CDC Periodontal Disease Surveillance Project: Background, Objectives, and Progress Report

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This supplement contains papers presented at the 2006 International Association of Dental Research (IADR) symposium entitled "Development of Self-Reported Measures for Population-Based Surveillance of Periodontitis." These papers highlight activities of an independent periodontal disease surveillance workgroup convened by the Division of Oral Health (DOH), Centers for Disease Control and Prevention (CDC), in collaboration with the American Academy of Periodontology, to examine the feasibility of using self-reported measures for population-based surveillance of periodontal disease in the United States. This workgroup was convened in 2003 as part of a CDC periodontal disease surveillance project. *J Periodontol 2007;78:1366-1371.*

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CDC is the leading federal public health agency in the United States and is responsible for recommending surveillance methods that guide efforts to prevent and control disease and its risk factors. The DOH within CDC supports state- and community-based programs and efforts to prevent oral disease by promoting science-based prevention strategies and monitoring oral health status and risk factors. Historically, surveillance has been useful in tracking trends and patterns of oral diseases (and their risk factors) for assessing their burden on populations and for planning, implementing, and evaluating effective intervention at the state and local levels.

Periodontal disease is highly prevalent in older adults, affecting ~34% of the American population aged >30 years (~36 million persons), and it is severe in ~13% of adults.[1] Severe periodontal disease often results in tooth loss, which can diminish quality of life, and is related to poorer general health in adults. Recent studies[2-4] suggest that periodontal disease has important systemic implications that can influence the risk for certain systemic diseases, such as cardiovascular diseases, diabetes, and reproductive outcomes. However, periodontal disease can be prevented and controlled.

Current methods of periodontal disease surveillance in the population require clinically based periodontal examinations, which are resource intensive and costly. Thus, the capacity to monitor the disease

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at the population level has been restricted, especially among subsets of the population at highest risk for the disease. Federally funded national surveys, such as the National Health and Nutrition Examination Survey (NHANES), continue to be the only source for national data on periodontal disease. Clinically based periodontal examinations in NHANES ceased after the 2003 to 2004 data-collection cycle. In addition, population-based surveillance of periodontal disease is virtually non-existent at the state and local levels, even though most public health activities are designed to target state and local populations. Existing state-based oral health surveillance systems do not have the resources required to support clinically assessed periodontal data. The future of population-based periodontal disease surveillance at the national/state/local levels relies on developing less resource-demanding measures that can be integrated into existing surveillance systems.

In April of 2003, the CDC, in collaboration with the American Academy of Periodontology (AAP), held a conference entitled "Public Health Implications of Periodontal Infections in Adults." Discussions at this conference emphasized the importance of surveillance of periodontal disease, as an important oral disease and as a potential risk factor for systemic diseases.[5] Leading oral epidemiologists, biostatisticians, and periodontists attended this meeting. From these experts, a workgroup (see page 1372) was convened and charged to examine and make recommendations for alternative valid population-based surveillance measures for periodontal disease that could be integrated into existing surveillance mechanisms such as the Behavioral Risk Factor Surveillance System (BRFSS). Thus, the primary objectives of this project were to determine whether self-reported measures can be valid measures for predicting the prevalence of periodontitis and, if so, to identify and develop self-reported questions for use in the United States population.

This supplement contains a comprehensive summary of all work done by the CDC-AAP Periodontal Disease Surveillance Workgroup, including the accomplishments/activities presented at the 2006 IADR Symposium in Orlando, Florida.[6] The consensus of the scientific evidence reported in this supplement suggests that multivariable modeling of self-reported measures is promising for predicting the prevalence of periodontitis and warrants further evaluation.

The first two papers[7,8] of this supplement discuss the historical perspectives for this project and make the case for alternative approaches for public health surveillance of periodontal disease. Most notably, the required resources and the cost of clinically assessed periodontal measures have restricted periodontal disease surveillance at various public health levels and subpopulations. Surveillance of periodontal status in the United States has ceased in NHANES since 2005 because of the extensive resources required for clinical examinations. The suggestions from both papers and the prevailing position at the CDC are that the future of periodontal disease surveillance may lie in developing measures that demand fewer resources and can be integrated into state and local health surveys, with no resources to support clinically assessed periodontal measures. Both papers assessed the strengths and weaknesses of alternative surveillance systems for periodontitis and make the case for further exploration of the use of self-report measures. This decision was based partly on compelling evidence for their high reliability and validity in surveillance of chronic health behaviors and outcomes as demonstrated by the CDC-sponsored BRFSS.

The CDC Periodontal Disease Surveillance Project began with an initial literature review of previous studies that assessed the validity of self-reported measures for predicting periodontal disease prevalence.[9] The findings from this review guided the workgroup to focus on exploring the use of combined self-reported measures and known risk factors for periodontitis in predicting the prevalence of periodontitis in the population. This strategy was encouraged, in part, by prior CDC successes in developing multivariable predictive models for population estimates using a combination of self-reported measures and risk factors.[8] In anticipation of this approach and to guide future analytical work with the project, the workgroup researched and explored statistical methodologies for projecting estimates, using multiple measures of clinical subsamples, to a larger survey population. In this supplement, a technical report by LaVange and Koch[10] exemplifies the methodology of projecting clinical estimates from a subsample to a larger survey population using multivariable prediction models. By this method, valid variables measured in the larger population (e.g., self-report measures) serve as predictors, and the resulting prediction model is applied to the entire population to produce estimates of prevalence for the clinical outcome of interest (e.g., periodontitis). Their technical report describes this projection methodology, its use in the National Vietnam Veterans Readjustment Study, and its possible application for the surveillance of periodontitis.

This supplement also discusses the important prerequisite for this project of developing standard case definitions for population-based studies of periodontitis. These "standard" definitions were necessary to introduce consistency into the analytical work across multiple studies and for use in future field studies. In addition, the workgroup recognized the lack of standard historical case definitions for population studies of periodontitis and the implications for surveillance and epidemiologic studies of the disease. The breadth

of expertise in the workgroup, which includes extensive clinical expertise in periodontology, periodontal disease epidemiology, and statistics, and the imperative to establish a standard provided a unique and timely opportunity to reach consensus on standard population-based case definitions for moderate and severe periodontitis. The article by Page and Eke[11] chronicles the history of definitions of periodontitis and prevalence estimates from various survey data, which provide a rationale for selecting clinical criteria to consider in the definitions. This article describes the consensus workgroup definitions developed by the workgroup for moderate and severe periodontitis. Moderate periodontitis was defined as two or more interproximal sites with >4 mm clinical attachment loss (CAL), not on the same tooth, or two or more interproximal sites with probing depths (PD) >5 mm, not on the same tooth. Severe periodontitis was defined as two or more interproximal sites with CAL ≥6 mm, not on the same tooth, and one or more interproximal sites with PD ≥5 mm. These definitions are expected to serve as the standard definitions of moderate and severe periodontitis in future surveillance and epidemiological studies.

Another important prerequisite for the project was to decide on acceptable levels of validity for public health surveillance of periodontitis. Statistical guidelines and other evidence from surveillance of chronic diseases were considered. The receiver operating characteristic (ROC) curve (also called area under curve [AUC]) statistics were used as the most desirable index for validity for multivariable modeling across the spectrum of probabilities of the disease in the population. Following the threshold recommended by Swets,[12] the predictive ability of multivariable models was assessed as useful for ROC values between 7.0 and 9.0 and excellent for ROC values >9.0. Also, sensitivity and specificity at specific thresholds of predicted probabilities based on observed prevalence of disease were considered. The review by Nelson et al.[13] on the validity of self-report measures used for surveillance of chronic disease for public health application classified validity as high for values of sensitivity or specificity ≥80% and moderate for values between 60% and 79%. Notably, these benchmarks for sensitivity and specificity in public health surveillance are more liberal than those seen for clinical tests. The articles by LaVange and Koch,[10] Slade,[14] and Taylor and Borgnakke[15] outline and discuss the unique statistical challenges and analytical approaches to the analytical methods used in this project.

The supplement presents several analytical articles using the above model outcomes and statistical guidelines to develop a final fitting prediction model for periodontitis. The purposes of these secondary data analyses were as follows: 1) to assess the additional predictive power from using multivariable models to predict the prevalence of periodontitis; 2) to begin identifying the candidate variables for inclusion in the final prediction variables; and 3) to further develop the analytical methods for this multivariable model. Although each of these papers analyzed datasets from different sets of self-reported questions and from different represented populations and nationalities, increased validity using multivariable models was demonstrated consistently across their results. For example, the article by Dietrich et al.,[16] using a German dataset, reported an ROC statistic of >8.0 and high sensitivity and specificity values for predicting periodontal disease assessed by radiographs. Similarly, the article by Taylor and Borgnakke,[15] using the Detroit Area Epidemiological Survey data, reported measures of accuracy for AUC of 8.0 to 9.2 and sensitivity and specificity of 71% and 83% for moderate disease and 92% and 53% for severe disease, with an AUC of up to 0.92. Analysis of the Florida Dental Care Study data[17] reported an ROC on the order of 0.80, indicating that self-report measures were "moderately" related to periodontal attachment loss in this population of older adults. Multivariable modeling of the Buffalo data[18] reported an AUC of 0.76 and combined sensitivity and specificity of 142. These results demonstrated that multivariable modeling can improve the validity of self-reports in predicting periodontitis and, notably, that most of the values reached threshold levels considered useful for public health surveillance of periodontitis.

A second product of these analyses was the emergence of the most promising self-reported questions for predicting periodontitis based on their statistical merit in the various models. Overall, these studies implicated self-reported measures of gum disease, bone loss around teeth, history of treatment of gum disease, history of loose teeth, use of mouthwash or dental rinse, and cleaning between teeth as the most promising predictive variables for the model. As expected, traditional risk indicators for periodontitis, such as age, smoking, and diabetes, contributed significantly to the predictive power of these models.

The Australian National Survey of Adult Oral Health (ANSAOH) provided the opportunity to assess the validity of these selected questions in a validation survey and to test the operational aspects of fielding these questions. The timing of this project allowed us to enter our questions at the start of the ANSAOH and was very cost-effective for the further field assessment of our questions. ANSAOH is a population-based survey of oral health in Australians using interview and clinical protocols similar to NHANES. The article by Slade[14] reports on ANSAOH field assessment of our questions and on the interim results from 3 years of testing these questions. The Australian study showed high response to these questions and low correlations between these

questions. Also, the multivariable modeling of six self-reported variables, along with traditional risk indicators for periodontitis, attained useful levels of validity (ROC of 0.83) in predicting the prevalence of periodontitis in the Australian population.

Having identified a set of promising self-reported questions through these processes, the next phase of the project was to move into developing and testing these questions for use in the United States population. The workgroup recognized that these six promising questions originally were derived from several surveys and field tested in a United States and a non–United States population. Different population characteristics can influence comprehension levels and question–response processing of these questions. Thus, in preparation for further field testing these questions in the United States population, each question was evaluated cognitively among English- and Spanish-speaking United States respondents. Assessments were made on how they comprehended these questions and their question–response process, focusing on those questions that can lead to response error, especially among those with little understanding of the cause or symptoms of periodontitis. Miller et al.[19] describe the process and results of this cognitive assessment by the National Centers for Health Statistics (NCHS) Cognitive Testing Laboratory and recommendations for modification to these questions. These recommendations guided the workgroup in developing the final version of questions for use in the United States population.

In July of 2006, the workgroup met to discuss NCHS's cognitive assessments and final recommendations for changes in the original questions. After deliberation, the workgroup made slight modifications to the questions' language and format. Consideration was given to the cost, the number and format of questions that realistically can be placed on surveys, and the understanding of clinical terms and procedures. Table 1 lists the final set of eight questions as formatted and adopted by the workgroup for further testing in the United States population.

FUTURE DIRECTIONS

These eight questions will be field tested in the United States population in two phases. A pilot will use a small convenience sample of United States subjects to lay the groundwork and justify further testing of these questions in a national survey. The key objectives of this pilot phase will be as follows: 1) to confirm that these questions, or a subset of them, have sufficient validity for predicting periodontitis in this sample of the United States population; 2) to determine whether non-response rates to these questions differ among racial/ethnic groups; and 3) to assess the logistical aspects of conducting the pilot. This last objective will answer questions about the operational feasibility of conducting a larger, more representative study, including the length of time required to administer the questions, feedback from interviewers who administer the questions, and the time required to perform the mobile examination center (MEC) periodontal examinations.

Arrangements have been completed with NCHS to conduct this pilot study, and it was scheduled to begin in May 2007. The survey will follow the NHANES protocols for interviews and clinical examination and will include a full-mouth clinical examination. Findings from this pilot are expected to be published by the fall of 2007. If the pilot phase is successful, the next and final phase of this project would be to incorporate the valid questions into the full NHANES survey for 2009 to 2010. This final phase is crucial for generating statistical scoring algorithms for these questions in the United States population. Thus, some of the major aims of this final phase will be as follows: 1) to test the feasibility in NHANES of conducting interviews and clinical examinations that collect information about periodontitis; 2) to evaluate further the validity of these tested questions in diverse United States subpopulations of adults, aged 25 years and older; and 3) to generate the United States population parameter estimates for these questions that will be used to predict periodontitis prevalence in Unites States surveys in which the same questions are asked but no examinations are conducted. The final prediction model will be applied to each member of the survey sample to compute a predicted probability, and the probability sampling weights will be applied to produce weighted estimates of the predicted prevalence for the United States population.

The primary objectives of this project were to determine whether self-reported measures can be used for predicting the prevalence of periodontitis and, if so, to identify and develop self-reported questions for use in the United States population. The consensus of the scientific evidence reported in this supplement suggests that multivariable modeling of certain self-reported measures is promising for predicting the prevalence of periodontitis and warrants further evaluation. We anticipate that successful completion of this project will provide valid, reliable, and cost-effective surveillance methods for predicting the prevalence of periodontitis using only responses to questions administered in interviews. This will allow the prevalence of periodontitis to be estimated at lower cost in national-, state-, and local-level surveys in which clinical examinations are not feasible. Also, these questions could be useful tools for health professionals to screen patients at high risk for periodontitis and its sequelae and enable large-scale, cost-effective screening for periodontitis for etiologic studies pertinent to periodontitis and associated systemic conditions.

Table 1.

Self-Report Questions (translations in English/Spanish)

Preamble: Gum disease is a common problem with the mouth. People with gum disease might have swollen gums, receding gums, sore or infected gums, or loose teeth.
Preámbulo: La enfermedad de las encías es un problema común en la boca. Las personas que sufren de la enfermedad de las encías pueden tener encías inflamadas, encías retraídas, adoloridas, infectadas y pueden llegar a dientes que se mueven.

1. Do you think you might have gum disease?
☐Yes ☐No ☐Don't know ☐Refused
¿Piensa usted que tal vez sufra de la enfermedad de las encías?
☐*Sí* ☐*No* ☐*No sabe* ☐*No contesta*

2. Overall, how would you rate the health of your teeth and gums?
☐Excellent
☐Very good
☐Good
☐Fair
☐Poor
☐Don't know
☐Refused
En general, ¿cómo diría que es el estado de salud de sus dientes y encías?
☐*Excelente*
☐*Muy bueno*
☐*Bueno*
☐*Regular*
☐*Malo*
☐*No sabe*
☐*No contesta*

3. Have you ever had treatment for gum disease, such as scaling and root planing, sometimes called "deep" cleaning?
☐Yes ☐No ☐Don't know ☐Refused
¿Alguna vez ha tenido usted tratamiento de las encías tipo raspado o alisado de las raíces, que a veces se conoce como limpieza "profunda"?
☐*Sí* ☐*No* ☐*No sabe* ☐*No contesta*

4. Have you ever had any teeth become loose on their own, without an injury?
☐Yes ☐No ☐Don't know ☐Refused
¿Alguna vez se le ha aflojado algún diente por sí solo sin haber tenido una lesión?
☐*Sí* ☐*No* ☐*No sabe* ☐*No contesta*

5. Have you ever been told by a dental professional that you lost bone around your teeth?
☐Yes ☐No ☐Don't know ☐Refused
¿Alguna vez le ha dicho un profesional de la salud dental que usted ha perdido hueso alrededor de los dientes?
☐*Sí* ☐*No* ☐*No sabe* ☐*No contesta*

6. During the past 3 months, have you noticed a tooth that doesn't look right?
☐Yes ☐No ☐Don't know ☐Refused
¿En los últimos tres meses, ha notado que alguno de sus dientes no parece verse bien?
☐*Sí* ☐*No* ☐*No sabe* ☐*No contesta*

7. Aside from brushing your teeth with a toothbrush, in the last 7 days, how many times did you use dental floss or any other device to clean between your teeth?
_____ Number
¿Aparte del cepillado de sus dientes, cuantas veces ha usado la seda/hilo dental o algún otro medio o utensilio para limpiarse entre los dientes en los últimos siete días?
_____ *Número de veces*

8. Aside from brushing your teeth with a toothbrush, in the last 7 days, how many times did you use mouthwash or other dental rinse product that you use to treat dental disease or dental problems?
_____ Number
¿Aparte del cepillado de sus dientes, cuantas veces a usado un enjuague bucal u otro producto liquido para el tratamiento de enfermedades dentales en los últimos siete días?
_____ *Número de veces*

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