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Playing to our Strengths: An Academic/Health Department Collaboration to Facilitate Public Protections Against Tuberculosis

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Playing to our Strengths: An Academic/Health Department Collaboration to Facilitate Public Protections Against Tuberculosis

ABSTRACT

Background:

Economic modeling and analysis can facilitate evidence-based policy and practice. Such analyses may exceed the technical capacity and mission of public health agencies, yet may be critical to sustain health protections such as tuberculosis (TB) control. The net effect of TB prevention is incompletely understood, hampering objective value judgments of national TB elimination policies. This may promote inefficiencies and threaten individual and public health protections.

We describe how a HRSA-funded Texas Public Health Training Center (TPHTC) coordinated specialized analytical skills with the needs of a state public health department to create a user-friendly tool to inform planning and resource allocation; and to identify risks, benefits, opportunities, and value in the context of Texas' Department of State Health Services (TDSHS) TB control programs.

Methods:

Key informants within TDSHS and faculty from the University of North Texas Health Science Center (UNTHSC) and its associated TPHTC collaborated to develop a combined health, cost, and outcome model to answer questions of interest to TDSHS. The model incorporates standard techniques, TB specific logic and data, and Texas specific population, epidemiologic, and programmatic data into a Microsoft Excel platform. Outcome measures include 2013 USD costs from a public agency perspective and health losses denominated in Quality Adjusted Life Years (QALYs) (but not assigned a dollar value). Outcomes represent the 10-year accrued net present value (NPV) of variable costs associated with each incident TB case. The model used only publicly available, non-confidential data.

Results:

Under current public TB prevention and control practices we estimate public spending for acute medical care and health losses for Texas' 1325 TB cases in 2011 will exceed a NPV $100,000,000 and 4800 QALYs by 2022; societal costs would likely be much higher. Public TB control is relatively cost effective and preserves 3.7 QALYs/case averted at $54,000/QALY.

Implications:

Partnerships between academic institutions and public health departments offer the potential to produce the economic analyses needed for judicious use of public resources. We used accessible methods, data, and technology to create a model to analyze the relative value of public TB control in Texas as well as to identify potential efficiencies within activities. Our analysis suggests public efforts against latent TB infection effectively and efficiently mitigate some of the substantial health and cost impact of TB to Texas. Most of TB's burden remains, however, and more careful targeting of prevention by risk promises rich rewards.

Keywords
public health, partnership, modeling, economic analysis

Cover Page Footnote
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Health authorities are faced with the need to prioritize and use limited public resources as efficiently as possible, but doing so can be daunting. Economic analysis can facilitate efforts to advocate for critical public programs such as TB control as a priority among domestic health protections, as well as to identify efficiencies and optimize efforts within existing programs. Such work may reach beyond the technical capacity and scope of mission within local and regional health departments, however.

Health, cost, and other outcomes associated with TB or its prevention and cure remain incompletely understood. Consequently, objective value judgments can be difficult and prioritization of broad elements such as emphasis on cure over prevention or even of national TB elimination policies relative to other investments may lack an evidence basis.[1] Without evidence of value, health authorities face the renewed dismantling of public TB control infrastructure and the subsequent dangerous and costly U.S. TB resurgence known to follow.[2] Recent studies suggest opportunity costs associated with potentially preventable TB may be greater than appreciated.[1,4] Accessible and tools to systematically quantify and compare these at the local, regional, and state health departments are needed to most effectively advocate for and allocate vital health resources.

We describe how a HRSA-funded Texas Public Health Training Center (TPHTC) coordinated functional economic research at the practice level to focus specialized analytical skills on the needs of a state public health department (Figure 1). This collaboration between CDC-funded investigators and personnel from the Texas Department of State Health Services (TDSHS) resulted in a user-friendly, Excel-based tool to inform TB program planning and resource allocation.

Figure 1. An example of how multiple stakeholders can work together to maximize the efficiency of public health resources.

METHODS:

Between January and April 2013, key TDSHS informants worked with faculty from the University of North Texas Health Science Center (UNTHSC) and its associated TPHTC to develop a combined health, cost, and outcome model to answer two questions of interest to TDSHS. The first identifies 'global value' of TB prevention--what potentially preventable economic and disease burden does TB create to Texas? The second identifies 'programmatic value' in prevention--which of the various diagnostic and treatment combinations potentially offer the most efficient TB prevention in current practice?

Collaborators met weekly to design and inform the model and then vet its validity, function, performance, and relevance. The final model incorporates previously published methodologies for the study of TB cost with standard techniques for economic analyses in healthcare in a Microsoft Excel platform, and includes both TB specific logic and publicly available Texas specific population, epidemiologic, and programmatic data.[1,2] Within a TB infected population, potential outcomes are a function of risk, cost, and natural history. The model uses a semi-Markov process to consider these, then to estimate and compare cost and effect among various circumstances or planned action.

The model was created for public health agencies and allows users to readily update or change its assumptions. It also allows users to compare large or small differences in epidemiology, treatment, public policy, technology, cost, and many other factors, or to conduct sensitivity analyses. The resulting tool calculates the potential number of preventable TB cases and their associated economic burden, and informs diagnostic and treatment decisions to prevent the most TB cases for the greatest value.
We assume prevention "value" to be the costs averted by preventing an incident case, quantified as the 10-year accrued net present value (NPV) of individual health losses and public agency spending associated with an incident TB case. Healthcare costs are given in 2013 U.S. dollars (USD), and reflect costs incurred by the public health system to treat a patient; health losses were enumerated in Quality Adjusted Life Years (QALYs); both cost and health outcomes are discounted at 3% per annum where appropriate.[3] Relative value given varied factors is given as the incremental cost effectiveness ratio (ICER) for the change scenario when compared to baseline. Global value of public investment in TB prevention was estimated relative to a counterfactual scenario in which the public activities do not take place. Private systems do not typically conduct surveillance and prevention efforts similar to those of interest in this simulation and we assume no change in private health system activities.

RESULTS:

In 2011, 1,325 new cases of active TB were reported among Texans. We estimate the costs to public payers associated with these cases will exceed $100,000,000 by 2022; costs to all payers —i.e., "societal costs"-- would likely be much higher (Table 1). Further, we estimate the 10-year burden of associated morbidity and mortality stemming from those cases will result in health losses exceeding 4,800 QALYs. These opportunity costs suggest that on average each successfully prevented TB case would avert a respective $82,000 and 3.7 QALYs of publicly funded acute healthcare spending and health loss (Table 1).

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Table 1: Model predicted 10-year net health loss and agency variable cost of care associated with incident TB, Texas 2011 (1325 cases)

	Clinical event	2011 TX incidence	Events/ base case	Cost/ event	Cost/ base case	Statewide cost
Variable cost components						
Uncomplicated tuberculosis	outpt course of care	1,209	0.91	$7,046	$6,429	$7,772,833
Tuberculosis/HIV co-infection (TB-HIV)	outpt course of care	100	0.08	$8,760	$661	$876,000
Multi-drug resistant tuberculosis (MDR TB) (HIV + or -)	outpt course of care	16	0.01	$48,491	$586	$775,856
Contact, case	outpt course of care	10,415	7.86	$603	$4,737	$6,276,467
Contact, suspect	outpt course of care	10,136	7.65	$478	$3,653	$4,840,477
High-probability (HP) suspect	outpt course of care	1,365	1.03	$3,253	$3,351	$4,439,532
Hospitalization day	inpt day	19,593	11.60	$1,350	$15,656	$26,443,449
Secondary Transmission	Secondary TB 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[1]	discounted QALY, 10-year sum	1,692	2.36			1692
Acute illness/treatment	discounted QALY	331	0.25			331
Disproportionate death after treatment[4]	discounted QALY, 10-year sum	2,686	2.03			2686
Health losses	discounted QALY, 10-year sum					**4861**

Analysis of return on investment and cost-effectiveness of TB surveillance and prevention from a public payer perspective predicts public spending prevents incident TB at a cost of $257,000 per case, a 10-year net loss of (-)$1,380 per preventive treatment provided (data not shown).

These results indicate that Texas' current TB screening and treatment practices are relatively efficient in producing health, with the cost of $54,000 per QALY considered acceptable by health economists (Table 2). Sensitivity analyses were conducted to identify cost and outcome 'drivers' in the model and to predict potentially efficient program strategies. Many such efficiencies exist. For instance, a 50% improvement in targeted screening programs (e.g. same number of diagnoses with half the screenings) would reduce the net spending loss for preventive treatments to less than $500 and decrease the price per QALY to $29,000. Targeting surveillance to populations with 15% LTBI prevalence would yield a further 50% improvement in screening detection, avert TB for $66,000/case, and provide a positive net return on investment ($38) per preventive treatment.

Table 2: Health outcomes and costs in Texas associated with tuberculosis according to current screening and treatment practices		
	No screening or treatment	**Current standard of care ***
Total number	30,948	24,225
Total prevention program cost	$0	$46,327,289
Predicted TB incidence over 10 years	674	494
TB Cases averted over 10 years	0	180
Deaths attributable to TB over 10 years	32.49	23.82
Net life years lost over 10 years due to TB	244.67	179.42
QALYs lost over 10 years due to TB illness and mortality	1158.97	849.88
QALY loss prevented over 10 years	0	309.09
Average cost per TB case averted	n/a	$257,857
Average cost per QALY saved	n/a	$54,511

* Screening by tuberculin skin test with 9 months of isoniazid for TB prevention where indicated

IMPLICATIONS

Robust and integrated data and the analyses they inform are necessary to optimize public health protections, and this project suggests how academic/practitioner partnerships using these can provide a roadmap to best practices. We created and provided an accessible, objective, Microsoft Excel-based model to explore the cost-effectiveness of TB control in Texas. We then used relevant local data to answer questions of interest to health authorities and reported findings to Texas Department of State Health Services' executive leadership and to its TB elimination division. Even given our limited analytical perspective and assumptions of generally loose targeting, TB prevention—proactive public interventions to prevent asymptomatic, non-communicable latent TB infection from progression to active, communicable TB disease—is not only effective but a "good buy" by the standards of health economists.

Prevention interventions should include carefully targeting screening to populations at greatest risk for TB infection, and/or which have factors that increase risk for progression from latent to active TB. Under current screening protocols, about 2% of screenings result in positive diagnoses—far below the estimated statewide prevalence estimate of nearly 5%. When modeled under current program activity assumptions, approximately two-thirds of the theoretically preventable health loss attributable to TB remains. This indicates what gains remain to be realized before the full potential of prevention is attained by interventions to increase adherence to preventive therapies, for instance.

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Positive financial returns to the system making healthcare investments are very rare, as is health department capacity to conduct the analyses that would identify these--or even to guide judicious use of public resources. It is striking that our relatively brief and inexpensive collaboration between academia and state health authorities identified routine protections against TB as effective and cost effective. Continued efforts to improve TB prevention through evidence-based advocacy, more objective program or population targeting, and enhanced risk control should be a priority and may be well rewarded with greater efficiencies, improved population health, and even cost savings.

SUMMARY BOX:

What is Already Known about This Topic? Much is known about the natural history, treatments and their costs, and acute health losses associated with active tuberculosis. Much less is known about the costs and benefits of TB prevention, leaving it difficult for health authorities to objectively judge the relative value of pursuing prevention as a matter of practice or policy in their context. Barriers exist to effective consideration of these unanswered questions by either academic or public health entities alone.

What is Added by this Report? We describe a health department/academic collaboration to build a versatile and context-sensitive modeling tool using publicly available data and common software, and its use to inform statewide public resource allocation decisions. Governmental public health agencies can be a valuable resource for population-level data and existing mechanisms for reaching communities with the greatest needs. Targeted prevention efforts can maximize the use of scarce public health resources to result in the full potential of prevention efforts.

What are the Implications for Public Health Practice, Policy, and Research? Applied economic analysis is an accessible, relevant, and often very useful strategy to facilitate and support key health authority activities, and the careful coordination of academic skills with practitioner perspectives can be an effective means to conduct such analyses.

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