Policy Scenarios

Policy scenarios look at impact of increasingly fine targeting of IPT

Assess number of cases prevented per IPT administration under three scenarios:

Policy scenarios look at impact of increasingly fine targeting of IPT

Assess number of cases prevented per IPT administration under three scenarios:

1. Community-based screening: Individuals $\leq$ 30 y/o are screened randomly in the community and those with LTBI administered IPT.

Policy scenarios look at impact of increasingly fine targeting of IPT

Assess number of cases prevented per IPT administration under three scenarios:

1. Community-based screening: Individuals $\leq$ 30 y/o are screened randomly in the community and those with LTBI administered IPT.

2. Household-based IPT: Household contacts $\leq$ 30 y/o are given IPT, regardless of LTBI status.

Policy scenarios look at impact of increasingly fine targeting of IPT

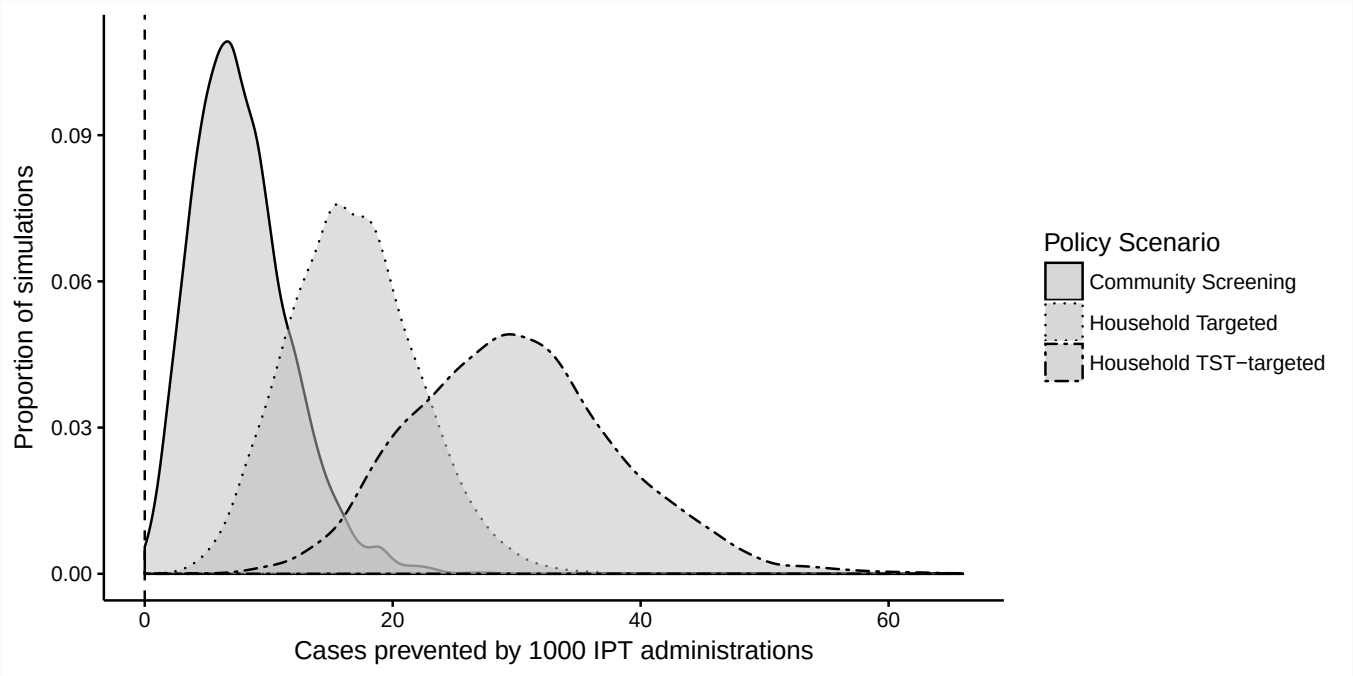
Assess number of cases prevented per IPT administration under three scenarios:

1. Community-based screening: Individuals $\leq$ 30 y/o are screened randomly in the community and those with LTBI administered IPT.

2. Household-based IPT: Household contacts $\leq$ 30 y/o are given IPT, regardless of LTBI status.

3. Household-based screening + IPT: Household contacts $\leq$ 30 y/o with LTBI are given IPT.

Targeting IPT on household contacts with LTBI more effective than blanket screening



Number of incident TB cases prevented by 1000 IPT administrations for three screening scenarios. Household-targeted > Community in 88% of simulations. Household TST-targeted > household-targeted in 96% of simulations.

Ratio of cases prevented between scenarios approximates relative cost-efficacy

- Household-targeted intervention more cost-effective than community screening at up to 2.2x cost per IPT administration (95% PPI = 0.5, 12.5).
- Household TST-targeted intervention $>$ than household targeted up to 1.8x per-administration cost (95% PPI = 1.0, 3.6)

What next?

- Simulation modeling to understand implications of heterogeneity in community exposure for indirect effects of household intervention.

What next?

- Simulation modeling to understand implications of heterogeneity in community exposure for indirect effects of household intervention.

- New methods to explore the urban phylogeography of TB to find less-obvious sources of contact heterogeneity.

What next?

- Simulation modeling to understand implications of heterogeneity in community exposure for indirect effects of household intervention.
- New methods to explore the urban phylogeography of TB to find less-obvious sources of contact heterogeneity.
- Development of spatially adaptive interventions.

For more info...

International Journal of Epidemiology, 2017, 1–8
doi: 10.1093/ije/dyx171
Original article

Original article

Protective effects of household-based TB interventions are robust to neighbourhood-level variation in exposure risk in Lima, Peru: a model-based analysis

Jon Zelner,[1,2] Megan Murray,[3,4] Mercedes Becerra,[4,5,6] Jerome Galea,[4] Leonid Lecca,[4,5] Roger Calderon,[5] Rosa Yataco,[5] Zibiao Zhang[6] and Ted Cohen[7]

[1]Department of Epidemiology, [2]Center for Social Epidemiology and Population Health, University of Michigan School of Public Health, Ann Arbor, MI, USA, [3]Department of Epidemiology, [4]Department of Global Health and Social Medicine, Harvard Medical School, Boston, MA, USA, [5]Partners In Health/ Socios En Salud, Boston, MA, USA/Lima, Peru, [6]Division of Global Health Equity, Brigham and Women's Hospital. Boston, MA, USA and [7]Department of Epidemiology of Microbial Diseases, Yale School of Public Health, New Haven, CT, USA

Thanks!

Appendix

Models & Methods

Include individual and household-level covariates to model total risk of LTBI (y_i)

$$\lambda_i^{HH} = X_i^H \beta^H$$

$$\lambda_{ij} = \left(\lambda_{ij}^{COM} + \lambda_i^{HH}\right) e^{X_i \gamma}$$

$$Pr(y_i = 1) = 1 - exp(-\lambda_{ij})$$

- λ_i^{HH}: Household force of infection
- X_i^H: Household and individual covariates for individual i.
- β^H: Parameters controlling household infection risk.
- γ : Parameters controlling individual susceptibility.

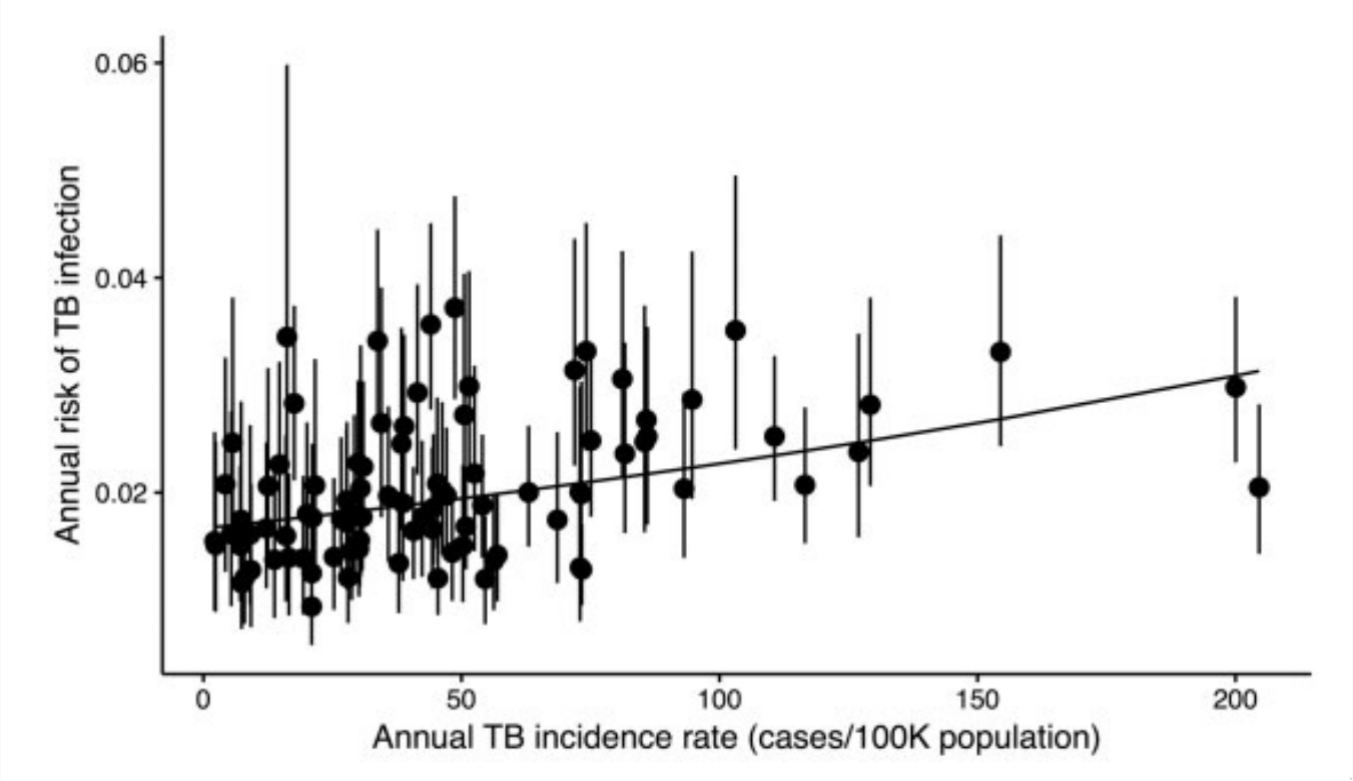
Link household exposure incident TB disease

$$Pr(z_i = 1|y_i, \zeta_i) = \begin{cases} logit^{-1}(x'\beta), & \text{if } y_i = 0 \\ logit^{-1}(\alpha_{COM} + x'\beta), & \text{if } y_i = 1, \zeta_i = 0 \\ logit^{-1}(\alpha_{HH} + x'\beta), & \text{otherwise} \end{cases}$$

z_i: incident TB; y_i: LTBI status, β: log odds-ratios; ζ : latent household infection indicator.

Results

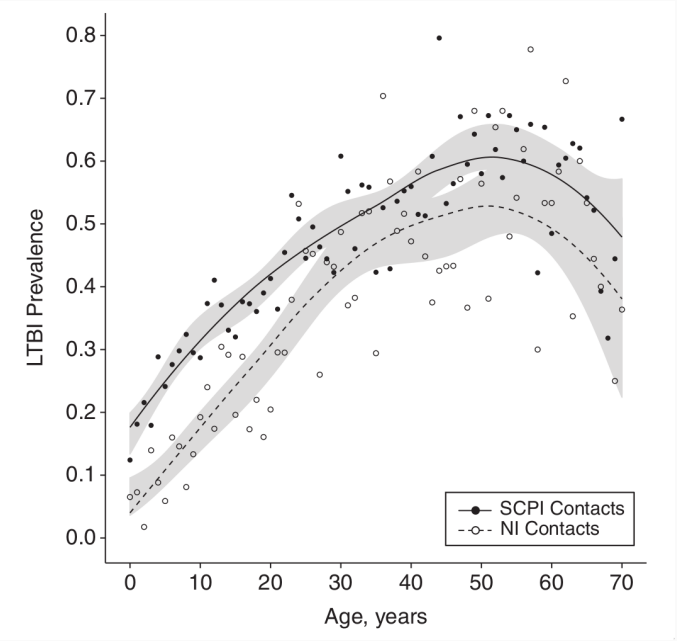
High-incidence HCs = High-ARTI HCs



An increase of 100 TB cases/100K pop'n associated with a 1.4x increase in HC-level ARTI. 95% CI = (1.05, 1.78)

Slope of LTBI age-prevalence is proportional to annual risk of TB infection, α

Distance between solid and dashed lines is proportional to risk of TB infection from exposure to a smear-positive household case.



Prevalence of latent TB infection in individuals with (solid line) and without (dashed line) household exposure in Lima, Peru. (From Zelner et al., *AJE* 2014)

LTBI and SCPI exposure associated with increased risk of incident TB

Relative to TST-negative:

- Household-acquired LTBI: OR = 5.8 (95% CI = 1.5, 12.0)
- Community-acquired LTBI: OR = 2.3 (95% CI = 1.1, 4.3)

LTBI and SCPI exposure associated with increased risk of incident TB

Relative to TST-negative:

- Household-acquired LTBI: OR = 5.8 (95% CI = 1.5, 12.0)
- Community-acquired LTBI: OR = 2.3 (95% CI = 1.1, 4.3)

Relative to smear/culture-negative exposed:

- SCPI exposure: OR = 1.8 (95% CI = 1.1, 3.0)

Link household exposure and infection to incident TB disease

$$Pr(z_i = 1|y_i, \zeta_i) = \begin{cases} logit^{-1}(x'\beta), & \text{if } y_i = 0 \\ logit^{-1}(\alpha_{COM} + x'\beta), & \text{if } y_i = 1, \zeta_i = 0 \\ logit^{-1}(\alpha_{HH} + x'\beta), & \text{otherwise} \end{cases}$$

z_i: incident TB; y_i: LTBI status, β: log odds-ratios; ζ : latent household infection indicator.

LTBI Risks

Table 1. Risk factors for LTBI. Table contains estimates and 95% posterior credible intervals (CIs) for risk of infection associated with culture-positive (CPI), smear/culture-positive (SCPI) household exposure, as well as the risk of infection associated with exposure to a co-prevalent household case with unknown smear and culture status. The table also contains estimates of hazard ratios for factors associated with individual- and household-level risks, such as overcrowding (more than three people per bedroom), living in a household with a thatch or mud roof as compared with a metal or wood roof, and BCG vaccination

Type	Variable	Median	95% CI	Units
Household exposure	CPI	0.07	0.04,0.10	Infections/exposure
	SCPI	0.14	0.12,0.17	Infections/exposure
	Co-prevalent	0.18	0.10,0.27	Infections/exposure
Susceptibility risks	Crowding	1.13	1.00,1.27	Hazard ratio
	Poor roof	0.91	0.71,1.20	Hazard ratio
	BCG	0.92	0.80,1.09	Hazard ratio

Incident TB Risks

Table 2. Risk factors for incident TB. Table contains odds ratios for incident TB disease during year-long following period, associated with household exposure as well as BCG vaccination and isoniazid preventive therapy

Type	Variable	Median	95% CI
	Intercept	−3.66	−4.37,−2.97
	Age	0.97	0.92,1.01
	HIV-positive	3.99	0.58,16.36
TST	TST-negative	REF	
	Community-acquired LTBI	2.32	1.09,4.27
	Household-acquired LTBI	5.78	1.48,11.98
Exposure	NI	REF	
	CPI	1.40	0.77,2.50
	SCPI	1.82	1.09,3.00
	Co-prevalent	1.24	0.69,2.10
Intervention	IPT	0.37	0.25,0.56
	BCG	0.36	0.19,0.71
	Age x BCG	1.03	0.99,1.08

References

References i

1. World Health Organization. Global tuberculosis report 2016. 2016.

2. Ayles H, Muyoyeta M, DuToit E, et al. Effect of household and community interventions on the burden of tuberculosis in southern Africa: the ZAMSTAR community-randomised trial. *The Lancet*. 2013;382:1183–1194.

3. Otero L, Shah L, Verdonck K, et al. A prospective longitudinal study of tuberculosis among household contacts of

References ii

smear-positive tuberculosis cases in lima, peru. *BMC*. 2016;16(259).

4. Zelner JL, Murray MB, Becerra MC, et al. Bacillus Calmette-Guerin and Isoniazid Preventive Therapy Protect Contacts of Patients with Tuberculosis. *American Journal of Respiratory and Critical Care Medicine*. 2014;189(7):853–859.

5. Yadav RP, Nishikiori N, Satha P, et al. Cost-effectiveness of a tuberculosis active case finding program targeting household and neighborhood contacts in cambodia. *American Journal of Tr*. 2014;90(5):866–872.