

ROI and practical economic evaluation in the public health setting: TB case study

Report to the Commissioner

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Intro and general rationale

- My background
- Need to justify our efforts—within program, to decision makers
 - Diverse, important programs/alternatives compete
 - Allocation decisions made by non-health bodies
 - Abstract, intangible, indirect rationale = weak
 - Value of prevention generally invisible
 - Careful allocation = more bang for buck
- Value is excellent justification
 - cost, effect relative to alternatives, denominated in health and money
 - “Better” does not mean “cheaper” (But that’s ok)
 - Healthcare value often intangible and subjective, judgments very difficult

So many difficult questions...

- Do services align with/produce goals?
 - Are they justified by harm reduction and health?
- How well, at what price, and to whom?
 - Are outcomes affordable? Valuable?
 - Are there limits? Where?
- Do we make rational decisions?
 - Priorities and tradeoffs; evidence and emotion
- Could we do better?
 - How?
- Is our message effective and voice clear?
- **Economic analysis = reality check**

ROI: TB as a case study

- 1) Explore costs and benefits of prevention
 - Compare diagnostics and treatments to identify relative efficiencies
 - Compare conditional value, limits and thresholds
- 2) Sustain/promote/direct/justify health protections via more effective advocacy
 - Advocate for vital mission of public health
 - Provide tangible, comparable, and intuitive data

Common terms/concepts in health economics

- Cost, outcome/return
 - Money, effort, or health invested, forgone, preserved, or gained
 - Cost vs. charge
 - Opportunity cost considers alternatives
 - The forgone benefit had the available investment been used otherwise
- Perspective (considers the stakeholders)
- Net vs. gross (considers time value of health and money)
- Cost effectiveness analysis (considers *value*, abstract)
 - Measures incremental cost/outcome among selected alternatives
 - *Cost effective* not often *cost saving* (where dollar return exceeds investment); this is very rare
 - Incremental cost
- Cost benefit analysis (considers *price*, concrete)
 - The dollars required to gain an outcome
- Sensitivity analysis (allows range of probability to be explored)

Return on investment

- Analysis of net outcome of an investment (result of new spending)
- ROI common in private market, but important caveats for public agencies:
 - Health has value that is subjective and intangible
 - Public investments are not generally profit driven; made for reasons of public interest: social justice, common good, ethical obligation, etc.
 - “Profits” generally represent cost shifts, and are seldom real savings. *Earnings* can occur where reimbursements exist
 - Time horizons, perspectives, other assumptions must be clear

Methods: model, metrics, assumptions

- General model
 - Semi-Markov model uses existing data and standard methods
 - Excel based; flexible and variable
 - Compares diagnostic (TST vs. IGRA), treatment (INH, DOT, short course) combos by population, risk, adherence, etc.
 - Net 10-year total where cost or outcomes occur over time
 - Risk/outcome/cost assumptions per prior study or best current published source; can also use purely theoretical assumptions
 - Cost standardized--Jan 2013 \$ via medical care CPI
- Outcomes generally presented as relative opportunity costs associated with a preventable case from a public health cost perspective
 - Dollar costs denominated by clinical outcomes (e.g. cost per case averted, life years, QALYs); health outcomes not assigned value
 - Incremental Cost Effectiveness Ratio (ICER)
 - Other minor outcomes of interest included

Strengths and limitations

- Robust, current, flexible model
 - Value is conditional—moving target. Must be able to compare scenarios
 - Output ranges from intuitive and easily understood by non health and non TB-health audience to econ heavy
- Economic analysis inherently limited
 - Many non-economic reasons to allocate resources
 - Model gives population average outcomes, confidence intervals for individuals very wide
 - Imprecise—point estimate
 - GIGO
 - Interpretation skill critical—may be as harmful as beneficial
- Underestimated value
 - Agency perspective--health losses, individual, other societal costs not priced
 - 10-year horizon does not capture lifelong disease reduction of preventive treatment
 - Good solid underestimate often more valuable than precision (precise estimate is a misnomer anyway)

Result: Selected money and health costs to state payers and patients, TX 2011 incident active TB

Table 1: 10-year net health loss and agency variable cost of care associated with incident TB, Texas 2011

	Clinical event	2011 TX incidence	Events/base case	Cost/event	Cost/base case	Statewide cost
Variable cost components						
Uncomplicated tuberculosis	outpatient course of care	1,209	0.91	\$7,046	\$6,429	\$7,772,833
Tuberculosis/HIV coinfection (TB-HIV)	outpatient course of care	100	0.08	\$8,760	\$661	\$876,000
Multi-drug resistant tuberculosis (MDR TB) (HIV + or -)	outpatient course of care	16	0.01	\$48,491	\$586	\$775,856
Contact, case	outpatient course of care	10,415	7.86	\$603	\$4,737	\$6,276,467
Contact, suspect	outpatient course of care	10,136	7.65	\$478	\$3,653	\$4,840,477
High-probability (HP) suspect	outpatient course of care	1,365	1.03	\$3,253	\$3,351	\$4,439,532
Hospitalization day	inpatient day	19,593	11.60	\$1,350	\$15,656	\$26,443,449
Secondary Transmission	incident TB secondary case	1,297	1.20	\$39,516	\$47,419	\$51,269,300
Variable cost	1 TB case	1,325			\$82,491	\$102,693,915
Health outcome components						
Death during treatment	discounted QALY, 10-year sum	152	0.05			152
Pulmonary impairment after TB	discounted QALY, 10-year sum	1,692	2.36			1692
Acute illness/treatment	discounted QALY	331	0.25			331
Disproportionate death after treatment	discounted QALY, 10-year sum	2,686	2.03			2686
health losses	discounted QALY, 10-year sum					4861

Result: ROI to state payers, TX 2011 screening and prevention

Table 2: ROI, 2011 PH screening and preventive tx		
	No treatment	TST/9H
Average variable public health direct cost/incident	\$82,491	\$82,491
N at risk (no tx) or N treated	30,948	24,225
Total prevention program cost	0	\$46,327,289
10-year predicted TB incidence	674	494
10-year predicted cases averted	0	180
10-year expected TB cost	\$55,571,135	\$40,750,517
10-year total TB cost averted	n/a	\$14,820,618
Net present value 10-year expected cost averted	n/a	\$12,834,693
Average screening/tx cost per treatment	n/a	\$1,912
Net present value 10-year cost averted/preventive tx	n/a	\$530
NPV 10-year return on investment, per treatment	n/a	(\$1,383)
Assumes 1.1 million PH screenings, 31,000 preventive tx, normalized to TX gender, HIV distribution, new vs. remote infections for 2011 TX incident active cases per Styblo		

Result: Health outcomes by cost to state payers, TX 2011 screening and prevention

Table 3: 2011 PH screening and preventive tx health outcomes and cost

	No screen/tx	TST/9H
N at risk (no tx) or N treated	30,948	24,225
Total prevention program cost	0	\$46,327,289
10-year predicted TB incidence	674	494
10-year predicted cases averted	0	180
10 year loss, TB attributable deaths	32.49	23.82
10-year loss, net life years	244.67	179.42
10-year loss, net QALYs lost to acute and chronic illness and TB attributable mortality	1,158.97	849.88
10-year predicted QALY loss averted	0	309.09
Average cost/case averted	n/a	\$257,857
Average cost/QALY saved	n/a	\$54,511

Assumptions of table 2 remain

Result: CEA of prevention diagnostic and treatment alternatives

Cost effectiveness and TB prevention: relative cost vs. 10-year health outcomes in lives lost, discounted years of life lost, and discounted QALYs lost to morbidity and mortality

	No tx	TST 9H	9H DOT	3HP	3HP DOT	IGRA 9H	9H DOT	3HP	3HP DOT
N at risk (no tx) or N treated	30,948	24,225	24,225	24,225	24,225	24,610	24,610	24,610	24,610
Total prevention program cost	0	\$46,327,289	\$83,023,762	\$45,863,099	\$52,839,129	\$190,800,939	\$228,079,683	\$181,417,593	\$193,247,686
10-year predicted TB incidence	674	494	470	522	480	429	438	464	411
10-year predicted cases averted	0	180	203	151	193	245	236	209	263
10 year loss, TB attributable deaths	32.49	23.82	22.69	25.18	23.15	20.67	21.11	22.39	19.82
10-year loss, net life years	244.67	179.42	170.86	189.68	174.39	155.66	158.96	168.65	149.30
10-year loss, net QALYs lost to acute and chronic illness and TB attributable	1,158.97	849.88	809.32	898.48	826.08	737.34	752.97	798.87	707.21
Average cost/case averted		\$257,857	\$408,512	\$302,904	\$273,077	\$778,542	\$966,490	\$866,730	\$735,933
Average cost/QALY saved		\$54,511	\$102,584	\$51,045	\$63,964	\$258,769	\$302,905	\$227,094	\$273,254
incremental cost/QALY vs. reference		reference	\$904,909	\$9,550	\$273,636	\$1,283,818	\$1,875,648	\$2,648,335	\$1,029,823

Note: Assumed LTBI prevalence (as treatments/screening) = 2.9%

Sensitivity to increased risk (by prevalence)

Cost effectiveness and TB prevention: relative cost vs. 10-year health outcomes in lives lost, discounted years of life lost, and discounted QALYs lost to morbidity and mortality where LTBI prevalence by screening = 17%									
		TST				IGRA			
	No screen/tx	9H	9H DOT	3HP	3HP DOT	9H	9H DOT	3HP	3HP DOT
N at risk (no tx) or N treated	30,948	24,225	24,225	24,225	24,225	24,610	24,610	24,610	24,610
Total prevention program cost	0	\$10,255,419	\$46,951,893	\$12,027,685	\$17,813,343	\$34,228,833	\$71,507,577	\$34,552,957	\$41,216,170
10-year predicted TB incidence	674	494	470	522	480	429	438	464	411
10-year predicted cases averted	0	180	203	151	193	245	236	209	263
10 year loss, TB attributable deaths	32.49	23.82	22.69	25.18	23.15	20.67	21.11	22.39	19.82
10-year loss, net life years	244.67	179.42	170.86	189.68	174.39	155.66	158.96	168.65	149.30
10-year loss, net QALYs lost to acute and chronic illness and TB attributable mortality	1,158.97	849.88	809.32	898.48	826.08	737.34	752.97	798.87	707.21
Average cost/case averted		\$57,081	\$231,023	\$79,437	\$92,061	\$139,667	\$303,014	\$165,078	\$156,961
Average cost/QALY saved		\$12,067	\$58,014	\$13,387	\$21,564	\$46,422	\$94,967	\$43,253	\$58,280
incremental cost/QALY vs. reference		reference	\$904,909	\$36,464	\$317,594	\$213,032	\$632,110	\$476,333	\$217,016

Note that under these assumptions, TST/9H returns a 10-year NPV of \$106/preventive tx

General conclusions

- Proactive approach is valuable
 - High opportunity cost for passive case finding/treatment (cure, not control)
 - All TX model predicts 10-year incidence = 19,000 cases
 - Public medical spending \$1.6 billion; individual health losses = 1800 deaths/ 70,000 QALYs
- These are underestimates; societal perspective would show much greater value
- TST = value diagnostic, unsupervised INH = value treatment
 - IGRA and DOT more effective but unaffordable for untargeted use
 - Generally any treatment used with TST is relatively cost effective; IGRA with any treatment is generally not
- Prevention value contingent on risk
 - HIV + and recent infection largest activation risk drivers
 - Increased risk profile in population = greater value
 - LTBI prevalence drives relative value/utility of IGRA vs. TST
 - IGRA becomes more valuable relative to TST as LTBI prevalence increases; TST typically dominant where LTBI is low/moderate prevalence

Scenario analysis

- High risk, high prevalence (100% HIV +/-recent infection); 20% LTBI prevalence
 - All options highly cost effective, all cost saving
- Low risk, low prevalence (100% HIV -/remote infection); 5% LTBI prevalence
 - TST/9H remains cost effective (38K/QALY)
- Targeted testing (assume 100% of prevalence within 25% population—plausible scenario)
 - 9H/TST becomes *cost saving*; all but IGRA with 9H DOT are *cost effective*
- Cost shift: 3rd party payers cover IGRA for 50% of population
 - IGRA continues to be most costly choice
- Breakthrough technology: DOT via telemonitoring @ \$100/treatment
 - Improved outcomes without substantial savings

Research and advocacy

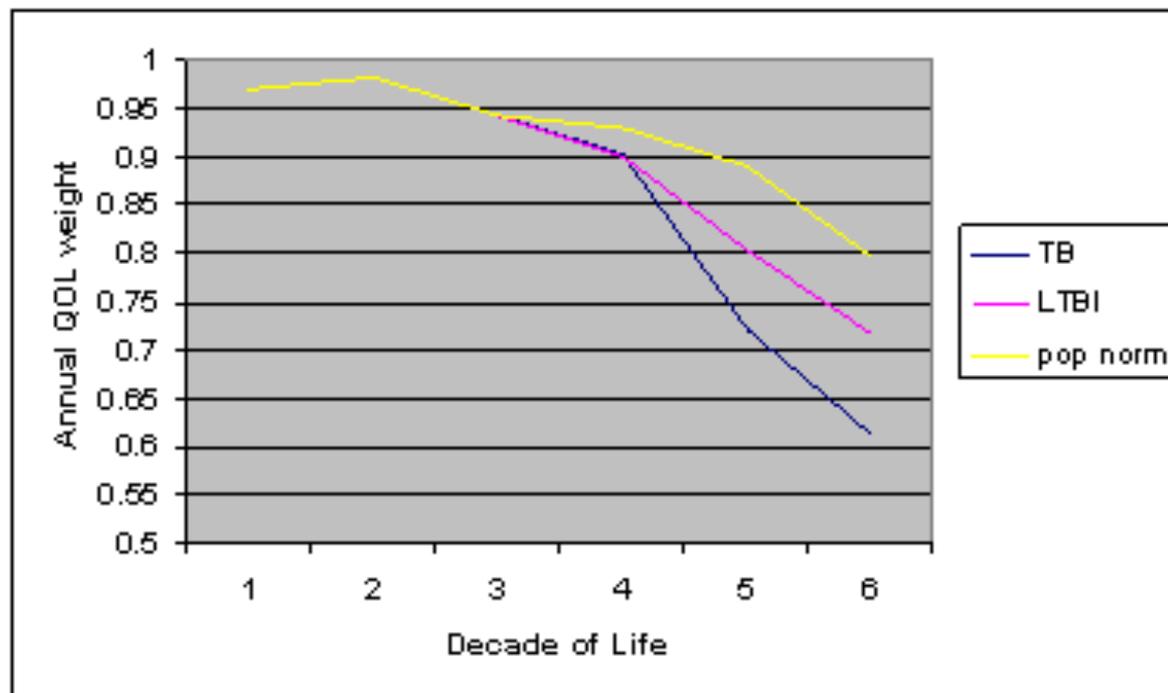
- Health authorities entrusted with stewardship of “blood and treasure”
 - Must advocate for best use of these among many competing alternatives
 - Well meant and “gut” decisions are insufficient--clear and credible evidence of relative value is essential
- Failure to sustain vital health protections brings real and direct damage
 - In NY in late 1980s, program cuts led to TB resurgence that resulted in over \$1 billion in excess costs, outbreaks are not infrequent and can consume vast energies and resources
 - Substantial money costs are associated with the presence of TB in our communities. Health and life lost to TB can never be recovered
- TB is preventable but lacks priority and consistent support
 - Value of TB prevention is poorly described and difficult to discern and communicate
 - Opportunity costs can be an intuitive way to illustrate value
- We have identified disproportionate mortality hazard among individuals with a history of cured active TB
 - Suggests marginal returns for better/quicker cure treatments low vs. prevention

Other ways to use comparative effectiveness/PHSS research

- Identify distribution, shape, and magnitude of attributable health losses
 - Target low-hanging fruit for maximum efficiency
- Compare unlike programs on similar basis
- Other?

Describing attributable loss: health related quality of life after TB cure

Annual Quality of Life Weight in Pulmonary TB Patients, Comparison Group, and Average US population



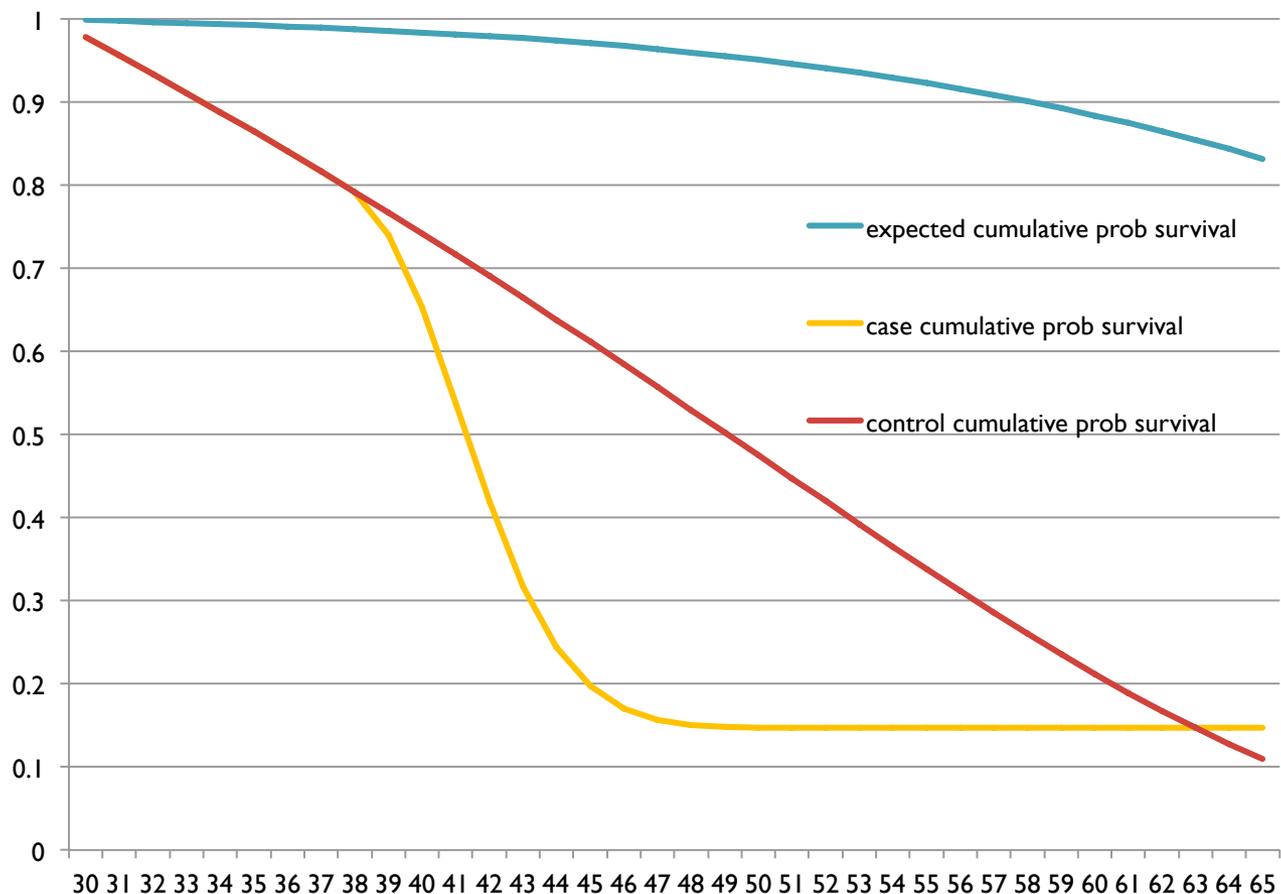
TB= Pulmonary tuberculosis, n=107

Comparison=control group with similar pulmonary risk factors, n=210

Avg. US population weighted to gender and demographic mix found in cohort

Describing attributable loss: survival after TB cure

Survival by age for gender adjusted US all population (from CDC Life Tables), TB survivors, and LTBI comparison subjects (predicted by adjusted Cox regression)



From an analysis of 11,135 individuals over 119,772 person years of at-risk observation

Comparisons across unlike programs: CE of selected activities (health system perspective)

Intervention	\$/QALY*
Liver transplantation	350,000
Annual retinopathy screening, 45 y/o diabetes pt	231,000
Elective repeat C-section	120,000
Dual-side airbags	76,000
Diabetes screening, all individuals + 25 yrs	67,000
ESRD treatment (including dialysis/transplants)	67,000
Hep. A vaccination	54,000
Heart transplant	51,000
Chemotherapy, 60 y/o w/breast CA	41,000
Driver side-airbags	31,000
TB prevention in jail	25,008
School-based tobacco prevention	22,000
TB prevention at homeless shelters	10,353

*2002 USD\$; from Harvard Center for Risk Analysis; Miller et al

Acknowledgments

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Questions?

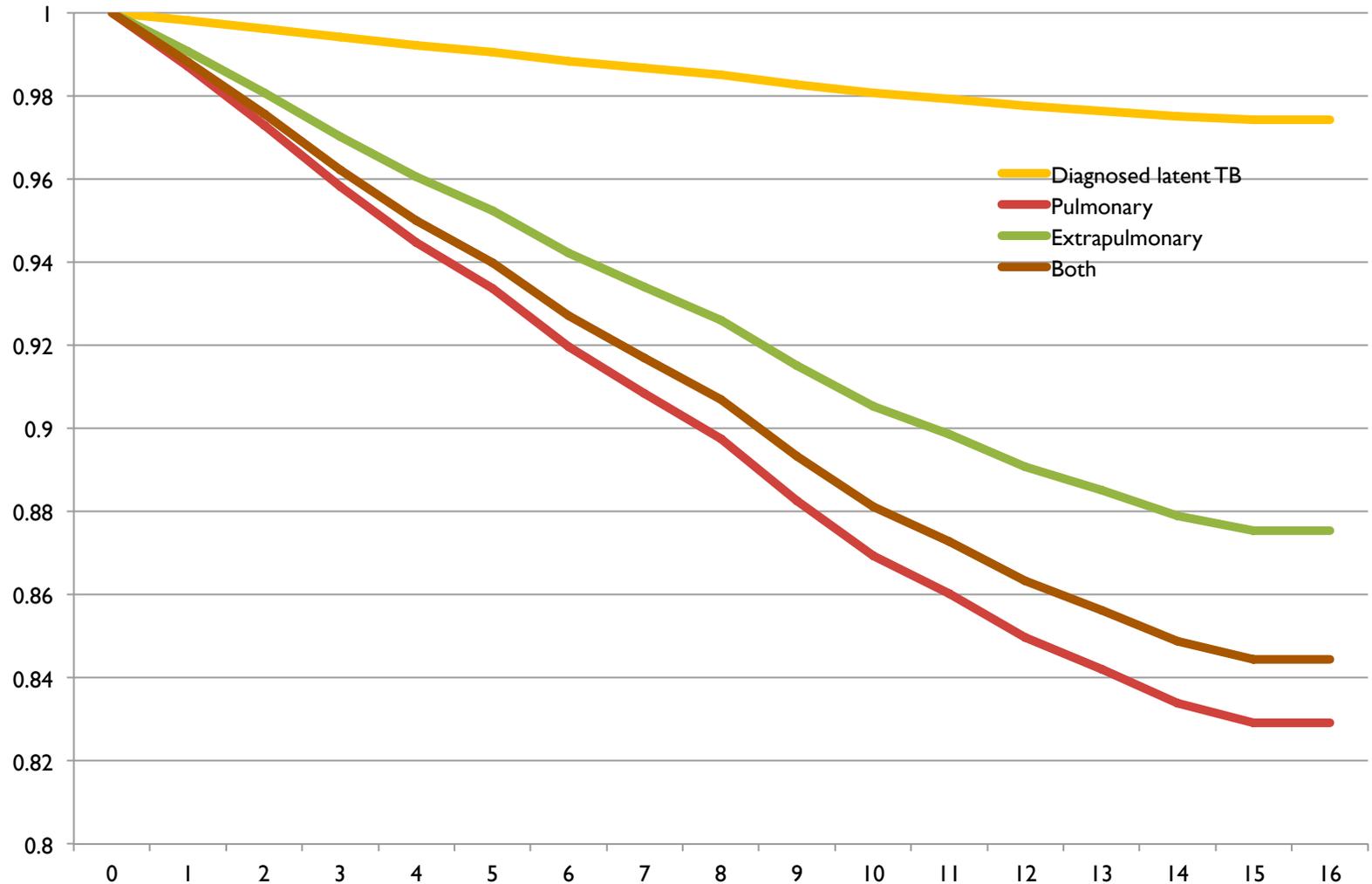


Supplemental material

Results

- 11,135 individuals over 119,772 person years of observation included in analysis
- TB survivors more frequently dead at vital status ascertainment than LTBI comparison subjects (20% vs. 3.1%)
- Subjects with a history of fully treated TB suffered an adjusted excess mortality averaging 7.6 deaths/1,000 person years relative to the comparison group (8.8 vs. 1.2 p-value<.001).
- Mortality hazard among TB survivors is not evenly distributed
 - Markers of frailty include extra-pulmonary site of disease, known HIV, and US nativity
- The adjusted average survival after cure among TB survivor decedents was 4.1 years
 - 1.6 years less than decedent comparison subjects (4.1 vs. 5.7 years, respectively).

Cox-regression probability of survival by number of years post-diagnosis/treatment and site of disease, adjusted for age, gender, race/ethnicity, HIV, and nativity



Cox regression adjusted mortality/1000 person-years and 95% confidence interval among study cohort by TB history, site, and selected characteristics.

	LTBI comparison	Any TB	PTB only	EPTB only	Both PTB/EPTB
Overall	1.23 (.72, 1.74)	8.79 (4.94, 12.64)**	8.31 (5.17, 11.44)**	6.02 (3.34, 8.70)**	7.55 (3.89, 11.21)**
Age					
18-39	.86 (.59, 1.13)	5.89 (3.30, 8.47)**	5.23 (2.74, 7.71)**	6.22 (2.64, 9.81)**	9.74 (4.67, 14.81)**
40-64	1.60 (.82, 2.37)	7.27 (4.43, 10.11)**	8.22 (5.06, 11.37)**	4.28 (2.04, 6.53)*	5.34 (2.16, 8.51)*
>=65	5.09 (2.56, 7.62)	18.33 (13.26, 23.41)**	18.94 (13.77, 24.11)**	17.21 (11.46, 22.95)**	15.05 (8.16, 21.94)**
Gender					
Male	2.04 (1.12, 2.97)	9.69 (5.53, 13.85)**	9.32 (5.87, 12.76)**	5.92 (3.13, 8.72)**	8.50 (4.32, 12.68)**
Female	1.14 (.68, 1.60)	7.63 (4.12, 11.14)**	7.03 (4.18, 9.89)**	6.16 (3.19, 9.13)**	6.36 (2.60, 10.11)**
White	1.72 (1.05, 2.39)	11.73 (6.85, 16.61)**	11.24 (7.13, 15.36)**	6.96 (3.34, 10.58)**	12.48 (6.25, 18.71)**
Hispanic	1.25 (.61, 1.89)	8.30 (4.51, 12.09)**	7.99 (4.81, 11.17)**	6.40 (2.89, 9.91)**	4.42 (1.17, 7.68)
Black	1.69 (.84, 2.54)	7.64 (4.07, 11.21)**	7.17 (4.19, 10.16)**	4.37 (1.79, 6.95)	8.0 (3.23, 12.77)*
Other race	1.96 (1.01, 2.92)	8.28 (4.43, 12.13)**	7.60 (4.38, 10.81)**	6.14 (2.76, 9.52)*	7.76 (2.23, 13.29)*
HIV Positive	2.01 (.80, 3.22)	16.95 (10.69, 23.21)**	14.61 (9.36, 19.87)**	20.87 (13.24, 28.50)**	14.41 (7.10, 21.72)**
HIV unknown	1.59 (.94, 2.24)	8.42 (4.69, 12.14)**	8.0 (4.95, 11.05)**	5.53 (3.0, 8.06)**	7.24 (3.66, 10.81)**
Foreign born	.92 (.46, 1.37)	5.95 (3.08, 8.82)**	5.95 (3.46, 8.44)**	3.63 (1.74, 5.53)**	4.18 (1.38, 6.98)*
US born	3.48 (2.24, 4.73)	14.75 (9.27, 20.22)**	12.98 (8.60, 17.35)**	11.80 (6.97, 16.63)**	16.38 (9.87, 22.89)**

N = 11,135. Cox regression predicted mortality incidence/1000 person-years. Cox regression adjusts for all variables listed in table and location.

* Denotes difference between tuberculosis survivors and diagnosed LTBI is statistically significant at the 5% level; ** denotes significance at the 1% level.

Limitations

- Preliminary study, using available data
 - Retrospective design
 - Administrative data
 - Non-linearities for age
 - Potential ascertainment bias
- Limitations do not compromise findings
 - Direction, significance, and magnitude unchanged in alternate analyses
 - Testing indicated no confounding or systematic sample bias
 - Underestimates of mortality due to emigration or other factors would suggest our findings are conservative

Relative mortality hazard among tuberculosis survivors by site of disease and selected characteristics.

	Any TB	PTB only	EPTB only	Both PTB/EPTB
Overall	7.63 (2.32, 12.94)*	7.18 (2.64, 11.72)**	5.10 (1.68, 8.52)*	6.48 (1.78, 11.19)*
18-39	9.40 (3.74, 15.05)**	8.30 (3.08, 13.53)**	9.97 (2.53, 17.41)*	16.10 (4.11, 28.08)*
40-64	6.28 (1.95, 10.60)*	7.16 (2.20, 12.11)*	3.60 (.83, 6.38)	4.53 (.70, 8.37)
>=65	5.37 (1.43, 9.32)*	5.59 (1.48, 9.70)*	4.98 (1.08, 8.89)*	4.26 (.45, 8.08)
Male	6.66 (1.81, 11.51)*	6.38 (2.11, 10.64)*	3.93 (1.08, 6.79)*	5.77 (1.30, 10.25)*
Female	9.29 (2.84, 15.75)	8.52 (3.10, 13.94)**	7.40 (2.23, 12.57)*	7.66 (1.48, 13.83)*
White	9.79 (2.94, 16.64)*	9.34 (3.36, 15.31)**	5.56 (1.43, 9.69)*	10.49 (2.0, 18.97)*
Hispanic	9.25 (2.10, 16.40)*	8.88 (2.50, 15.26)*	7.01 (1.17, 12.85)*	4.77 (.11, 9.42)
Black	6.25 (1.41, 11.09)*	5.84 (1.61, 10.08)*	3.48 (.55, 6.40)	6.56 (.65, 12.48)
Other race	5.85 (1.35, 10.35)*	5.34 (1.47, 9.20)*	4.26 (.76, 7.76)	5.46 (0, 10.96)
HIV Positive	12.70 (1.68, 23.72)*	10.69 (1.83, 19.55)*	16.31 (1.21, 31.40)*	10.52 (.18, 20.87)
Unknown HIV	7.39 (2.24, 12.53)*	7.0 (2.57, 11.44)**	4.73 (1.53, 7.94)*	6.29 (1.69, 10.88)*
Foreign born	8.90 (2.15, 15.66)*	8.91 (2.63, 15.18)*	5.33 (1.25, 9.41)*	6.15 (.60, 11.71)
US born	6.17 (1.97, 10.36)*	5.33 (2.04, 8.63)*	4.80 (1.52, 8.07)*	6.97 (1.81, 12.12)*

Ratio of comparison:case hazard rate from multivariate Cox regression * Denotes statistical significance at the 5% level; ** denotes significance at the 1% level.

Cohort description and distribution of age, gender, race/ethnicity, HIV status, nativity, and vital status, N = 11,135. Significant differences of proportion indicated by * and ** (p of chi2 significant at 0.05 and 0.01 levels, respectively)

	All TB survivors	Fully treated TB survivors- N (%)			LTBI comparison - N (%)			
		Living	Dead	% dead	All LTBI	Living	Dead	% dead
Overall	3853 (100)	3054 (79.3)**	799 (20.7)**	20.7**	7282	7057 (96.9)**	225 (3.1)**	3.1**
		Time observed						
<5 years	386 (10.0)**	0	386 (48.3)**	100.0	60 (.8)**	0	60 (26.7)**	100.0
5-9 years	1613 (41.9)**	1312 (43.0)**	301 (37.7)*	18.7*	1763 (24.2)**	1656 (23.5)**	107 (47.6)**	6.1*
>=10 years	1854 (48.1)**	1742 (57.0)**	112 (14.0)**	6.0**	5459 (75.0)**	5401 (76.5)**	58 (25.8)*	1.1**
Unadj obs duration, years	9.2	10.3	5.3		11.6	11.7	7.1	
		Selected descriptives						
18-39	823 (21.4)**	758 (24.8)*	65 (8.1)*	7.9**	2480 (34.1)**	2446 (34.7)*	34 (15.1)*	1.4**
40-64	1917 (49.8)	1610 (52.7)	307 (38.4)**	16.0**	4185 (57.5)	4051 (57.4)	134 (59.6)**	3.2**
>=65	1113 (28.9)**	686 (22.5)**	427 (53.4)**	38.4**	617 (8.5)**	560 (7.9)**	57 (25.3)**	9.3**
Male	2399 (62.3)	1817 (59.5)	582 (72.8)	24.3**	4157 (57.1)	3990 (56.5)	167 (74.2)	4.0**
Female	1454 (37.7)	1237 (40.5)	217 (27.2)	14.9**	3125 (42.9)	3067 (43.5)	58 (25.8)	1.9**
White	895 (23.2)	547 (17.9)	348 (43.6)**	38.9**	1590 (21.8)	1520 (21.5)	70 (31.1)**	4.4**
Hispanic	945 (24.5)	768 (25.2)	177 (22.2)	18.7**	2354 (32.3)	2304 (32.7)	50 (22.2)	2.1**
Black	933 (24.2)	763 (25.0)	170 (21.3)*	18.2**	1652 (22.7)	1581 (22.4)	71 (31.6)*	4.3**
Other race	1080 (28.3)	976 (32.0)*	104 (13.0)	9.6**	1686 (23.2)	1652 (23.4)*	34 (15.1)	2.0**
HIV Positive	334 (8.7)	222 (7.3)	112 (14.0)*	33.5**	384 (5.3)	367 (5.2)	17 (7.6)*	4.4**
HIV Unknown	3519 (91.3)	2832 (92.7)	687 (86.0)*	19.5**	6898 (94.7)	6690 (94.8)	208 (92.4)*	3.0**
Foreign born	2257 (58.6)	2051 (67.2)	206 (25.8)	9.1**	4252 (58.4)	4203 (59.6)	49 (21.8)	1.2**
US born	1596 (41.4)	1003 (32.8)	593 (74.2)	37.2**	3030 (41.6)	2854 (40.4)	176 (78.2)	5.8**

Conclusions/Outcomes

- Fully treated TB survivors have 7 times expected mortality
 - 1 in 5 had died an average of 4.1 years after treatment completion
- Clinical practice enhancement
 - Targets testing/care toward TB survivors at most risk;
 - Targets priority prevention activities toward populations at most risk
- Resource allocation and advocacy
 - Data helps inform economic models
 - Used by TXDSHS in current legislative session
- Policy enhancement
 - Full value of TB prevention greater than often understood
 - TB “cure” is insufficient protection; prevention likely best to modify risk