

Using private TB sector sales data to refine subnational burden estimates in Pakistan

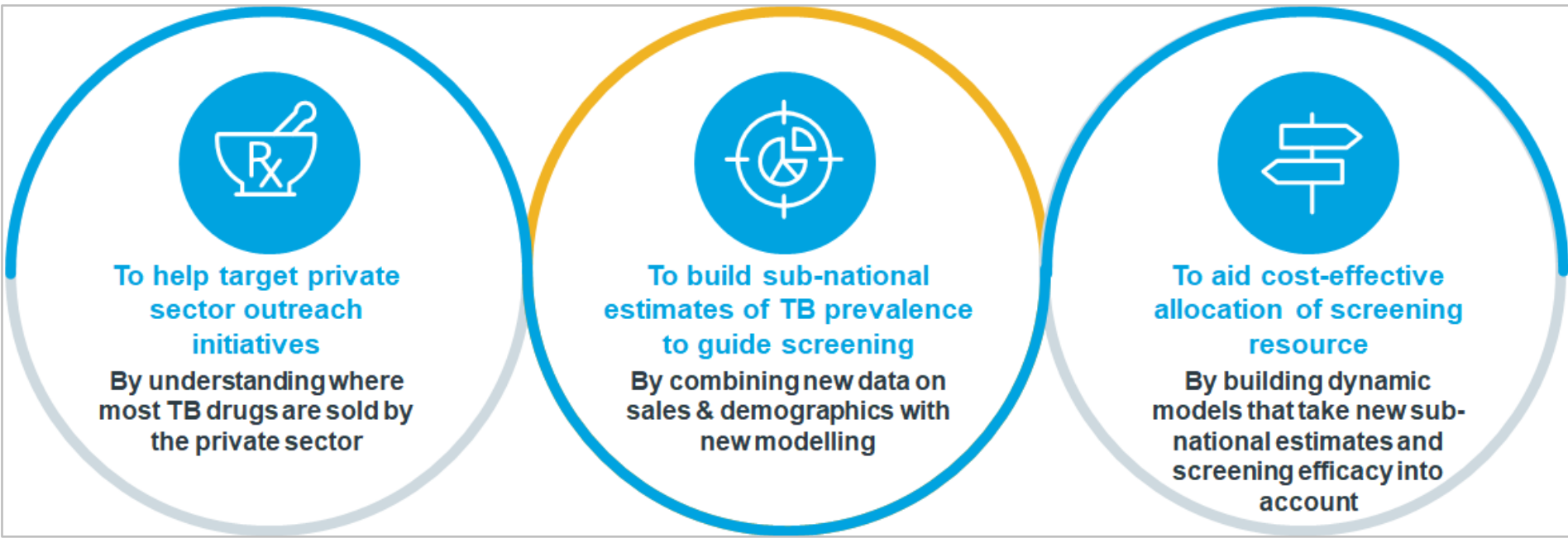
Introduction

Setting

Pakistan is among the five countries which accounted for more than half of the people with tuberculosis (TB) who are missed globally, as measured by the gap between the estimated number of incident cases and the number of people notified on TB treatment in 2022. Data suggests that as of 2022, 30% (~180,000) of TB patients are either not diagnosed (missing) or not notified (diagnosed but not notified). Pakistan’s national and provincial TB programs (NTP; PTP) have engaged with the private sector to use the outputs from geospatial models as the starting point to prioritize chest camp locations. In Pakistan, preliminary results of comparing locally disaggregated TB notification data and TB drug sales data showed discrepancies between TB notifications and the volume of TB drugs sold at facility level.

Study overview

In light of the above, The Global Fund to fight AIDS, TB and Malaria contracted a consortium (KIT Royal Tropical Institute, SurveyAuto, Imperial Consultants, and IQVIA) to provide information and tools to support the NTP & PTPs in three activities:

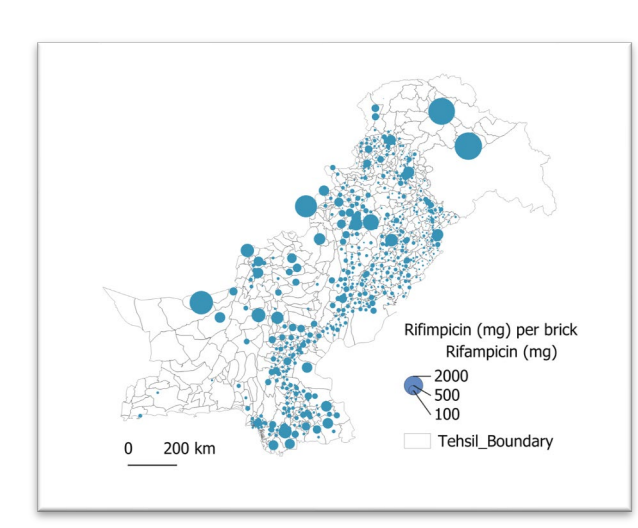
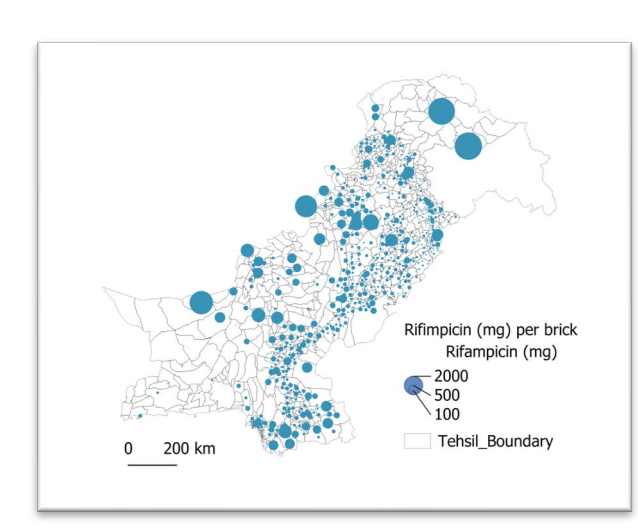
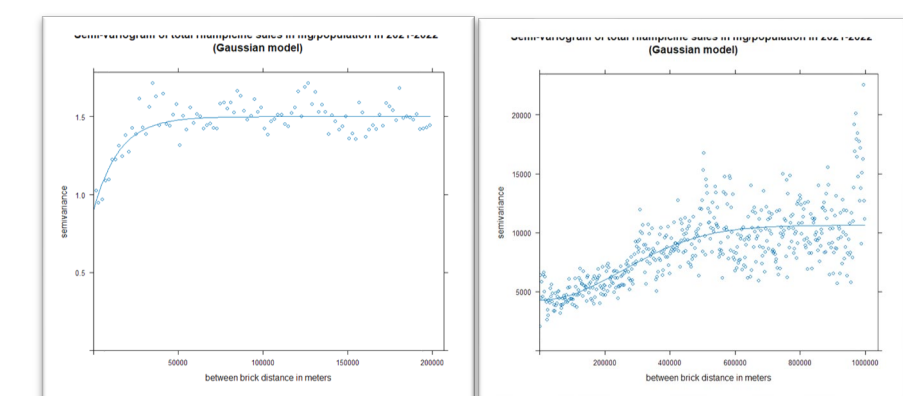


Aim

We aim to report our findings on the first (left) activity above. As part of the second activity objective of updating a geospatial model predicting TB positivity rates among people screened in chest camps in Pakistan to include private sector TB drug sales data has been added as a covariate, here we present the results of the univariate analysis between rifampicin sales data and chest camp TB positivity rates.

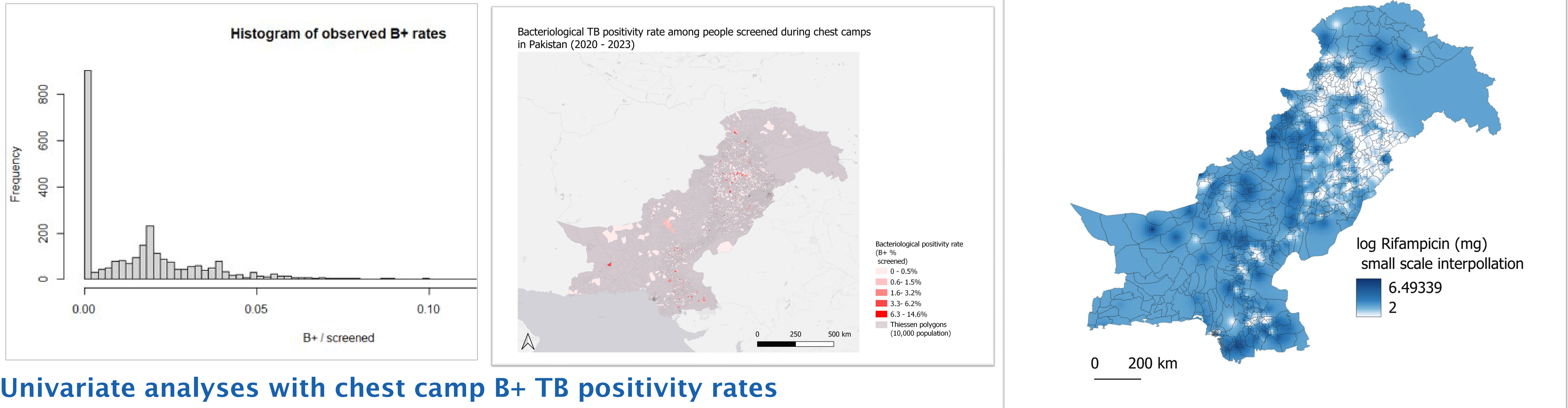
Methods

- Geocoding, aggregation, mapping:** Individual private sector vendor level TB drug sales data of first-line antibiotic rifampicin were aggregated to the lowest level unit of analysis relevant for the TB program (‘brick’).

- Sensitivity analysis for spatial precision of sales mapping:** We carried out sensitivity analyses on outlying brick vendors to optimize accuracy of geolocation (55-meter precision accepted).

- Brick mapping:** We mapped the raw rifampicin sales data by brick to visualize spatial patterns.

- Check for spatial clustering:** After linking sales data with chest camp data (locations), we assessed levels of sales data spatial clustering to inform our interpolation technique.

- Univariate regression analysis:** A zero-inflated Poisson regression, using an offset of number of people screened, was used to explore associations between the number of bacteriologically positive TB cases detected and rifampicin demand (log [mg/population]).

Results

The average chest camp bacteriologically confirmed TB positivity rate per 10,000 population thiesen polygon, across all provinces is 1,75% for over 6,000 camps conducted between 2020 and 2023. Univariate analysis of rifampicin demand (mg/pop) shows a significant positive correlation when using a 5km population catchment area for a brick (group of vendors). The association becomes stronger if we use the non-population corrected rifampicin milligrams sales data (presented below), and weaker when we use a larger catchment area (e.g. larger population denominator, not presented).



Univariate analyses with chest camp B+ TB positivity rates

Rifampicin sales (2021-2022) *without population correction* (zero-inflated Poisson using *people screened* as offset)

Count model coefficients (Poisson with log link):				
	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	-5.26548	0.25138	-20.946	< 2e-16 ***
pred_log_riftotal	0.08078	0.01671	4.835	1.33e-06 ***

Number of people screened on occurrence of zero-case chest camps

Zero-inflation model coefficients (binomial with logit link):				
	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	-2.1701893	0.1757516	-12.348	<2e-16 ***
screened	-0.0012327	0.0004981	-2.475	0.0133 *

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Number of iterations in BFGS optimization: 17
Log-likelihood: -4717 on 4 Df

Conclusion

While rifampicin sales appear to show a significant positive correlation with chest camp positivity rates, we cannot yet conclude the nature of this relationship as improvements stand to be made in the method of population correction. Furthermore this positive correlation appeared to be mainly driven by observations from Punjab province, with non-significant findings in Khyber Pakhtunkhwa, Sindh and Balochistan, where far fewer chest camp events were available for the regression analysis.

Next Steps

Telecom mobility data will be used to estimate the catchment population for each private sector brick-aggregated point of sale, redistributing those sales data to its catchment population. These redistributed drug sales data will be used in a predictive spatial model to estimate the burden of bacteriologically confirmed TB patients in Pakistan.

Authors

C. Mergenthaler (1), E. Rood (1), P. Stephens (2), Syed R (2), Z. Khan (2), M. Uzair (2), U. Saif (3), B. Butt (3), S. Alba (1), A. Latif (4)

4



3



2



1

