Key considerations for incorporating heterogeneity into models of TB detection, transmission and intervention.

Sourya Shrestha, Johns Hopkins School of Public Health

TB MAC/WHO Task Force Annual Meeting
Glion, Sep 21, 2017

Acknowledgements

Motivation

TB is heterogenous — factors that drive (and/or are associated with) could be geographic, demographic, socio-economic, immunological/biological, etc.

Motivation

Tuberculosis and Poverty: Why Are the Poor at Greater Risk in India?

Olivia Oxlade[1], Megan Murray[1,2,3]

TB prevalence (per 100,000) by Wealth Quintile

Socio-economic condition

Heterogeneity in tuberculosis transmission and the role of geographic hotspots in propagating epidemics

David W. Dowdy[a,b,1], Jonathan E. Golub[a,b], Richard E. Chaisson[a,b], and Valeria Saraceni[c]
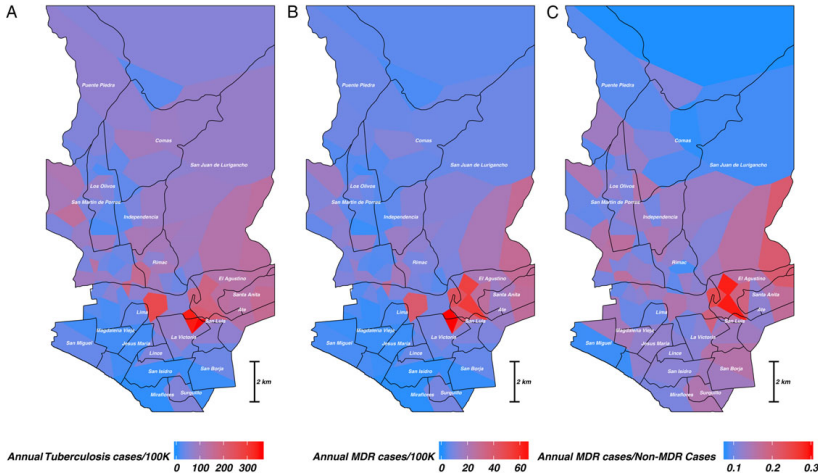

Geography

The Journal of Infectious Diseases

MAJOR ARTICLE

Identifying Hotspots of Multidrug-Resistant Tuberculosis Transmission Using Spatial and Molecular Genetic Data

Jonathan L. Zelner,[1] Megan B. Murray,[2] Mercedes C. Becerra,[3] Jerome Galea,[4] Leonid Lecca,[4] Roger Calderon,[4] Rosa Yataco,[4] Carmen Contreras,[4] Zibiao Zhang,[5] Justin Manjourides,[6] Bryan T. Grenfell,[7,8] and Ted Cohen[9]
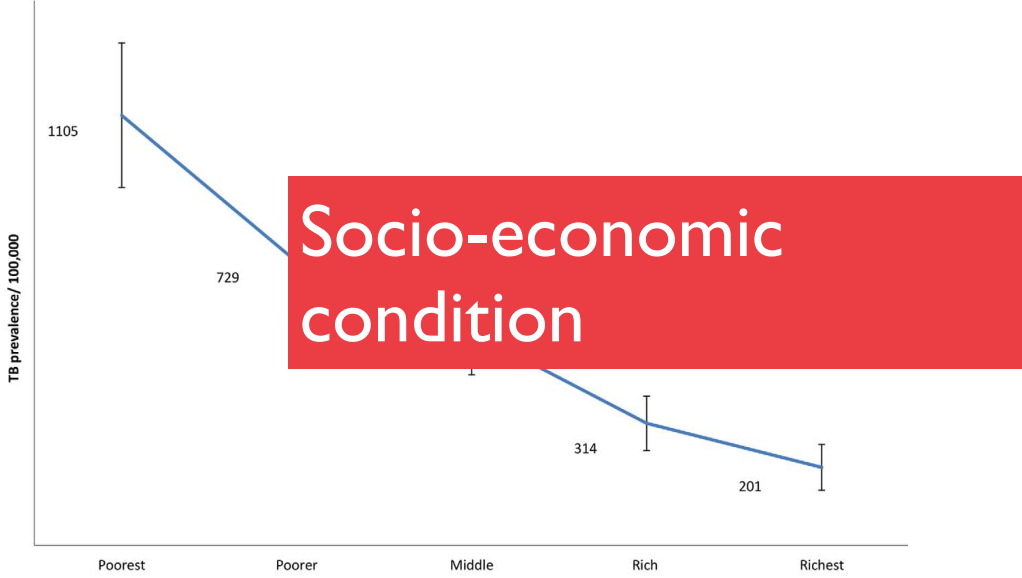
Burden of New and Recurrent Tuberculosis in a Major South African City Stratified by Age and HIV-Status

Robin Wood[1,2,3], Stephen D. Lawn[1,2,4], Judy Caldwell[5], Richard Kaplan[1,2], Keren Middelkoop[1,2], Linda-Gail Bekker[1,2]*
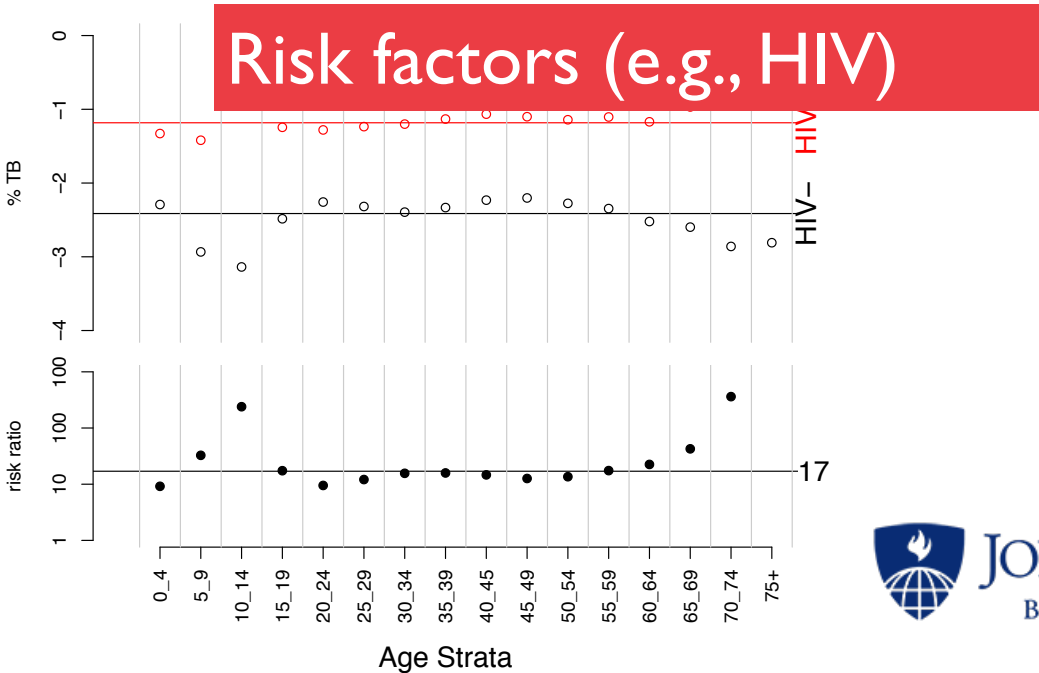
Risk factors (e.g., HIV)

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Motivation

Prisons

Mines

Slums

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Motivation

TB is heterogenous — factors that drive (and/or are associated with) could be geographic, demographic, socio-economic, immunological/biological, etc.

Targeted campaigns/interventions that leverage these heterogeneities could be relatively more effective in case detection/incidence reduction.

# Outline

Part I: Modeling Implications of Heterogeneity for TB/HIV interventions.
- Model conceptualization to captures levels of Heterogeneity in TB/HIV settings.
- Exploration of role of heterogeneity in TB/HIV interventions.

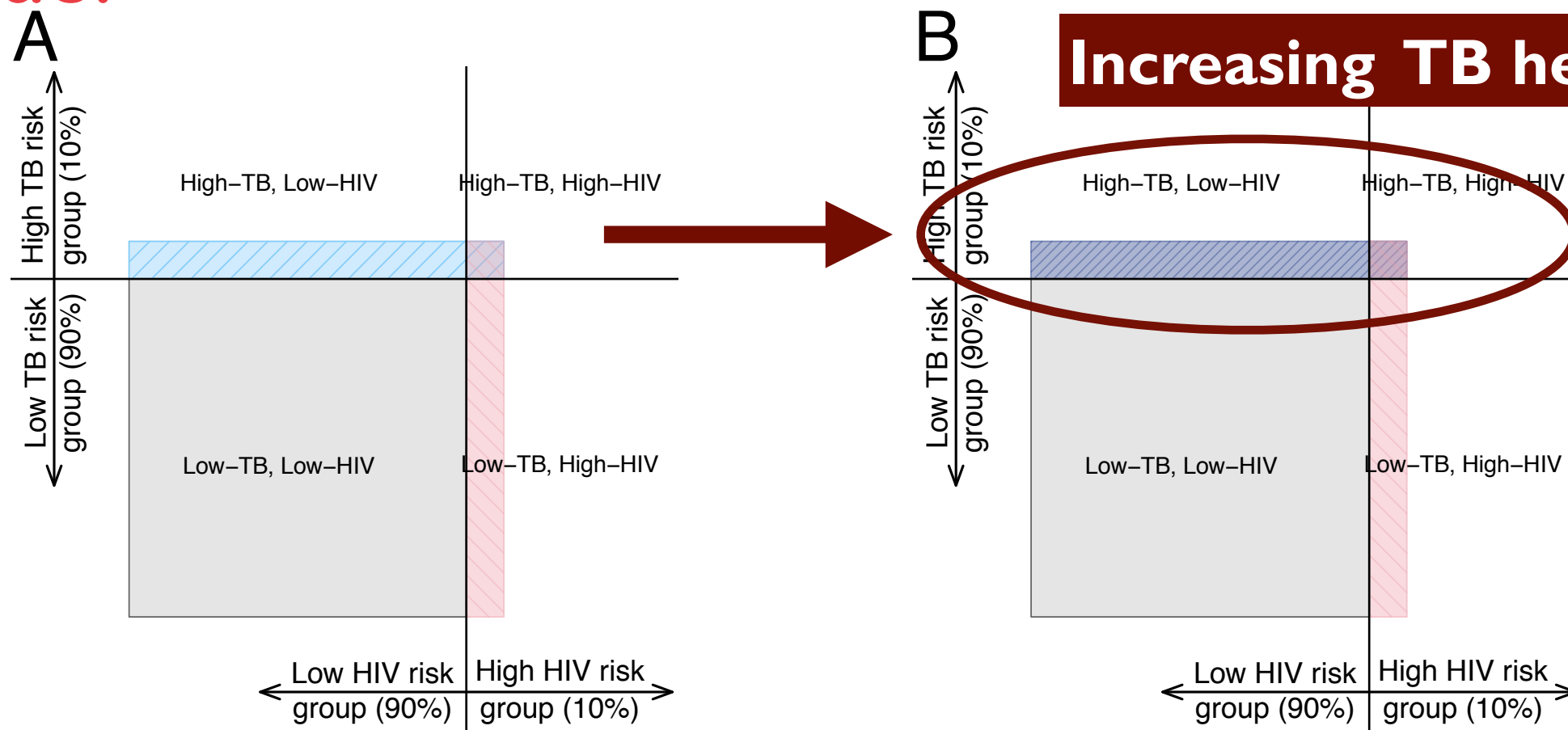**Part II: Targeted TB vaccination in South African mining communities.**
- Modeling South African mining communities.
- Comparing adult TB vaccination strategies.

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Part I

Modeling Implications of Heterogeneity for TB/HIV interventions.
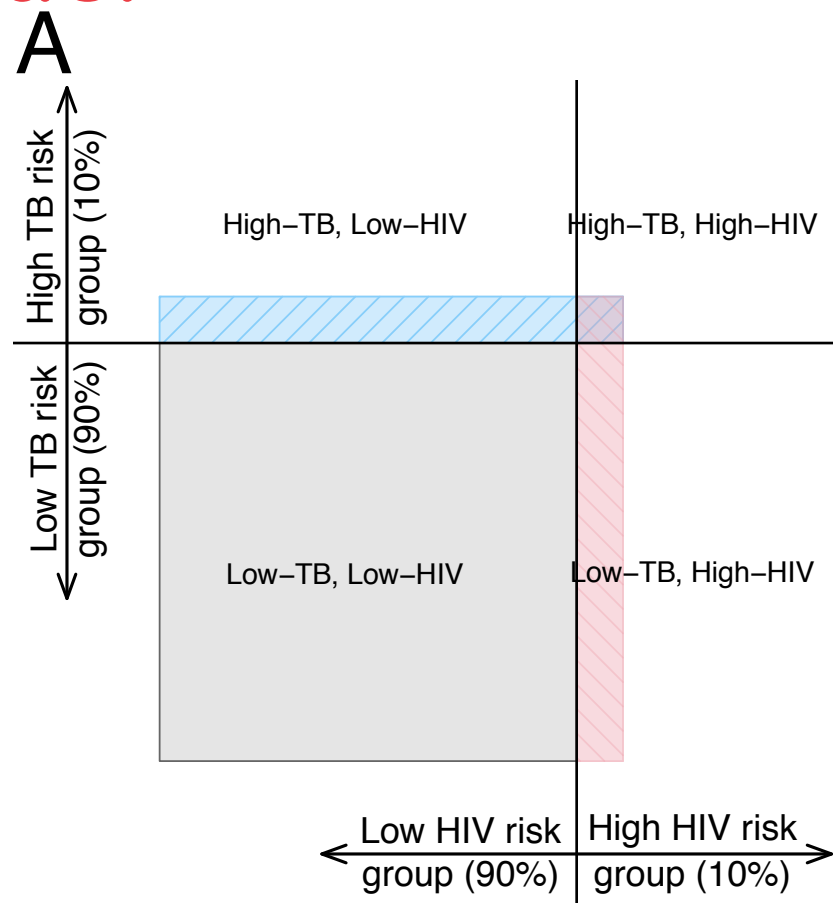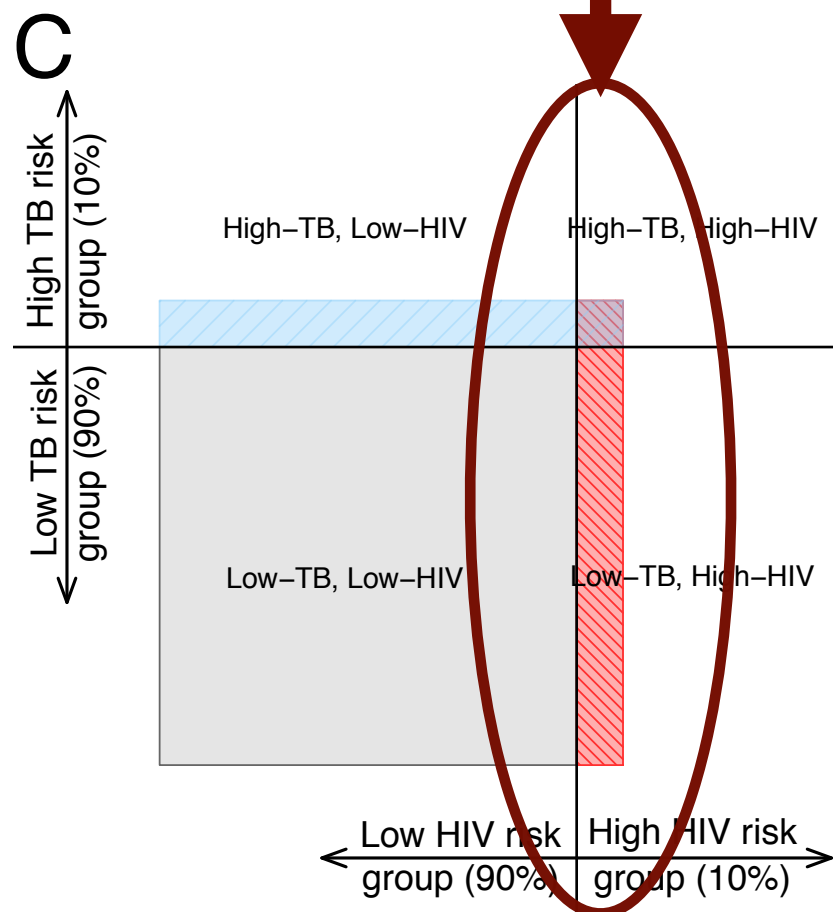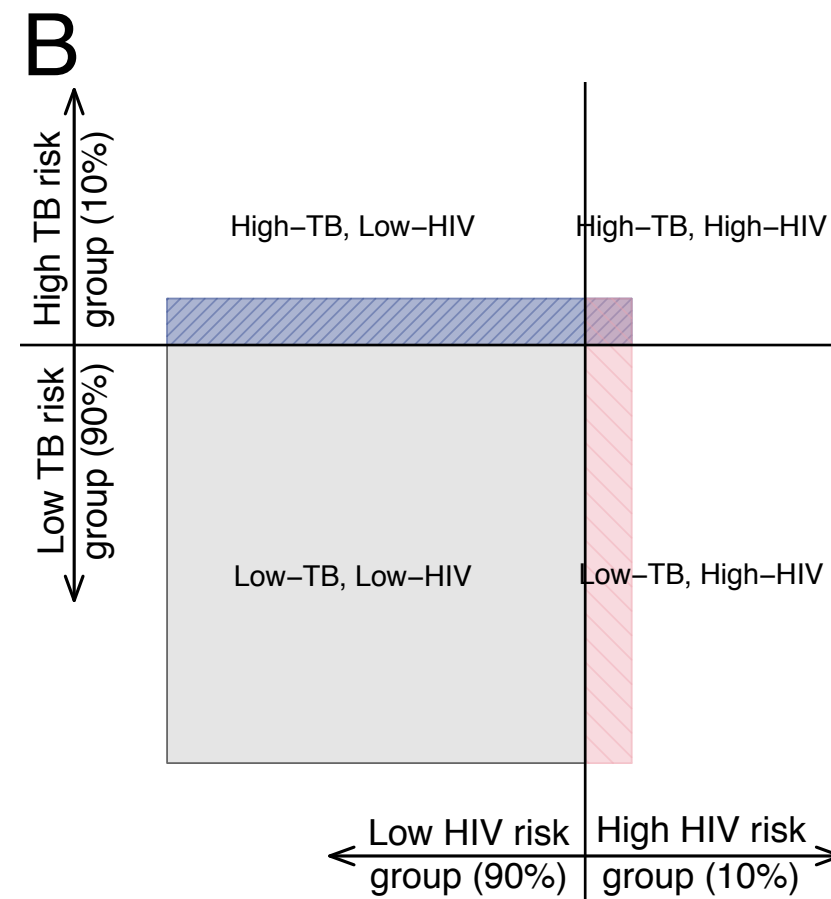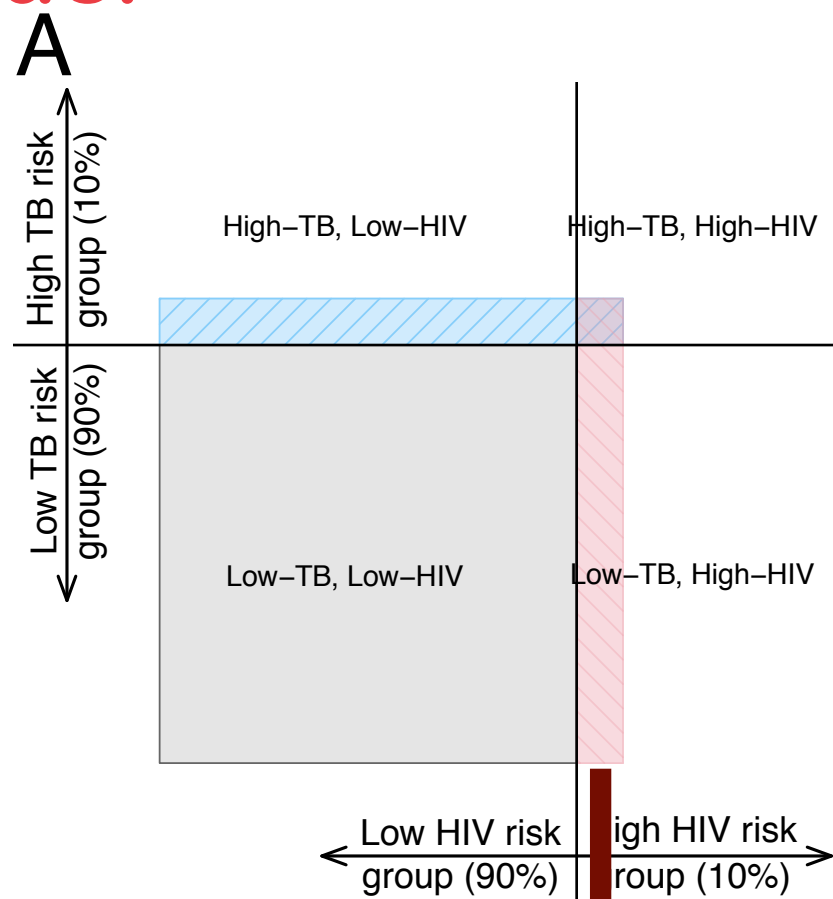
Model A
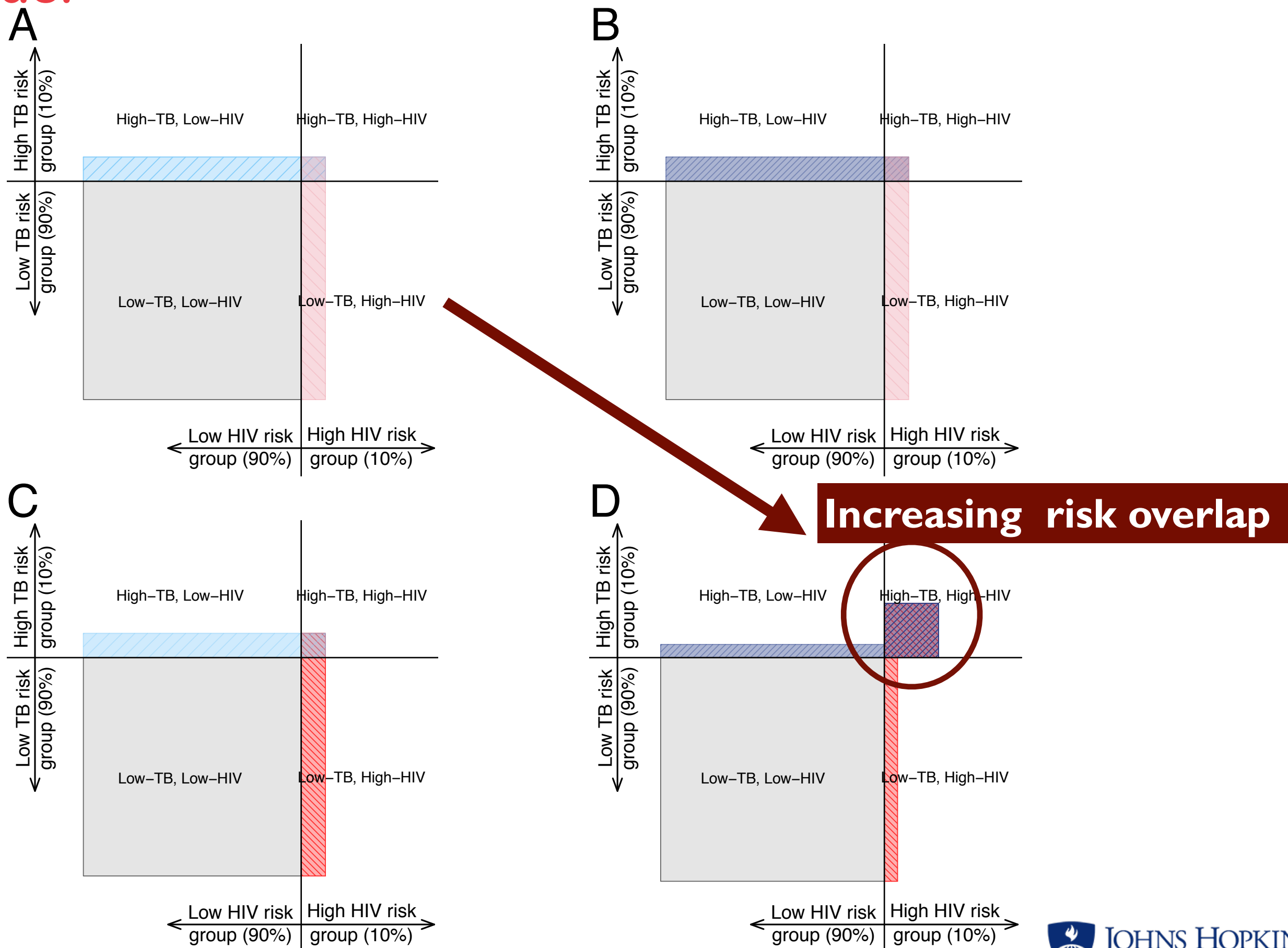
Model

Model
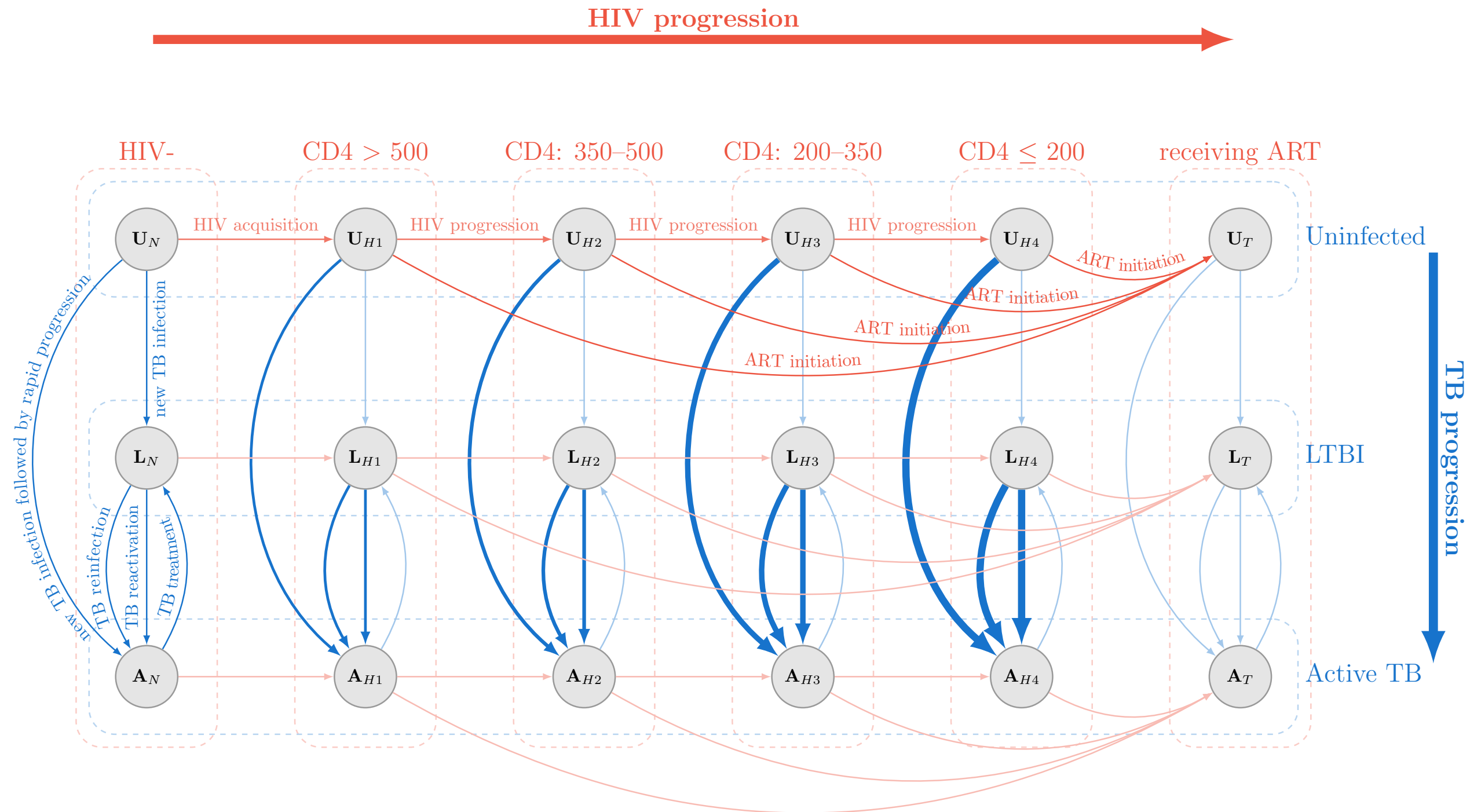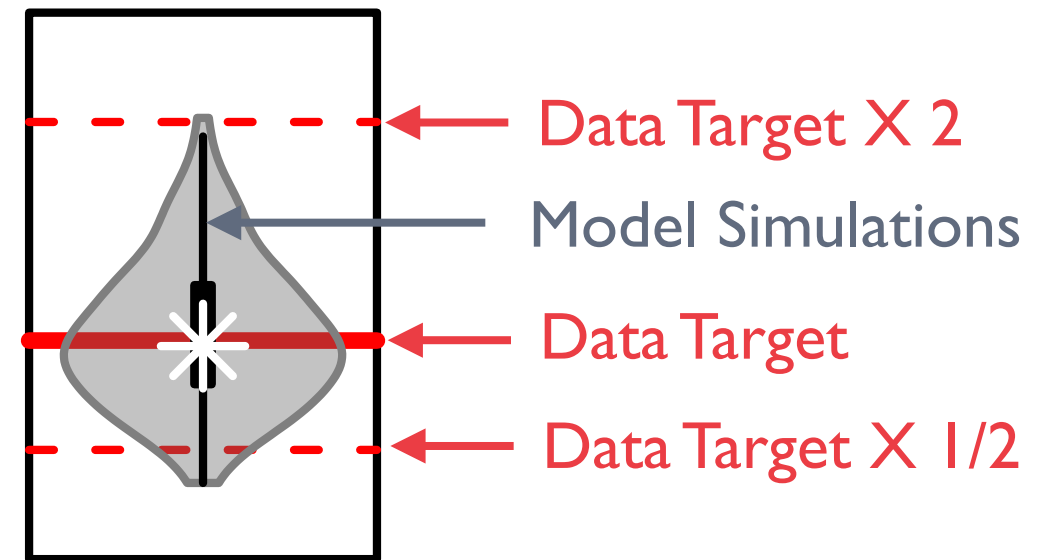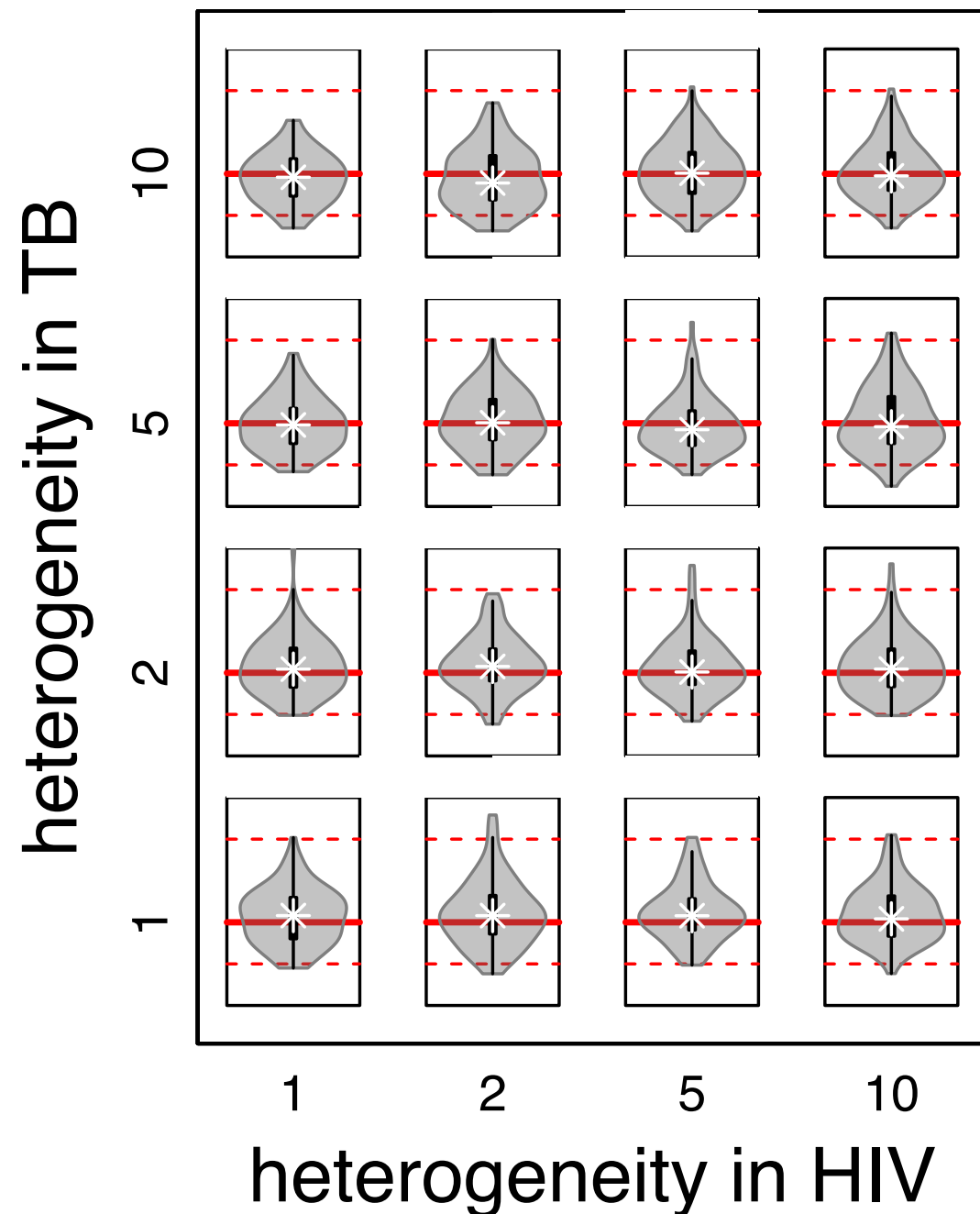
Model

Model

- HIV increases the risk of TB disease

- Enhancement increases with decrease in CD4 counts

Settings

Parameter Description	Canada	India	Kenya	South Africa
Calibration Targets[†]				
TB incidence per 100,000 per year	5.2	167	246	834
HIV prevalence per 100,000	175	163	6,000	12,200
HIV-TB incidence per 100,000 per year	0.29	8.3	89	509
TB incidence prior to HIV epidemic per 100,000 per year	12	500	250	500
ART coverage (%)	43.4	40.2	55	31.2
Female share of PLHIV (%)	18.5	42.3	58.3	60.3

heterogeneity in TB

1 2 5 10

heterogeneity in HIV

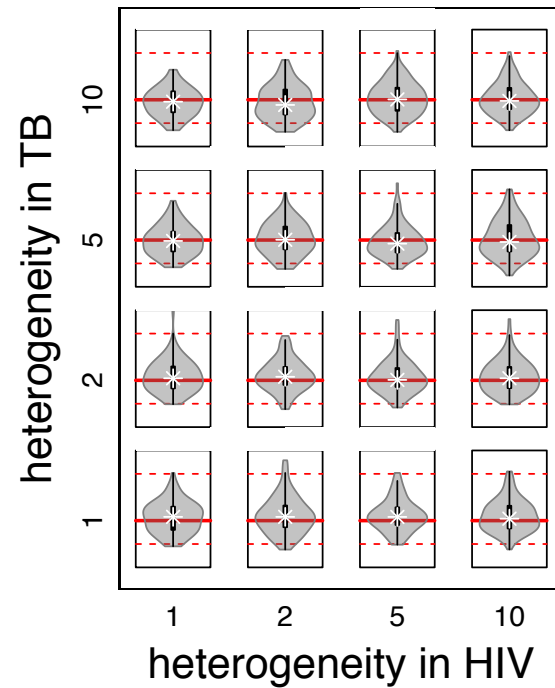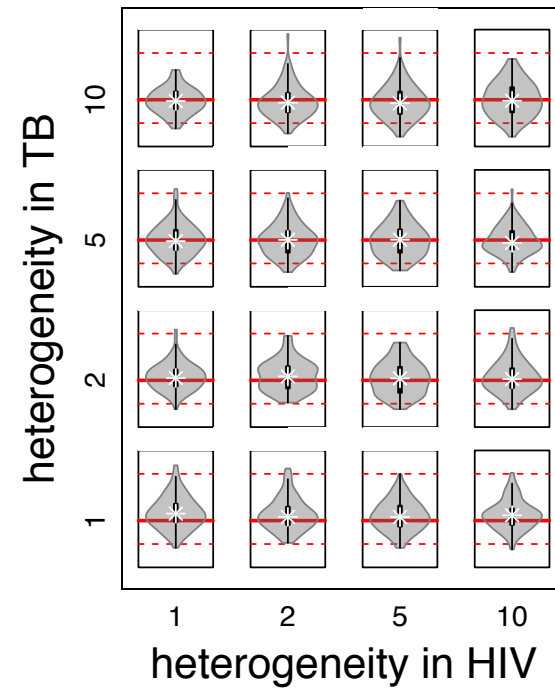Data Target X 2

Model Simulations

Data Target

Data Target X 1/2

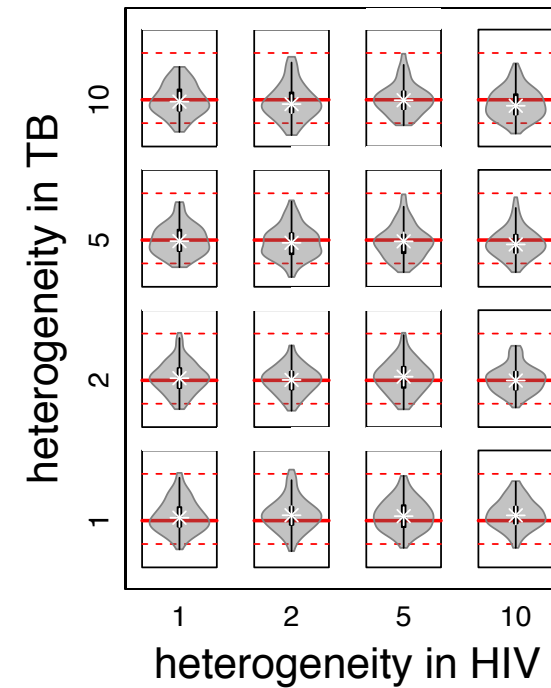Model were calibrated to different levels of heterogeneity in TB and HIV in each setting.
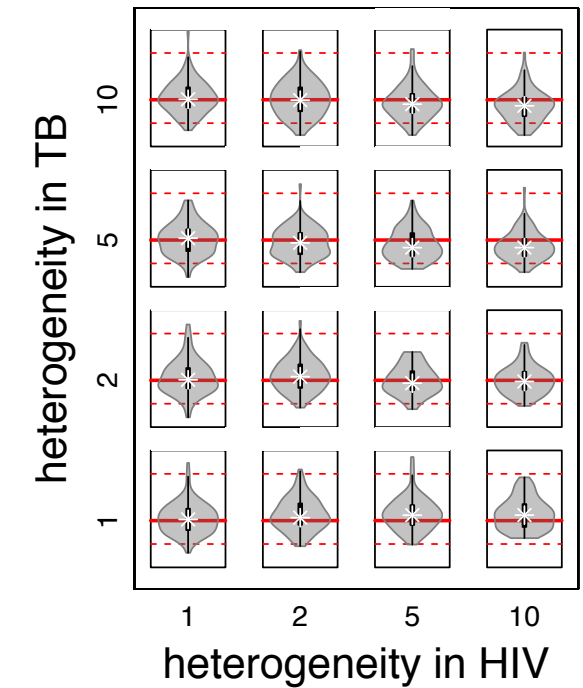
Methods

Risk Overlap: ο = 0%   Risk Overlap: ο =10%   Risk Overlap: ο =50%   Risk Overlap: ο =100%

.. across different levels of risk overlaps