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DEVELOPMENT AND VALIDATION OF T-BACCO SCORE A PROGNOSTIC TUBERCULOSIS (TB) LOSS TO FOLLOW-UP SCORING TOOL AMONG TB SMOKERS

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ABSTRACT

Loss to follow-up (LTFU) and smoking during TB treatment are major challenges for TB control programs. Smoking increases the severity and prolongs TB treatment duration, leading to a higher LTFU rate. We aim to develop a prognostic scoring tool to predict LTFU among TB patients who smoke to improve successful TB treatment outcomes. The development of the predictive model utilized prospectively collected longitudinal data of adult TB patients who smoked in the state of Selangor between the years 2013 until the year 2017, which were obtained from the Malaysian Tuberculosis Information System (MyTB) database. Data were randomly split into development and internal validation cohorts. A simple prognostic score (T-BACCO SCORE) was constructed based on the regression coefficients of predictors in the final logistic model of the development cohort. The estimated missing data was 2.8% from the development cohort and was completely at random. Model discrimination was determined using c-statistics (AUCs), and calibration was based on the Hosmer and Lemeshow goodness of fit test and calibration curve. The model highlights several variables with different T-BACCO SCORE values as predictors for LTFU among TB patients who smoke (e.g., age group, ethnicity, locality, nationality, educational level, monthly income level, employment status, TB case category, TB detection methods, X-ray categories, HIV status, and sputum status). The scores were categorized into three groups that predict the risk for LTFU: low-risk (<15 points), medium-risk (15 to 25 points), and high-risk (> 25 points). T-BACCO SCORE exhibited fair discrimination with a c-statistic of 0.681 (95% CI 0.627-0.710) and good calibration with a nonsignificant chi-square Hosmer–Lemeshow's goodness of fit test $\chi 2=4.893$ and accompanying p-value of 0.769. In the external validation of T-BACCO SCORE, the validation model provided a good discrimination ability with an AUC of 0.706 (95% CI 0.636-0.775), which is comparable with the discriminative performance of the development model AUC 0.681 (95% CI 0.652-0.710). This value indicates that the T-BACCO SCORE model was able to distinguish 70.6% correct of the LTFU outcome among TB patients who smoke. The validation model has a nonsignificant chi-square Hosmer–Lemeshow goodness of fit test value, $\chi 2=5.037$, p-value = 0.754, and a satisfactory calibration curve. A larger population pool is needed for a strong calibration performance for model validation. In sum, predicting LTFU among TB patients who smoke in the early phase of TB treatment is achievable using this simple T-BACCO SCORE. The tool's applicability in clinical settings helps healthcare professionals manage TB smokers based on their risk scores.

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CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

Tuberculosis (TB) is one of the diseases with the highest morbidity and mortality. An estimated 10 million cases of TB occurred in 2019, leading to 1.3 million death worldwide (WHO, 2019). TB is listed as one of the major health challenges in the Sustainable Developmental Goals (SDGs) as stated in Goal 3.3; "end the epidemics of HIV/AIDS, TB, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases, and other communicable diseases". The global fight against TB has been intensified under the "End TB Strategy" to end the global TB epidemic by 2035. The 2035 targets are to reduce the TB incidence rate by 90% to 10 cases per 100000 population per year, to reduce the absolute number of TB death by 95% compared to the baseline of 2015, and to eliminate catastrophic costs faced by TB-affected families (WHO, 2015). This ambitious target can only be achieved over the next 20 years if there is intensive action by all countries in implementing all the pillars and components outlined in the action guideline developed by the WHO's Global TB Programme.

TB is the leading cause of death in Malaysia from a single infectious disease ranking above HIV/AIDS, dengue fever, and malaria from 2012-2016 (Ministry of Health 2017). At the same times, TB and smoking are increasingly co-existent globally (Gajalakshmi, Peto, Kanaka, & Jha, 2003). The effect of smoking was predicted to increase the number of TB cases by 7% and the death rate by 66% compared to a model prediction that did not account for the effect of smoking (Basu, Stuckler, Bitton, & Glantz, 2011a). A large proportion of the TB burden was attributed to smoking (40%), followed by diabetes mellitus(15%) (Lönnroth et al., 2010b). Tobacco smoke exposure increases TB risk independent of other risk factors such as socioeconomic status, intravenous drug use, and alcohol consumption (Dujaili, Sulaiman, Awaisu, Muttalif, & Blebil, 2011). TB, combined with the effect of smoking, will simultaneously damage the lungs and interact at the cellular and an immunological level (Schneider & Novotny, 2007). Besides playing a vital role in the development of TB, smoking is also an independent predictor of poor TB treatment outcomes, including the loss to follow-up