**Title:** Identify Patterns of Importance Risk Factors Associated with STI Testing among Adolescents in Local School Districts and States around the United States Using YRBSS 2019 Data use Machine Learning Algorithm

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**Introduction:** Brief background/context for your study, gaps in relevant knowledge, the significance of the proposed research, the study question you hope to answer

Burden of disease

The health of the young American population aged 15 to 24 is facing significant challenges from sexually transmitted infections (STI), which include chlamydia, gonorrhea, genital herpes, human papillomavirus (HPV), syphilis, and HIV, defined by the Centers for Diseases Control and Prevention (CDC). Young people account for at least half of all new sexually transmitted infections (STIs) contracted yearly, and a quarter of sexually active adolescent females have STIs(Shannon & Klausner, 2018). In 2021 alone, there were at least 2.5 million reported cases of chlamydia, gonorrhea, syphilis, and congenital syphilis, according to the CDC. From 2020 to 2021, syphilis cases alone have risen by 26%, and the number of syphilis cases last year was the highest since 1948(Liddon et al., 2022). Scientists believe that the number of cases is underreported, and there are untreated infections, so these numbers may be higher.

The consequence or harm of STI among teenagers.

Most STIs cause significant suffering in the acute phase and can produce long-term damage with severe consequences, such as miscarriage, infertility, heart and bone, and even brain damage(Nicoll & Hamers, 2002). The increase in the incidence of STDs may also bring many serious consequences, such as increased drug resistance to STDs, poor health quality of the next generation, increased social and medical costs, and increased social insecurity(WHO regional office for Europe, 2001). Considering the severe consequences and disease burden on the population and individual level of adolescent health, multiple organizations and agencies recommend some STI screening for adolescents. In addition, STIs are characterized by un-symptomatic occurrences, which can infect others unknowingly(Samkange-Zeeb et al., 2011).

Different resources of STI testing in different states and local school districts.

According to the National Academies of Sciences, health inequities have become a major challenge for the nation, resulting in health disparities between states and school districts around the United States(Weinstein et al., 2017). In addition, the communities encountered threats from inequalities in health, sociality, ethnicity, economy, employment, and education that can impede the deployment of STI testing to adolescents.

STI testing is an effective way of reducing STIs.

STI testing is an effective way of reducing STIs. The implementation of STI testing guided by the WHO **A**ffordable, **S**ensitive, **S**pecific, User-friendly, **R**apid and robust, **E**quipment-free, and **D**eliverable criteria become a benchmark for controlling the rapid spreading of STIs globally(Peeling, Holmes et al., 2006). The STI screening provided its value in controlling the spreading of STIs by interrupting the transmission chain between the patients and their sexually active partners(Dewart et al., 2018). Most STIs can be treated with a single dose of antibiotics. Therefore, the early and high prevalence of testing is crucial in controlling the rising STIs among adolescents in the United States(Peeling, Mabey, et al., 2006).

The complex YRBSS dataset and limitations of traditional statistic analysis methods, and the ML method is an effective ways of dealing with the challenge.

Traditional statistical methods may have limited ability to handle such data. Machine learning (ML) mainly focuses on prediction, and epidemiology mainly needs to know causal effects (causal/etiologic inference), requires background knowledge, and is biased towards parametric/semiparametric estimation, so it is not easy to combine the two. However, in recent years an increasing number of studies on machine learning have been published in frontier epidemiological methods, with a primary focus on public health, explaining chronic diseases, risk factors for chronic diseases, and infectious, parasitic, and communicable diseases(dos Santos et al., 2019). Machine learning (ML) algorithms provide an effective tool for analyzing these datasets and can find hidden links and patterns in the data that may be difficult to spot using more traditional approaches(Mooney & Pejaver, 2018). These methods have the potential to considerably advance our knowledge of STI testing risk factors and make it possible to identify vulnerable individuals more precisely.

Research gap

The low prevalence of STI testing is threatening the populational health of teenagers(St Lawrence et al., 2002). Previous studies identified barriers, such as limited access to healthcare, parental pressure, social stigma, STI-related attitudes, and limited knowledge of STIs and their consequences, that prevent adolescents from receiving STI testing(Copen et al., 2015-2016 CDC.)(Bronwen Lichtenstein, 2003)(Shepherd & Harwood, 2017). However, limited studies research the pattern of risk factors associated with STI testing and compare the difference between the pattern of risk factors in different states and local school districts. The association between risk factors and STI testing in local school districts and states has yet to be fully understood.

Significance of study

In this study, we used machine learning methods to improve the accuracy of the model’s ability to explain the association based on the YRBSS dataset. The understanding of risk factor patterns between different states and local school districts is essential in identifying and providing appropriate aid and support precisely for vulnerable populations among adolescents.

Research question

The purpose of this study is to examine the pattern of risk factors' importance associated with STI testing and compare the difference between the pattern of risk factors' importance in different states and local school districts using the data from the Youth Risk Behavior Surveillance System (YRBSS) 2019 database. We employ machine learning techniques to analyze the association between age, gender, school grade, race, unintentional injuries and violence, tobacco use, alcohol and other drug use, and risky sexual behavior with STI testing other than HIV.

**Study Aims:** 1‐2 specific study aims/study questions

Aim 1: To identify the risk factors associated with STI testing other than HIV among high school students.

Aim 2: To compare the patterns of risk factors associated with STI testing other than HIV among high school students between selected states and local school districts.

Aim 3: Compare the performance of multinomial logistic regression, random forest, support vector machines (SVM), Elastic Net regression, ridge regression, lasso regression, and classification tree methods on the analysis of YRBSS dataset.

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