Effects of Coronavirus Disease Pandemic on Tuberculosis Notifications, Malawi

Appendix

Models

We used 2 models to estimate effects of coronavirus disease (COVID-19) on rates of tuberculosis (TB) case notifications in Blantyre, Malawi. One model estimates the effects of COVID-19 on TB case notifications, the other estimates differential effects of COVID-19 on TB case notifications by various factors.

Model 1

To estimate effects of COVID-19 on Blantyre TB case notification rates we used the following formula:

\[ \log(\text{cases}) = \alpha + \beta_1(\text{covid}) + \beta_2(\text{month}) + \beta_3(\text{covid} \times \text{month.since.covid}) + \log(\text{population}) \]

In this formula, cases are the expected numbers of notified TB cases per month, \( \alpha \) is the intercept, \( \text{covid} \) is the indicator variable for the period before or after introduction of COVID-19 restrictions (before or after April 1, 2020), \( \text{month} \) is the indicator for month from June 2016, \( \text{month.since.covid} \) is the number of months after April 1, 2020, and \( \text{population} \) is the monthly updated population denominator for Blantyre District.

Model 2

To estimate differential effects of COVID-19 on the number of TB cases notified by sex, HIV status, and whether TB was diagnosed at a primary care versus central hospital, we used the following formula:

\[ \log(\text{cases}) = \alpha + \beta_1(\text{male}) + \beta_2(\text{hivpositive}) + \beta_3(\text{facqech}) + \sum_{i,j,k} \beta_{i,j,k}^{(0)}(\text{sex}_i \times \text{hiv}_j \times \text{fac}_k) \cdot \text{month} + \text{covid} \times \sum_{i,j,k} \beta_{i,j,k}^{(1)}(\text{sex}_i \times \text{hiv}_j \times \text{fac}_k) \cdot \text{month.since.covid} \]
In this formula, cases indicates the expected numbers of notified TB cases per month, $\alpha$ is the intercept, covid is the indicator variable for the period before or after introduction of COVID-19 restrictions (before or after April 1, 2020), month is the indicator for month from June 2016, month.since.covid is the number of months after April 1, 2020, sex$_i$ is the indicator for the sex of a person ($i = \text{positive}, \in = \text{negative}$), hiv$_j$ is the indicator for HIV status of person ($j = \text{male}, \in = \text{female}$), fac$_k$ is the indicator for the facility where TB was diagnosed ($k = \text{hc}, \in = \text{qech}$) in which hc indicates a primary healthcare center and qech indicates Queen Elizabeth Central Hospital.