Modelling TB under detection in Bangladesh.

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MATCH approach

MATCH: Mapping and Analysis for Tailored disease Control and Health system strengthening

 ✓ Builds NTP capacity to target interventions using existing data

✓ Use mapping and spatial analysis techniques to inform decision making





Subnational data analyses are required to effectively address the ongoing TB epidemic



Estimating TB under-detection at subnational level

Extrapolating TB cluster prevalence to estimate local TB prevalence and incidence rates and compare these with numbers notified.

- Issues with lack of power at individual clusters; geographic point support could partially address this.
- Requires good geographical coverage of clusters to represent factors driving TB transmissions

Model TB notification to predict expected notification and identify gaps.

- Model the effect of program performance and coverage on case notification rates.
- Validation using TB prevalence data from survey
- Approach presented here

The MATCH analytical framework





Model development

Fitting a model to assess association between observed case notification rates and determinants of access/coverage accounting for spatial autocorrelation

CNR = access + effort + performance + spatial effect + true error

Observed notified cases

- Factors affecting local case notification
- Access to services
- Programme performance

Effects spatial autocorrelation: U

- movements,
- TB transmission / burden
- availability of care

Corrects for lack of independence

Unexplained variation:

 Other factors affecting access or burden which are not explained by the model

Data used

Component	Description	Source
TB NOTIFICATION DATA	Total numbers of new and relapse cases and retreatment cases notified per upazila in 2016, age and gender disaggregated	National Tuberculosis Control program (NTP), Bangladesh
POPULATION DATA	Population numbers derived from the population census conducted in 2011 aggregated to the level of upazila projected to 2016	Bangladesh household and population census 2010, Bangladesh bureau of statistics 2012
SES DATA	Literacy rate and poverty headcount (people living below the lower poverty line) derived from the household income and expenditure survey conducted in 2010 aggregated to the level of upazila	Household Income and Expenditure survey (HIES, 2010). Bangladesh bureau of statistics 2012
HEALTH SYSTEMS DATA	Number of persons with presumptive TB who had bacteriological diagnostic testing for TB performed; number of people initiating TB treatment and the number of retreatment cases per upazila for the year 2016	National Tuberculosis Control program (NTP), Bangladesh
SPATIAL DATA:	Polygon features of administrative boundaries of upazilas in Bangladesh in the year 2015; Line features of road network in Bangladesh	UN OCHA (via the Humanitarian data exchange) accessed March 2017; Open Street Map 2018

Modelling results

Constant	Coef 41.81	SE 10.3242	z 4.0495	р 5.13Е-05
Poverty	-8.32	4.05	-2.05	0.04
Tested/Population	0.09	0.01	9.77	< 0.001
Retreatment/notified	-8.54	1.34	-6.38	0.00

TB prevalence survey 2007-2009:

Prevalence 5 times higher in lowest wealth quartiles as compared to higher quartile:

Hossain et at (2012)PLOS One



between upazilla distance (km)



Predicting under-notification

1. **De-trend** raw notifications by taking out the effects of poverty testing and retreatment rate

2. Identify gaps in routinely collected surveillance data



Validation

Cluster level prevalence data aggregated per Upazila for 2016.



Bangladesh modelled undernotification vs ovserved undernotification

10 percent outliers are labeled



X = Ratio of observednotification vs expected (i.e.detrended) notification

Y = Ratio of prevalence rate vs. observed notification rate.



Significant association between predicted underreporting and observed gap and (0.73; p = 0.002)

Conclusion

Case notification data are highly associated to factors related to access and coverage of services.

Spatial models allow to quantify these associations at high level of granularity accounting for autocorrelation in data

Correcting for factors of access and performance allows to generate standardized case notification rates which can inform where TB under-detection might occur



CASE

CENTRE FOR APPLIED SPATIAL EPIDEMIOLOGY

The Centre for Applied Spatial Epidemiology (CASE) supports health professionals to use available data and spatial analys techniques to improve decision making and more effectively deliver health care to all.



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