BRIEF COMMUNICATION

# Identification of Adult Populations at High Risk for Dental Caries Using a Computerized Database and Patient Records: A Pilot Project

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## Abstract

***Objectives:*** *The purpose of this study is to test the usefulness of dental insurance claims history, supplemented with radiographic caries diagnoses, as a means of identifying caries-active and caries-inactive working adults, as determined by bacterial levels. Computerized identification of at-risk groups may facilitate subject selection for clinical trials designed to test caries-preventive strategies.* ***Methods:*** *Two groups of subjects were initially selected from an insurance database based upon their dental service utilization during a one-year period: a "low restorative" group of individuals defined as persons who had received no restorative treatment, and a "high restorative" group comprised of individuals who had received at least three multisurfaced restorations. A chart review confirmed a diagnosis of caries in the high restorative group and an absence of caries in the low restorative group. Subjects were then approached for saliva collection. The low and high restorative groups were compared for salivary mutans streptococci and lactobacilli levels, stimulated flow rate, and buffer capacity (n=48).* ***Results:*** *The high and low restorative groups differed in mutans streptococci levels, but not on other measures.* ***Conclusions:*** *A group of subjects who had recently received multisurfaced restorations that were placed for reasons of caries had significantly higher levels of mutans streptococci and potential for continued caries activity when compared to a group of subjects who had received no restorations and were caries free. [J Public Health 2000;60(2):82-84]*

*Key Words: caries, risk assessment, clinical trial, mutans streptococci.*

Identification of subjects who are at higher risk of developing dental caries is an essential step in the design of clinical trials of caries-preventive strategies and agents. A review of caries prediction models concluded that past caries experience is the most significant predictor of future caries activity, and that the presence of high levels of certain bacteria (lactobacilli, mutans streptococci) improves the accuracy of the prediction models (1). In addition, groups of subjects with higher levels of mutans streptococci have demonstrated elevated caries activity compared to those with lower levels (2-5).

Use of computer databases might provide a method of identification of large numbers of subjects with a positive history of past caries (6). A record of receiving restorative treatment may provide a measure of past caries experience. In the absence of diagnostic codes, this record would need to be supplemented with diagnostic information, i.e., the reason for restoration placement, because some restorations can be placed for reasons other than caries.

The purpose of this study is to test a method of patient selection that involves the use of a computerized database supplemented with clinical diagnosis. Clinical diagnosis will be confirmed with a review of recent bitewing radiographs. The goal of the selection method is to select a group of patients who are at higher risk of developing caries in the future when compared to the general population. Bacterial levels will validate the group caries activity. Identification of such higher-risk groups will improve the design of clinical trials of caries-preventive programs.

## Methods

The study comprised three phases: database survey, chart review, and salivary sample. All procedures were approved by the University of Washington Human Subjects Committee and the Kaiser Permanente Center for Health Research Committee for the Protection of Human Subjects.

**Database Survey.** Investigators (JM, AW) at Kaiser Permanente Center for Health Research reviewed their database for the years 1995–96 (Figure 1). This review was restricted to adult subscribers 21–65 years of age who had electronic records for bitewing radiographs and prevention appointments ($n$=114,235). From this restricted list, two groups were identified: a low restorative group comprising subjects who had received no restorative treatment (amalgams, composites, crowns, endodontics) or extractions, but may have had periodontal treatment ($n$=25,436); and a high restorative group comprising individuals who had received at least three two-surface (or more) proximal restorations during 1995–96 ($n$=4,060). From this initial sample, the charts of patients scheduled for upcoming appointments were selected for review ($n$=166).

**Chart Review.** An investigator from

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**FIGURE 1**
**Outline of Patient Selection**

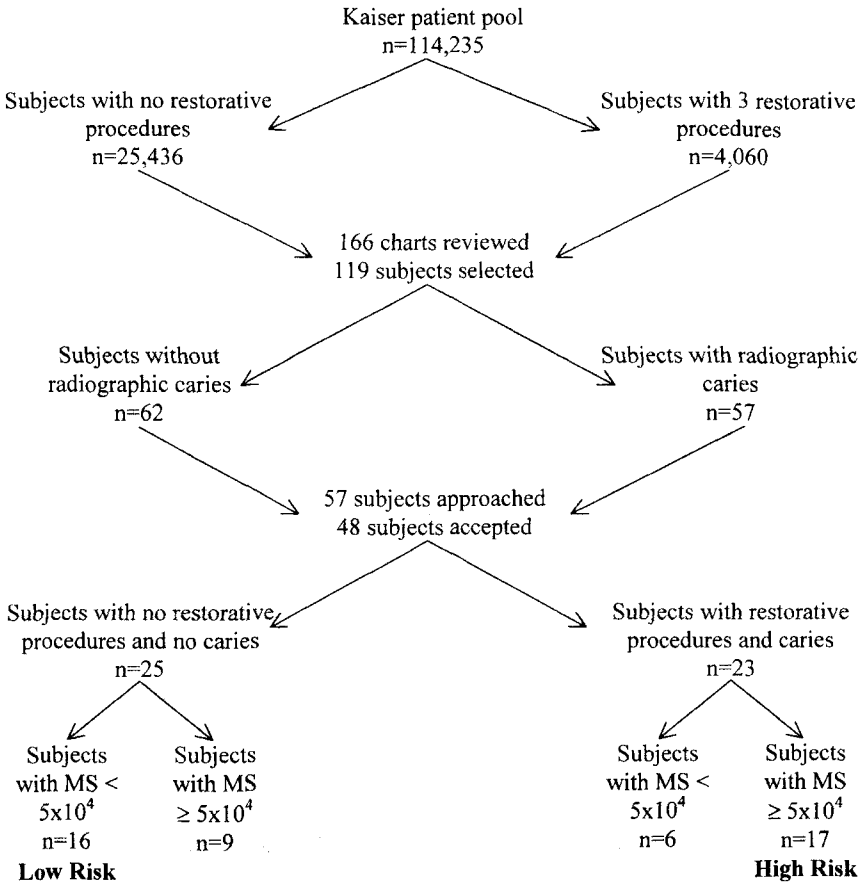


**TABLE 1**
**Comparison of Procedure Code with Radiographic Caries Screening**

| ≥3 Restorative Procedure Codes | ≥1 Radiographic Carious Lesion + | − | Total |
|---|---|---|---|
| + | 57 | 32 | 89 |
| − | 15 | 62 | 77 |
| Total | 72 | 94 | 166 |

Sensitivity=79.2, specificity=66.0, % agreement=71.7.

**TABLE 2**
**Comparison of Procedure Code and Radiographic Caries Screening with Mutans Streptococci Levels**

| ≥3 Restorative Procedures 1 Radiographic Carious Lesion | >5 x $10^4$ cfu Mutans Streptococci + | − | Total |
|---|---|---|---|
| + | 17 | 6 | 23 |
| − | 9 | 16 | 25 |
| Total | 26 | 22 | 48 |

Sensitivity=65.4, specificity=72.7, % agreement=68.8.

the University of Washington (VP) reviewed posterior bitewings to confirm a diagnosis of caries. The blind review was supervised by a Kaiser investigator (JM). A comparison of the computerized restorative procedure code with the radiographic confirmation of caries is presented in Table 1. One hundred and nineteen charts (62 low restoratives with no caries, 57 high restoratives with caries) were selected for the next phase based upon agreement between the restorative classification and radiographic caries diagnosis.

**Saliva Sample.** Fifty-seven subjects were approached for permission to collect a saliva sample at their regularly scheduled dental appointment. Forty-eight subjects accepted (refusal rate=16%). A stimulated saliva sample was taken and the salivary flow rate recorded. One milliliter of saliva was added to a test tube of 0.005 N HCl. Color change was compared to a color chart to estimate buffer capacity. A second milliliter of saliva was added to 9 ml of transport fluid. Three tenfold dilutions were made in phosphate-buffered saline (pH 7.5). Two 20 ml aliquots of each dilution were plated on mitis-salivarius-bacitracin agar and Rogosa agar. Plates were incubated anaerobically, 48 hours for estimation of mutans streptococci and 72 hours for lactobacilli. Mutans streptococci levels greater than $5 \times 10^4$ were considered high.

**Data Analysis.** Descriptive statistics were used to summarize each patient's age, sex, income, race, and education in the two groups. Bacterial levels in the two groups of subjects were compared using a two-sided two-sample *T*-test at significance level .05. The logarithmic transformation (base 10) was applied to the bacterial counts before analysis to stabilize the variance. Buffering capacity and flow rate were also compared using *T*-tests. With 25 patients per group planned (total of 50) the study would have power of 93 percent to detect a group difference equal to one standard deviation, and power of 73 percent to detect a group difference equal to three-quarters of a standard deviation.

## Results

This population of working adults (median age=40) had a median income between $30,000 and $40,000. More than 80 percent had at least 12 years of

**TABLE 3**
**Results of Stimulated Salivary Samples by Restorative Group**

| | Low Restorative ($n$=25) | | | | | High Restorative ($n$=23) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | SE | Min. | Max. | Mean | SD | SE | Min. | Max. | $P$ |
| Buffer pH | 5.6 | 1.1 | 0.2 | 4.0 | 7.0 | 5.4 | 1.0 | 0.2 | 4.0 | 7.0 | .48 |
| Flow rate* ml/min | 1.7 | 0.9 | 0.2 | 0.6 | 4.1 | 1.5 | 0.8 | 0.2 | 0.7 | 3.4 | .40 |
| Mutans streptococci, cfu log-base 10 | **4.4** | **1.1** | **0.2** | **1.0** | **6.1** | **5.0** | **0.7** | **0.2** | **3.4** | **6.3** | **.04** |
| Lactobacilli, cfu log-base 10 | 3.1 | 1.1 | 0.2 | 1.0 | 4.8 | 3.4 | 1.3 | 0.3 | 1.0 | 5.3 | .41 |

*One subject had missing flow rate value.

education. Fifty-two percent were male and 77 percent were Caucasian. The high and low restorative groups were well balanced with regard to age, sex, income, race, and schooling. Minor differences were observed for some variables due to limited sample sizes; however, these would not have appreciable effects on the comparisons of bacterial levels.

Forty-eight subjects provided samples (23 high risk, 25 low risk) (Table 2). The specificity of the selection process was slightly better than the sensitivity (73% vs 65%), indicating that the process was perhaps better at selecting those without disease, a trend that is common with most prediction models. Approximately 70 percent of the subjects were correctly classified into their respective risk groups.

A comparison of the salivary factors from the high and low restorative groups is provided in Table 3. A significant difference was found between the groups for mean log-transformed mutans streptococci counts ($P$=.04), but not for log-transformed lactobacilli, buffering capacity, or flow rate. The difference in mean log-transformed mutans streptococci was 0.6, which represents a fourfold higher level in the high-risk group relative to the low-risk group ($\log_{10}$ 4=0.6). This result was supported by a comparison of the median mutans streptococci counts (120,000 cfu vs 27,000 cfu)

## Discussion

The claims database survey and radiographic review established two groups of subjects that were significantly different with regard to mutans streptococci levels. These same groups were not different in regard to age, sex, income, race, or schooling. While not as useful for individual prediction, mutans streptococci levels used at a group level have proven successful in selecting groups of subjects with elevated caries activity (2-5). That these groups differed significantly in regard to mutans streptococci levels may imply a difference in future caries activity.

Past caries experience has proved to be the most significant predictor of future caries activity (1,7). Computerized records of restorative treatment proved to be a reasonable first screen for describing past caries experience; however, caries could not be confirmed for 36 percent of the 89 subjects selected as "high restoratives." The reasons for this disagreement could be because either restorations were done for reasons other than caries, or caries was not evident on bitewing radiographs. These results suggest that it is essential to confirm a caries diagnosis if computerized databases are used to select caries-active populations. This project used radiographs to confirm a diagnosis of caries, a time-consuming process. With the adoption of diagnostic codes, the necessity for a chart review to confirm diagnoses can be eliminated.

Studies show that bacterial levels improve the accuracy of caries prediction models (8-10). In a cross-sectional sample, such as might be done in selection of subjects for clinical trials, mutans streptococci may provide additional information regarding a subject's caries activity. Screening for mutans streptococci resulted in the elimination of six (26%) subjects who had high utilization of restorative treatment and radiographic caries. The elimination of these subjects, while appropriate when selecting individuals for a clinical trial, may not be appropriate when trying to develop individualized caries-prevention programs for clinical practice. Certainly, the only way to confirm caries activity is to follow individuals over time, a strategy that is impractical when selecting subjects for clinical trials.

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