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A Comparison of Recommendations from a Computer-Based Decision System and Tobacco Treatment Specialists: Insights and Lessons Learned

Andrey Soares[a], Alireza Khamesipour[b], Joan M. Davis[c]

[a] *School of Medicine, University of Colorado, Aurora, CO, USA*
[b] *School of Technology & Computing, City University of Seattle, Seattle, WA, USA*
[c] *Missouri School of Dentistry and Oral Health, A.T. Still University, St. Louis, MO, USA*

Abstract

This pilot study examines the similarities and differences between treatment recommendations offered by a decision system and trained tobacco treatment specialists. Using a sample of ten de-identified patient cases who used tobacco, we compared recommendations from the manual and preliminary review of cases by four tobacco specialists with the automated analysis of patient cases using both the first version of the rule-based system and the second version with improved and additional rules.

Keywords:

Tobacco Cessation; Decision Making; Decision Support System, Clinical

Introduction

With approximately 70% of smokers visiting a healthcare provider at least once a year [1], numerous opportunities exist for personalized tobacco cessation interventions [2]. The aim of this pilot study was to compare the treatment recommendations offered by a computer-based decision system with recommendations from trained tobacco treatment specialists to assess adherence to a guideline and gain insights for developing effective evidence-based tools for informed medical decisions.

Methods

This pilot study involved four main steps: 1) creation of a dataset with ten de-identified dental patient cases, 2) execution of the system to analyze the cases using both the first version of the rule-based system (RBS1) and the second version with enhanced rules (RBS2), 3) analysis of the cases by four tobacco treatment specialists (TTS), and 4) comparison of the recommendations offered by the system and the specialists. The rule-based system used in this study was composed of three parts (Figure 1): facts (data) about a patient's health, a set of computable rules with embedded knowledge about tobacco cessation extracted from the Treating Tobacco Use and Dependence: 2008 Guideline [1], and a rule engine to process the facts and trigger the appropriate rules. After processing the data using the rules, the system generates a tailored list of treatment recommendations, and a list of discussion points for the healthcare provider to discuss with the patient. The data was analyzed for inter-rater reliability (IRR), correlation coefficients between treatment recommendations offered by the TTS, and percentage of treatments used by the system and the specialists. IRR agreement between multiple raters used Krippendorff's alpha (α), and the agreement between two raters used Cohen's kappa (k)

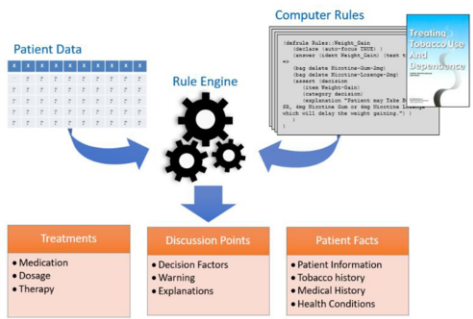

Figure I- Components of the Rule-based system

We used a dataset with ten randomly selected de-identified patient cases from the records obtained from a U.S. Midwest university-level dental hygiene clinic. The data includes information related to the patient's gender, age, ethnicity, pregnancy, type of tobacco used, level of nicotine dependence, previous quit attempts, systemic disease (e.g., heart disease, lung disease), and observations (e.g., weight, height, blood pressure) for a total of 41 health factors per case. The cases contained varying levels of completeness including recording of smoking status/habits, medical history/conditions, and occasionally inconsistent information. Three sets of recommendations were collected for this pilot study: from the system using the initial and enhanced rules, and from the tobacco treatment specialists. The specialists completed the analysis of the de-identified patient data and were asked to offer treatment recommendations and comments relevant to the cases, which provided insights on the factors influencing their decision for treatment. The possible treatment recommendations included motivational interviewing (MI), bupropion (150mg), nicotine gum (2mg and 4mg), nicotine inhaler (10mg/mL), nicotine lozenge (2mg and 4mg), nicotine patch (7mg, 14mg and 21mg), nicotine spray (10mg/mL), Varenicline (0.5mg), cognitive behavioral therapy (CBT), and referral to a quitline.

Results

Table 1 shows the preliminary treatment recommendations offered by the two versions of the system (RBS1 and RBS2) and by each of the four TTS for case #1. The table cells marked with "x" represent that the option was selected and could be used for a treatment plan, including combination therapy or alternative options. For example, TTS-1 recommended a treatment plan

with MI + 14mg patch + 2mg gum or 2mg lozenge + CBT + referral to a quitline.

Table 1- Preliminary recommendations for case #1

	Readiness to Quit	Motivational	Bupropion 150mg	Gum 2mg	Gum 4mg	Inhaler 10mg/mL	Lozenge 2mg	Lozenge 4mg	Patch 7mg	Patch 14mg	Patch 21mg	Spray 10mg/mL	Varenicline 0.5mg	CBT	Referral to Quitline
RBS1		x		x		x		x	x			x	x		
RBS2		x		x		x		x	x			x		x	x
TTS-1		x		x			x			x				x	x
TTS-2		x			x	x		x			x				x
TTS-3		x				x				x				x	
TTS-4		x			x	x		x		x		x		x	x

The average reliability agreement between all TTS is 0.294, with the highest agreement for case #2 (α=0.503), and the lowest for case #3 (α=0.1). The pair TTS-1 and TTS-3 have the most agreements (mean k=0.433). The pair TTS-3 and TTS-4 was the only pair with very good agreements for cases #2 and #7 with k=0.857 and k=0.815, respectively. The pair TTS-2 and TTS-4 had the least agreements (mean k=0.169), including no agreements in cases #4, #8 and #10. The agreement between the RBS1 and all TTS had an average of 0.161. The system had mostly no, poor and fair agreements, with no moderate agreement and the only good agreements between the pair TTS-1 and TTS-2 for case #10. The RBS1 had disagreements with TTS for all cases, including disagreement with all TTS for case #9, which is a patient that uses snuff, a smokeless tobacco product. The RBS1 had the most paired agreement with TTS-1 (mean k=0.037) and the least paired agreement with TTS-3 (mean k=-0.106). Figure 2 shows the results of the second version of the rule-based system (RBS2). The overall agreement (mean α=0.313) of the RBS2/TTS (grey circles) shows improvement from the first version (mean α=0.161) of system (RBS1) and more alignment with the TTS. The RBS2 had the most paired agreement with TTS-1 (mean k=0.463), including very good agreement for cases #4 (k=1.0) and good agreements for cases #2, #5, #7 and #10 (k between 0.602 and 0.737), and the least paired agreement with TTS-2 (mean k=0.27).

An analysis of treatment recommendations offered by the TTS shows correlations of some treatments that align with the 2008 Guideline. Nicotine lozenge 2mg and nicotine gum 2mg (r=0.81, p≤.001), and nicotine lozenge 4mg and nicotine gum 4mg (r=0.63, p≤.001) had positive relationship because the medications have similar nicotine content and could be used interchangeably. Similarly, spray and inhaler (r=0.51, p≤.001) and spray and patch 21mg (r=0.59, p≤.001) had positive relationship as they can be used for fast nicotine absorption. The most selected medications among TTS were nicotine lozenge 4mg (62.5%) followed by nicotine gum 4mg (47.5%) and bupropion and nicotine patch 21mg (40%). The least used medications were nicotine patch 7mg (15%), and nicotine lozenge 2mg and nicotine nasal spray (25%).

Conclusions

We were able to show the potential of using a rule-based system to support cessation interventions, and the improvement in the reliability agreement between the first (RBS1) and the second version of the system (RBS2) when compared with specialists' recommendations. The differences in treatment between the rule-based system, the individual TTS and among all TTS demonstrates the need to further refine treatment rules so that they accurately reflect not only the 2008 Guideline but current treatment protocols and patient differences. Future evidence-based tools must be designed to address the needs of the clinician and must also take into consideration provider knowledge, behavioral based conditions, patient preferences, level of confidence the treatment fits the patient's needs, and clinicians professional experience.

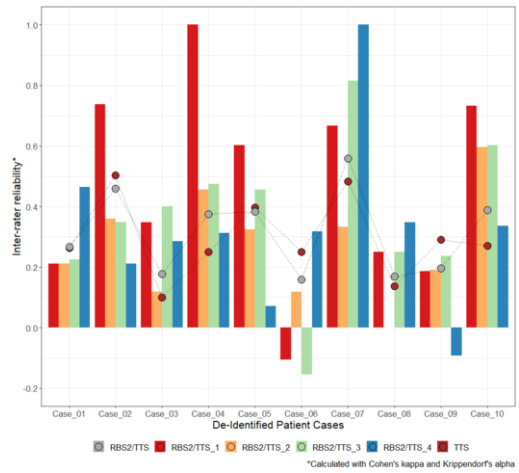

Figure 2- Inter-rater reliability agreement between the RBS2 and each TTS (bars), among TTS only (brown circles), and among RBS2 and TTS (grey circles)

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Address for correspondence

Andrey Soares, andrey.soares@cuanschutz.edu
School of Medicine, University of Colorado