

Patient self-report of oral health: Predicting the need for oral care

JB Epstein^{1*}, AL Watters², D Villines³, C Conway⁴, C Jones⁵, G Schwartz⁵ and K Fung⁶

¹Professor, Samuel Oschin Comprehensive Cancer Institute, Cedars-Sinai Medical Center, Los Angeles; Consultant, Division of Otolaryngology Head and Neck Surgery, City of Hope National Medical Center, Duarte, CA, USA

²Providence Cancer Center, Oral Oncology and Oral Medicine Clinic, Portland, Oregon, Clinical Assistant Professor, New York University College of Dentistry, Department of Oral and Maxillofacial Pathology, Radiology and Medicine, New York, New York, USA

³Director of Research, Advocate Health Care, Chicago, IL, USA

⁴Private student, University of Toronto, Toronto, Canada, USA

⁵Private practice, Ottawa, Canada

⁶Private practice, Ottawa, Canada, Division of Dentistry/Oral & Maxillofacial Surgery, Ottawa Hospital, Ottawa, Canada

Abstract

Background: People with complex medical conditions often experience barriers to oral care and are at an increased risk of developing dental disease, which may lead to local exacerbation, pain, and systemic infection. As access to primary medical care increases, improved screening methods by non-dental providers may address these barriers. This study investigates the predictive ability of a patient reported oral symptoms instrument to determine the need for urgent versus routine dental care.

Methods: Patients completed a questionnaire, querying, oral habits, dentate status, and symptoms of oral disease presence. An examiner determined the need for urgent versus routine care. Multivariate Logistic Regression was used to determine predictor variables in the model of urgent care needs and Area Under the Curve was used to determine discriminatory capabilities of the model.

Results: There were 114 urgent care and 890 routine cases (n = 1004). The oral health composite score ranged from zero (9.3%) to six (0.1%) with the mean score of 1.62 (sd = 0.98). The oral health composite score had modest diagnostic capability (AUC = 0.759).

Conclusions: The patient reported oral symptoms is a novel, reliable instrument that may have utility for non-dental providers in various settings to identify urgent dental care needs based on patient reported symptoms.

Introduction

Background

Chronic dental diseases are among the most prevalent health problems worldwide and the most common childhood chronic illness in the United States [1]. Oral conditions such as periodontal disease and dental caries are most common and severe in populations that experience socioeconomic, social, cultural, and geographic barriers to care [2-7]. Novel strategies for intervention, including those aimed at increasing education and screening by primary care medical providers, have been suggested. People with limited access to oral health care may be at increased risk of having untreated dental disease which may place them at risk of local infection, pain, and systemic infection during medical therapy [8,9].

In order to identify patients who require urgent dental and oral care needs, an accurate screening tool would be useful when oral conditions may be exacerbated during and following medical therapy and when effective dental management is not available. In the Institute of Medicine 2011 report on Improving Access to Oral Health Care for Vulnerable and Underserved Populations there was a call for a team-based, patient centered approach to care which can be met with various novel, inter-professional models [10]. However, physicians, nurses, and other non-dental providers lack the training necessary to diagnose dental disease or to make appropriate and timely referrals for treatment.

Recent public health efforts have focused on improved integration between medical and dental providers, as the number of practitioners in primary medical services vastly outweighs the number of oral health providers. However, medical providers are typically limited to palliative care for dental pain or infection [11,12]. The ability to identify patients with urgent dental disease before pain and infection is evident, without the use of dental radiographs or oral health trained providers, is essential. Patient reported outcome measures (PROMs) are frequently investigated in Quality of Life studies. As PROMs are integrated into clinical care, these instruments are increasingly used to detect disease burden in addition to assessing adequacy of symptom management. Many guidelines recommend an oral/dental evaluation prior to therapy for people with HNC, bone marrow/stem cell transplant, and chemotherapy by a dentist who has experience and expertise in treating and assessing patients undergoing cancer

Correspondence to: Joel B Epstein, DMD, MSD, FRCD(C), FDS RCS(Ed), 8500 Wilshire Blvd, Suite 800, Beverly Hills, CA 90211, USA, Tel: 310 685-8500; **E-mail:** Joel.epstein@cshs.org

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treatment [13-17]. Unfortunately, dental providers with this specific knowledge are relatively few in number and many cancer centers, even National Cancer Institute designated comprehensive cancer centers, may not have access to these resources [13].

At present, an instrument that can reliably predict objective oral health needs from subjective patient reported measures is not available. Therefore, we initiated development of an instrument to capture patient reported oral health status and compared these results with objectively identified oral health status by trained dental providers. Specifically, the objective was to develop an instrument to distinguish patients who had urgent oral health needs from those patients without urgent oral health needs.

Methods

Consecutive new patients referred to a private group specialty periodontal practice in Ottawa, Canada were approached upon office registration, from July 2013 to January 2014. 1,257 patients were approached to take part in the study; 253 patients seen in the practice declined to participate, or failed to complete the questionnaire; therefore the final data set included 1,004 cases for analysis. Patients were asked to complete a brief questionnaire, the patient self-report of oral symptoms (PROS) tool, which captured seven categories including demographic information, oral habits, dentate status, oral pain, oral function, pathology, and disease presence (Appendix 1). The survey was developed with input of medical, radiation and surgical oncologists, and dentists and reviewed by clinically experienced oral oncology experts who provided modifications prior to use in this setting.

Information collected included age, gender, reason for visit, tobacco and alcohol use, dentate status, tooth brushing and flossing habits, denture use, and time of most recent dental visit. The respondents were asked questions regarding signs of dental disease such as problems with third molars, broken or loose teeth, broken fillings, swollen gingiva, and bleeding gingiva. Functional deficits were assessed through report of difficulty swallowing solid food, changes in speech or eating, para functional habits, limited jaw opening, and problems with dentures. Additionally, three pain questions including jaw or tooth pain when biting, oral pain in the past year, or current tooth or facial pain were asked along with potential symptoms of oral pathology including xerostomia, mass or swelling in the mouth or jaw, and sores in the mouth. Finally respondents were asked to rate their overall oral health status as good, fair, or poor.

Routine head and neck, oral, dental, and periodontal exams were then performed. Respondents were stratified into two groups by one of the five examiners who were blinded to the survey results: non-urgent care and urgent care needs based on the results of the oral examination. All participating examiners were periodontists who were not calibrated between each other. These examiners were all board certified specialists and used their best clinical judgment in order to dichotomize the study population. Patients who required intervention within one to two weeks to prevent pain and infection due to deep decay, severe loss of periodontal support, periapical pathology, and oral lesions were stratified into the urgent care group. The remaining patients were grouped as needing non-urgent/routine care.

Statistical analysis

Categorical and dichotomous variables are presented as frequencies with percentages and continuous variables are presented as means \pm standard deviation. Univariate logistic regression was used

to determine independent predictors of the outcome variable (urgent care or non-urgent care) and were retained in the multivariate model. All variables were initially considered for the regression model as this was an exploratory analysis and a regression selection parameter was not used to assess a model with all parameters. Continuous variables that were statistically significant in the univariate screen analysis were transformed into dichotomous variables for clinical utility. Optimal cut-offs were determined with Receiver Operating Characteristic (ROC) curves, which plots the true positive rate against the false positive rate to display the trade-off between the sensitivity and specificity of the diagnostic test.

A model was developed based on results from the multivariate model with each symptom having a weight of one. Predictor variables that were statistically significant predictors received the same weight of one for having the risk factor in the equation and zero for not having the risk factor and the oral health composite score was determined. The discriminatory and diagnostic capability of the oral health composite score was assessed using ROC analysis. Results are reported as the Area under the Curve (AUC), which represents the probability that the oral health composite score result for a randomly chosen positive case, will exceed the result for a randomly chosen negative case. Analyses were performed using SPSS 22.0[®] for Windows (IBM Corp., Armonk, NY).

Results

Demographic data, patient characteristics, and oral complication symptoms are shown by care group status in Table 1. The urgent care group was older than the non-urgent care group (52.27 ± 15.24 vs. 45.30 ± 17.44 , $p < 0.01$) and there were no between group differences for tobacco and alcohol use. Respondents in the urgent care group were more likely to rate their oral health as poor than in the non-urgent care group (7.9% vs. 3.0%, $p = 0.01$). The urgent care group reported less regular tooth brushing (4.4% vs. 1.1%, $p = 0.01$) along with problems with dentures (6.1% vs. 2.0%, $p = 0.01$) and wisdom teeth (13.2% vs. 6.4%, $p < 0.01$) than in the non-urgent care group. Additionally, pain was reported more in the urgent care group than in the non-urgent care group for all three pain variables: tooth pain within one year (60.5% vs. 32.8%, $p < 0.01$); facial pain (34.2% vs. 10.8%, $p < 0.01$); jaw or tooth pain with biting (28.1% vs. 8.5%, $p < 0.01$). Swelling in the mouth or jaw and swollen gums were more frequently reported in the urgent care group (than in the non-urgent care group (27.2% vs. 5.6%, $p < 0.01$ and 28.1% vs. 12.5%, $p < 0.01$, respectively).

Additional oral symptoms also were more frequently reported in the urgent care group than non-urgent care group including: mouth sores (19.3% vs. 6.0%, $p < 0.01$); change in speech or eating due to oral problems, (17.5% vs. 7.3%, $p < 0.01$); loose teeth (23.7% vs. 9.8%, $p < 0.01$); bleeding in the mouth (21.1% vs. 12.2%, $p < 0.01$), and broken teeth or fillings (33.3% vs. 16.6%, $p < 0.01$). Dentate versus non-dentate status, flossing, dentures, dentist visit within the past year, difficulty swallowing solid food, having a specific rather than comprehensive consultation, xerostomia, parafunctional habits, and limited jaw opening did not differ statistically between the groups.

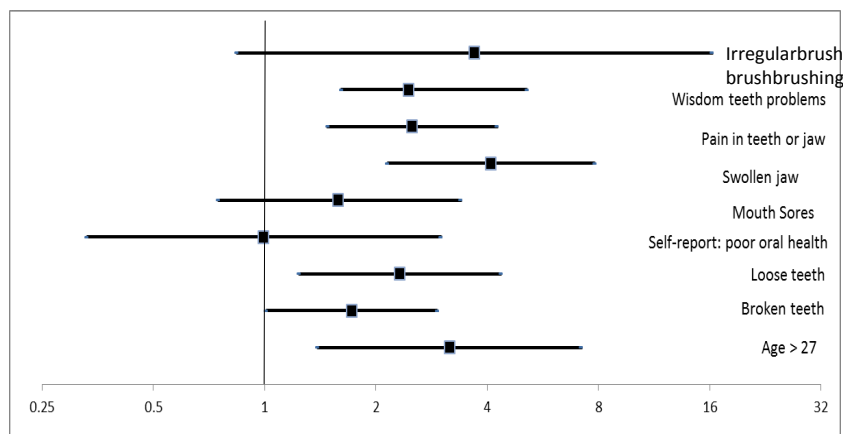
Multivariate predictors of urgent care needs

Univariate logistic regression screening was performed for all variables in Table 1 and statistical significance was similar to the between group comparisons. Figure 1 displays selected odds ratio and corresponding 95% CI for of each variable while controlling for the other variables in the multivariate model. Swelling in the mouth or jaw was the best predictor of needing urgent care (OR = 4.09, 95% CI = 2.15

Table 1. Demographic Characteristic, Smoking and Alcohol Use, Oral Care Habits, And Symptoms Of Oral Complications for the Total Sample and by Urgent Care Groups.

| | Total Sample (n = 1004) | Urgent Care (n = 114) | Non-urgent Care (n = 890) |
|---|----------------------------|--------------------------|------------------------------|
| Age | 46.08 ± 17.33 | 52.27 ± 15.24 | 45.30 ± 17.44 |
| Gender (female) | 557 (55.5%) | 60 (52.6%) | 497 (55.8%) |
| Tobacco use | 109 (10.9%) | 16 (14.0%) | 93 (10.4%) |
| Pack/day | 1.02 ± 1.33 | 1.0 ± 0.76 | 1.03 ± 1.43 |
| Alcohol use | 588 (58.6%) | 62 (54.4%) | 526 (59.1%) |
| Drink/day | 1.74 ± 0.84 | 2.08 ± 0.82 | 1.70 ± 0.83 |
| Oral status | | | |
| No teeth | 5 (0.5%) | 1 (0.9%) | 4 (0.4%) |
| Some teeth | 65 (6.5%) | 11 (9.6%) | 54 (6.1%) |
| Most teeth | 877 (87.4%) | 94 (82.5%) | 783 (88.0%) |
| Tooth brushing | | | |
| Irregular | 15 (1.5%) | 5 (4.4%) | 10 (1.1%) |
| Once a day | 186 (18.5%) | 25 (21.9%) | 161 (18.1%) |
| Twice a day | 798 (79.5%) | 82 (71.9%) | 716 (80.4%) |
| Flossing | | | |
| Never | 62 (6.2%) | 11 (9.6%) | 51 (5.7%) |
| Irregular | 417 (41.4%) | 44 (38.6%) | 372 (41.8%) |
| At least once a day | 502 (50.0%) | 55 (48.2%) | 447 (50.2%) |
| Dentures | 68 (6.8%) | 11 (9.6%) | 57 (6.4%) |
| Denture problem | 25 (2.5%) | 7 (6.1%) | 18 (2.0%) |
| Wisdom teeth problem | 72 (7.2%) | 15 (13.2%) | 57 (6.4%) |
| Seen Dentist w/in one year | 975 (97.1%) | 112 (98.2%) | 863 (97.0%) |
| Tooth pain w/in one year | 363 (36.0%) | 69 (60.5%) | 292 (32.8%) |
| Facial pain | 135 (13.4%) | 39 (34.2%) | 96 (10.8%) |
| Swelling in mouth or jaw | 81 (8.1%) | 31 (27.2%) | 50 (5.6%) |
| Mouth sores | 75 (7.5%) | 22 (19.3%) | 53 (6.0%) |
| Change in speech/ eating due to oral problems | 85 (8.5%) | 20 (17.5%) | 65 (7.3%) |
| Difficulty swallowing solid food | 22 (2.2%) | 4 (3.5%) | 18 (2.0%) |
| Loose teeth | 114 (11.4%) | 27 (23.7%) | 87 (9.8%) |
| Bleeding in mouth | 133 (13.2%) | 24 (21.1%) | 109 (12.2%) |
| Swollen gums | 143 (14.2%) | 32 (28.1%) | 111 (12.5%) |
| Broken teeth or filings | 186 (18.5%) | 38 (33.3%) | 148 (16.6%) |
| Consultation (specific) | 850 (84.7%) | 100 (87.7%) | 750 (84.3%) |
| Xerostomia | 109 (10.9%) | 15 (13.2%) | 94 (10.6%) |
| Grind teeth | 332 (33.1%) | 36 (31.6%) | 296 (33.3%) |
| Jaw or tooth pain with biting | 108 (10.8%) | 32 (28.1%) | 76 (8.5%) |
| Jaw opening limited | 60 (6.0%) | 9 (7.9%) | 51 (5.7%) |
| Self-report of oral health | | | |
| Poor | 36 (3.6%) | 9 (7.9%) | 27 (3.0%) |
| Fair | 318 (31.7%) | 40 (35.1%) | 278 (31.2%) |
| Good | 644 (64.1%) | 63 (55.3%) | 581 (65.3%) |

Demographic characteristic, smoking and alcohol use, oral care habits, and symptoms of oral complications are presented as means ± standard deviations for continuous variables and as frequencies with percentages for categorical variables. Data is presented for all subjects (total sample) and for the urgent and non-urgent care groups.



Selected odds ratio and corresponding 95% CI for of each variable while controlling for the other variables in the multivariate model. Variables that were statistically significant predictors in the univariate model were included in the multivariate model.

Figure 1. Multivariate odds ratios for predicting urgent care needs.

- 7.81, $p < 0.01$). Other variables that remained statistically significant predictors in the multivariate logistic regression model were wisdom teeth problems (OR = 2.45, 95% CI = 1.61-5.17, $p < 0.01$), jaw or tooth pain with biting (OR = 2.50, 95% CI = 1.48-4.25, $p < 0.01$), loose teeth (OR = 2.32, 95% CI = 1.24-4.35, $p < 0.01$), broken teeth or filings (OR = 1.72, 95% CI = 1.01-2.93, $p < 0.01$) and age over 27 years old (OR = 3.16, 95% CI = 1.39-7.19, $p < 0.01$).

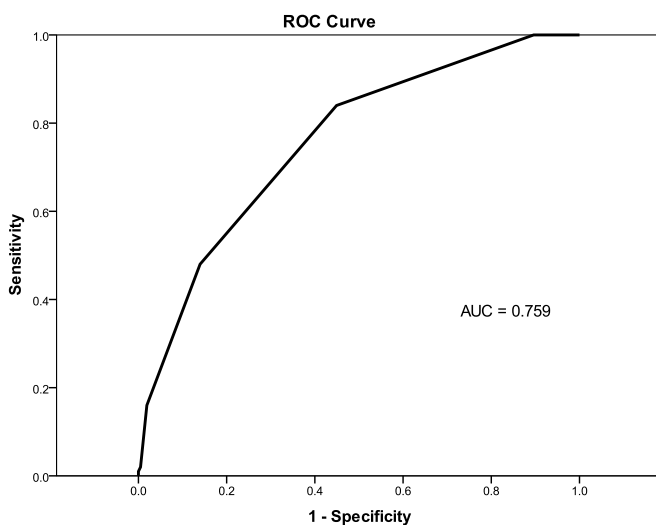
Diagnostic capability

The oral health composite score was computed and included the following variables: swelling in the mouth or jaw, wisdom teeth problems, jaw or tooth pain with biting, loose teeth, broken teeth or filings and age > 27 years old. Scores ranged from zero (9.3%) to six (0.1%) with the mean score of 1.62 ± 0.98 . The oral health composite score had modest urgent care diagnostic capability (AUC = 0.759) (Figure 2). The optimal cutoff was 1.5 corresponding to a sensitivity of 0.84 and a specificity of 0.55.

Discussion

The study evaluated the potential utility of PRO to predict the urgency of dental treatment in an out patient population. The goal is to develop a PRO that may provide data suggesting the need for dental evaluation and treatment for use in medically complex populations. Our findings suggest utility in this outpatient population. Further development requires evaluation of this PRO in specific medically complex populations.

Responses of patients requiring urgent dental care were less likely to report their oral health as good than patients in the non-urgent dental care group. Predictors of urgent oral care needs, when controlling for other predictors, included swelling in the mouth or jaw, third molar problems, jaw or tooth pain with biting, loose teeth, broken teeth or filings and age > 27 years old. Overall the strongest predictors of urgent oral care needs included swelling in the mouth or jaw, followed by age > 27 years, third molar problems, jaw or tooth pain with biting and loose teeth (Figure 2).



Oral Health Composite Score was computed as follows: predictor variables that were statistically significant predictors in the multivariate model received a weight of one for having the risk factor in the equation and zero for not having the risk factor and the oral health composite score was determined by summing the score.

Figure 2. Receiver Operating Characteristic Curves for Oral Health Composite Score with all Statistically Significant Predictors in the Oral Health Composite Score.

Creating a score from predictors allowed for modest diagnostic capability (AUC= 0.704). As this instrument provides an adjunctive instrument for non-dental trained health care providers, moderate diagnostic capability may be acceptable in this clinical setting. It is not however, a substitution for a clinical dental examination. Future studies should address how the PROS instrument could be revised to provide higher diagnostic capability. The instrument should be assessed in the medical setting among patients with underlying medical comorbidities, those in whom dental conditions may require treatment prior to medical management, and in patients in which the medical therapy limits future dental treatment. Additionally, the instrument should be used to identify patients who require preventive protocols for maintenance of oral health following acute medical care.

The PROS tool was primarily developed for patients with solid tumors such as breast, colon, prostate and lung for use prior to cancer treatment, as there are no current guidelines that require oral and dental examinations before treatment. This is in contrast to patients with HNC and stem cell transplants, in which current guidelines recommend that all patients receive comprehensive dental, oral, and head and neck examinations and necessary treatment, prior to cancer treatment. For many other patients who are at high risk of complications from untreated dental disease, the PROS tool may play an important role in identifying urgent oral care needs in patients with medical conditions such as poorly controlled diabetes, patients with renal, cardiac and hepatic diseases, people admitted to long-term care facilities, and in patients planning to or currently receiving osteolytic inhibitors.

The current study was conducted in a periodontal referral-based practice and therefore represents a specific patient population, unrelated to the general dental medical population that does not receive periodontal referral. The patients are older than the general dental practice cohort, and this is a biased sample as these patients were referred to the periodontal practice for problems that were already screened by the referring dentist. Although these populations may not be representative of other clinical populations, the sample size was large to help identify the reliability of this novel questionnaire. The findings in the current patient population suggest that PROS may identify a majority of urgent dental care needs. Additional research is needed to determine this tool's clinical effectiveness in other clinical populations. The current findings from this study suggest that PROS may differentiate patients with more urgent dental needs in an already-referred population.

Conclusions

An instrument that provides close correlation between patient-reported oral health and intra-oral clinical exam could be useful in multiple scenarios where barriers to access to care exist. Potential applications include medically-complex patient populations such as cancer patients, in large-scale community based screenings and outreach to underserve and geographically remote populations. Additionally, non-dental health care professionals may find an instrument that accurately predicts oral health status useful to determine which patients may require urgent dental referral and intervention in high risk patient populations and when focused oral health training is lacking.

This study suggests that patients who have swelling in the mouth or jaw, third molar problems, jaw or tooth pain with biting, and loose teeth should be considered for referral for urgent care based on those symptoms alone. If the patient is medically complex and may receive medical treatment that may increase risk of infection from any source

(including dental), or result in limitations of future options for care (specifically invasive and surgical procedures) complete oral and dental examination should be performed by experienced dental professionals. The PROS screening form presents a novel instrument that provides a reliable way to potentially identify people with urgent dental care needs based on patient reported dental and oral symptoms. The instrument is brief and simple to administer and can be used in a variety of settings when an oral exam by a trained dental professional is prohibited because of access to dental care or the urgency of medical care and should be evaluated in other clinical settings.

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Conflict of interest

The Authors have no potential conflicts of interest to disclose.

Appendix 1:

PRO Oral/Dental Screening Form for Oral Health

Patient's name: _____ Date: _____

Age: _____ Gender: M / F PID: _____

Consult: Comprehensive / Specific

Tobacco use: _____NO _____YES _____packs _____ per day or _____ week

Alcohol use: _____NO _____YES _____drinks _____ per day or _____ week

Oral status: _____ No teeth _____some teeth _____most teeth

Tooth brushing: _____ Never _____Irregular _____Once a day _____ Twice a day

Tooth flossing/Interdental cleaning: _____ Never _____Irregular _____At least once a day

Do you wear dentures? YES _____ NO _____

Do you have problems with your dentures? YES _____ NO _____

Do you have problems with 3rd molars (wisdom teeth)? YES _____ NO _____

Have you seen a dentist in the past year? YES _____ NO _____

Have you had dental (tooth) pain in the past year? YES _____ NO _____

Do you have any facial pain/ tooth pain now? YES _____ NO _____

Do you have any mass or swelling in the mouth or jaw? YES _____ NO _____

Do you have sores in your mouth? YES _____ NO _____

Have you had any change in speech or in eating due to mouth problems? YES _____ NO _____

Do you have difficulty swallowing solid food? YES _____ NO _____

Do you have loose teeth? YES _____ NO _____

Do you have bleeding in your mouth? YES _____ NO _____

Do you have swollen gums? YES _____ NO _____

Do you have any broken teeth or broken fillings? YES _____ NO _____

Do you have dry mouth? YES _____ NO _____

Do you grind your teeth? YES _____ NO _____

Do you have any jaw or tooth pain with biting? YES _____ NO _____

Is your jaw opening limited? YES _____ NO _____

How would you describe your oral health? _____Good _____Fair _____Poor

For office use only:

• Patient requires urgent care? _____ YES _____NO

• If yes, cite reason:

o Pain requiring analgesics

o Swelling

o Suspicious lesion

Other: _____

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