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Utilizing Dental Electronic Health Records Data to Predict Risk for Periodontal Disease

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Abstract

Periodontal disease is a major cause for tooth loss and adversely affects individuals' oral health and quality of life. Research shows its potential association with systemic diseases like diabetes and cardiovascular disease, and social habits such as smoking. This study explores mining potential risk factors from dental electronic health records to predict and display patients' contextualized risk for periodontal disease. We retrieved relevant risk factors from structured and unstructured data on 2,370 patients who underwent comprehensive oral examinations at the Indiana University School of Dentistry, Indianapolis, IN, USA. Predicting overall risk and displaying relationships between risk factors and their influence on the patient's oral and general health can be a powerful educational and disease management tool for patients and clinicians at the point of care.

Keywords:

Periodontal disease; diabetes; smoking; risk factors; risk prediction; dental electronic health records.

Introduction

Periodontal disease (PD) is a significant oral health challenge, with almost half of all US adults aged 30 years and older (65 million adults) diagnosed or at risk for the disease [1]. Several systemic conditions and social behaviors such as diabetes and smoking are major risk factors for PD. Numerous risk assessment approaches identify patients at risk for PD. However, they face multiple barriers such as duplicate data entry and insufficient explanation of the risk factor's influence on PD status. Increasing HER adoption in dental practices and availability of detailed, patient data offers an opportunity to explore risk prediction for PD [2]. In this study, we explore mining selected risk factors from a dental EHR to create a preliminary risk prediction model for periodontal disease.

Methods

Our data set contains 2,370 individuals, 18 years and older, who underwent a comprehensive dental care examination (CDT code - D0150) between January 1, 2011 and January 1, 2012 from the dental EHR implemented at the Indiana University School of Dentistry, Indianapolis, IN, USA. The data included demographics, medical and dental history, social history, oral findings, treatment history, diagnosis, and treatment planning in a structured or free-text format. We

extracted the known risk factors for PD from a subset of 200 randomly selected patients. For free text data, we built regular expressions for the keywords used by the providers to document a condition and converted free text into discrete values (present = 1, absent = 0), with manual comparison for accuracy. A novel risk prediction and visualization tool from prior research was applied to assess contextualized PD risk of an individual that combined dimensionality reduction, LDA-based classification and risk factor visualization [3].

Results

We retrieved risk factors of demographics, insurance, poor oral hygiene, bone loss information, vertical bone lesions, furcation involvement, subgingival restorations and calculus, deepest pocket depth, bleeding on probing, smoking, and diabetes. The accuracy with automated data was 92%, recall was 73% and precision was 93%. The precision was low for poor oral hygiene, furcation involvement, localized bone loss and subgingival calculus. Implicit keywords were missed in regular expressions such as bacterial plaque and calculus for poor oral hygiene and bone loss in a particular region for localized bone loss, resulting in low recall. The risk prediction and visualization method predicted 1,076 patients to be at high risk, with bone loss and demographic factors to be prominent risk drivers in this population. Ongoing analysis examines factor combinations to predict PD risk for the population and individual.

Conclusion

The risk assessment approach developed in this research has the potential to visualize and address the risk factors influencing a patients' PD as well as underlying systemic conditions at the point of care.

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