patients (n=207) comprised the study sample. One hundred records comprised the control group and one hundred and seven comprised the test group. Table 1 shows patient demographics. The control and test groups were fairly homogenous with regard to gender, age and type of dental insurance (See Table 1). In both the control and test groups, at

least 50% of the patients presented with active caries at visit one (See Table 3). Not all patients had the same number of visits during the study, but all patients had at least 2 visits over the course of one year. The total number of visits ranged from two to eleven, however, after visit five, the number of CAMBRA forms were inconsistent and infrequent in the dental record, therefore there was not sufficient data to report mean totals after visit five.

Dental records showed patients who completed CAMBRA improved their oral self-care behaviors. Plaque scores in the test group decreased and scores were statistically significant between groups at the last visit (p -value=0.0442). However, differences in new caries diagnosis were not statistically significant between groups (see Table 5). No relationship between new caries diagnosis, high plaque score, age, gender or type of insurance was found (See Table 2). Although statistical significance was not attained, the percentage of new caries diagnoses at the last visit was lower for the test group (See Table 3). Correlated with this finding was the change in oral self-care behaviors in the test group. CAMBRA records in the test group showed an increase in the number of protective factors over the course of five visits, except for the use of a prescribed chlorhexidine rinse (see Table 6). The most common reported protective factor was the use of fluoride toothpaste daily.

Discussion

The purpose of this study was to determine whether a caries management by risk assessment tool improves oral health behaviors and results in fewer caries diagnoses over time, as compared to traditional oral health education strategies. Patients in the test group had significantly lower plaque scores at their last visit indicating a change in oral self-care behaviors ($p = 0.0442$). A caries risk assessment approach, specifically CAMBRA, appears to have led patients to adopt behaviors that may improve oral health. Records from the test group showed

patients increased their use of six of the eight protective factors over time, including a 7.66% increase in the use of 5000 ppm fluoride toothpaste from visit one to visit three. Findings failed to reject the null hypothesis that there would be no difference in new caries diagnosis for patients of record with CAMBRA vs. patients who did not undergo risk assessment. Even though statistical significance was not obtained, raw data showed a greater reduction in new caries in the test group (see Table 5). The small sample size may have prevented a statistically significant effect of CAMBRA on new caries diagnosis.

The findings support previous research suggesting the use of a caries management by risk assessment protocol provides the ability to individualize preventive strategies such as the use of fluoride toothpaste, and specifically modify pathological factors putting the patient at risk for caries. The decrease in plaque scores over time suggests that patients were motivated to adopt several positive changes in their oral self-care habits and complied with the CAMBRA high caries risk protocol. The findings of this study add to the body of knowledge affirming the superiority of caries management by risk assessment over traditional oral health education methods ^{7,10,12,13,18}.

Evidence to date suggests using a caries risk assessment tool, like CAMBRA, may lower a patient's risk for caries in the future. Discussing the results of the caries risk assessment with a patient is a critical step that may contribute to the patient's motivation to change their oral self-care habits. CAMBRA allows patients the opportunity to visually see their risk vs. protective factors ratio, reflect on their oral self-care habits and make autonomous decisions regarding their oral health. Traditional preventive strategies commonly involve providing a patient with information, toothbrushing and/or flossing demonstrations and recommendations for changing behaviors. Historically, advice giving methods have been used to provide patient education,

however; providing instructions or solutions to improve an individual's oral self-care does not support patient autonomy. This method of patient education serves the agenda of the oral healthcare provider instead of the individual's interests related to their long-term oral health goals. Evidence-based research indicates advice giving methods or fear tactics are ineffective and will not sustain long-term positive behaviors^{21,22}.

In contrast, CAMBRA is very person-centered approach. After identifying factors contributing to new caries, a personalized care plan is then created in partnership with the patient. CAMBRA requires providers spend more time discussing the etiology of caries and contributing pathologic and protective factors. Patients are then free to choose to eliminate risk related behaviors and/or adopt behaviors that prevent caries. Patients may be more apt to accept the caries risk protocol because CAMBRA encourages them to be involved in the decision-making process. The literature suggests autonomy in decision-making increases patient compliance with oral self-care recommendations²³. Studies on motivational interviewing (MI) suggest behavior change is achieved by helping patients explore and resolve doubt in their own ability to change²³⁻²⁵. CAMBRA may facilitate this type of exploration and discussion between provider and patient. Potentially, the balance between pathological and preventive factors can be moved beneficially in the direction of preventing caries initiation and progression by an active interception.

Emerging evidence suggests caries management by risk assessment is a preventive strategy that should be adopted in practice, as it may lower a patient's risk for future caries and improves oral self-care behaviors^{13,18}. Effective risk management involves the understanding of risk and intentionally minimizing it with the best intention of securing the most successful outcome for the patient. The carious process is effectively reversible in the early stage before the

lesion has completely penetrated the enamel. Therefore, CAMBRA offers an early minimal intervention strategy, as it predicts an individual's expected caries experience over a period of time and allows identification of individualized preventive treatment strategies to mitigate disease.

A limitation of this study was the study setting, as well as control of the students' CAMBRA discussion and presentation. Patient's reported use of preventive regimens are based on self-report. In the School of Dentistry, subjects were not with the same student and faculty for all clinic visits, and therefore, general clinical notes, recorded plaque scores and frequency of CAMBRA form completions were not consistent between providers. Additionally, the limited sample size and length of time may have prevented a statistically significant effect of CAMBRA on new caries diagnosis. Future studies should include longer prospective studies with larger sample populations. Specific protective or risk factors within CAMBRA to determine if one or more have greater impact on caries development should also be a future research focus.

CLINICAL RELEVANCE

Scientific rationale for the study

Research is pointing to the use of risk assessment strategies to improve the oral and general health of the public.

Principle findings

Findings of this study showed subjects who completed CAMBRA improved their oral self-care behaviors as demonstrated by lower plaque index scores and adoption of oral health behaviors that favor health. However, differences in new caries diagnosis were not statistically significant between control and intervention.

Practical implications

Overall, this study supports existing evidence that the use of caries management by risk assessment appears to offer a preventive approach to oral health care delivery.

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TABLES

Table 1. Subject characteristics

<i>Variable</i>	<i>Control</i>	<i>Intervention</i>
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	n=100	n=107
<i>Age range (in years)</i>		
18-30	2	2
31-40	6	5
41-50	8	3
51-60	11	12
61-70	16	27
71-80	24	34
80+	33	24
<i>Gender</i>		
Male	54	62
Female	46	45
<i>Dental insurance</i>		
Private	23	25
State	18	23
None	59	59

Table 2. Subject characteristics vs. visits with reported new caries diagnosis and/or high plaque score

	<i>New caries diagnosis</i>	<i>High plaque score</i>
<i>Control</i>		
	Total visits with new caries diagnoses=118	Total visits with high plaque score=32
Age category	80+ years (36)	80+ (16)
Gender	Male (64)	Male (26)
Dental insurance	None (65)	None (27)
<i>Intervention</i>		
	Total visits with new caries diagnoses=120	Total visits with high plaque score=18
Age category	71-80 years (42)	51-60 and 80+ (5)
Gender	Male (72)	Male (12)
Dental insurance	None (59)	None (9)

Table 3. Patients with new caries diagnosis at first and last visits (%)

	<i>First visit</i>	<i>Last visit</i>

<i>Control</i>	49.00	29.00
<i>Intervention</i>	41.14	18.69

Table 4. Comparison of plaque scores between groups at first and last visit (%)

		<i>First visit</i>	<i>Last visit</i>
<i>Light</i>			
Control		56.32	53.75
Intervention		70.71	57.61
n (%)		<i>First visit</i>	<i>Last visit</i>
<i>Moderate</i>			
<i>New Caries</i>		0.2667	0.1018
Control		32.18	32.5
<i>Diagnosis</i>			
Intervention		23.23	39.13
<i>Plaque score</i>		0.1036	0.0442
<i>High</i>			
Control		11.49	13.75
Intervention		6.06	3.26

Table 5. Comparison of new caries diagnosis and plaque scores between groups at first and last visit (P >0.05)

Table 6. Mean Risk and Protective Factors Over Five Visits

<i>Visit</i>	<i>N Obs (# of subjects)</i>	<i>Variable</i>	<i>Mean</i>
1	107	Total R	1.8
		Total P	3.6
2	107	Total R	2.2
		Total P	3.8
3	103	Total R	2.0
		Total P	3.9
4	86	Total R	1.8
		Total P	3.9
5	61	Total R	2.0
		Total P	4.0

R=risk factors

P=protective factors

*Minimum of 2 visits over 1 year

APPENDICES

Appendix A: Subject enrollment form and data collection instrument (both groups)

Subject ID _____ Chart review/enrollment date _____

Individual enrolling subject: _____

Age: _____

Gender: Male Female

Group: Control Intervention

Insurance type: _____ None

Date of first recorded dental hygiene appointment in Axium: _____

Date of final recorded hygiene appointment in Axium: _____

Caries status at initial dental hygiene visit: Active At risk Controlled

Caries status at final dental hygiene visit: Active At risk Controlled

Plaque level at first visit: _____ Plaque level at last visit: _____

Intervention group only:

Date of first recorded plaque level: _____ Score: _____

Date of final recorded plaque level: _____ Score: _____

Number of protective factors at first visit: _____

Number of protective factors at final visit: _____

Number of risk factors at first visit: _____

Number of risk factors at final visit: _____

Date	Caries status	New caries diagnosis	Plaque level	Exam
	A C AR	Y/N		Y/N
	A C AR	Y/N		Y/N
	A C AR	Y/N		Y/N
	A C AR	Y/N		Y/N
	A C AR	Y/N		Y/N

Appendix B: Data collection instrument (intervention group only)

Chart #	Date:	Date:	Date:	Date:	Date:	Date:
	Answer	Answer	Answer	Answer	Answer	Answer
RISK FACTORS						
1.Visible heavy plaque on teeth	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N
PROTECTIVE FACTORS						
2.Drinks fluorinated water from municipal supply	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N
3. Fluoride toothpaste at least once a day	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N
4.Fluoride toothpaste at least 2xday	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N
5.Fluoride mouth rinse (0.05%NaF) daily	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N
6.5000 ppm F fluoride toothpaste daily	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N
7.Chlorhexidine prescribed/used one week each of last 6 months	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N
8.Xylitol gum/lozenges 4x daily last 6 months	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N
9.MI paste during last 6 months	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N
SUMMARY						
# of YES Risk Factors						
# of YES Protective Factors						

