Welcome to the RFF Weekly Policy Commentary, which is meant to provide an easy way to learn about important policy issues related to environmental, natural resource, energy, urban, and public health problems.

Following last week's discussion of health hazards from indoor air pollution, this week's commentary focuses on another major cause of premature death in developing countries—tuberculosis. Ramanan Laxminarayan, Eili Klein, and Sarah Darley discuss the widespread prevalence of tuberculosis and their estimates of the highly favorable benefit to cost ratio for potential interventions to contain the disease.

Controlling Tuberculosis: What Is the Benefit, at What Cost?

Ramanan Laxminarayan, Eili Klein, and Sarah Darley

After HIV/AIDS, tuberculosis (TB) is the most important cause of adult mortality due to infectious disease in low- and middle-income countries. It accounted for some 1.2 million deaths in 2004 in the 22 countries across Asia and Africa identified by the World Health Organization (WHO) as "high burden." (These countries are all in Asia and Africa; the Russian Federation and Brazil also have high rates of TB.) The advent of antibiotics was once thought to herald the end of "consumption," the wasting disease caused by a lung bacterium, but in many of these countries, poor sanitation, high rates of HIV infection, and drug-resistant strains of the bacterium have allowed tuberculosis to spread.

Tuberculosis is a contagious disease, spread through the air via coughing, sneezing, or even talking. In its most common form, known as pulmonary TB, the bacteria attack the lungs and can cause chronic coughing (often with bloody sputum), fever, and weight loss. The WHO estimates that, left untreated, each person with pulmonary TB will infect on average 10 to 15 people every year.

Weakened and unable to work, once-productive adults who have contracted the disease must be cared for by other members of their families, putting the caregivers at greater risk of infection and lowering their own productivity. The cost of treatment can account for as much as 8 to 20 percent of annual household income, but without it, most people die within 18 months of being infected. The burden of TB is borne not just by those afflicted and their families, but also by communities and

governments. Adult mortality dampens national economies by claiming productive workers. People are reluctant to invest in education or take entrepreneurial risks if they don't expect to live long enough to see the payoff, and they tend to have more children and invest less in their offspring.

Lifting the burden is one of the UN's Millennium Development Goals—specifically, reversing the incidence of TB by 2015. The Stop TB Partnership goes further and aims to halve prevalence and death rates by 2015, relative to 1990. One of the tools for reaching either target is DOTS, "directly observed treatment, short-course," in which patients take their drugs under a health worker's supervision (to ensure that they get the recommended doses at the appropriate intervals).

Determining the benefits of achieving the goals begins with quantifying the economic costs of *not* achieving the goals: how much does TB cost society? What is the economic burden of not doing more than is being currently done to prevent and treat TB?

To address these questions, we turned to a widely used concept in economics, the value of a statistical life (VSL), which puts a value not on Person X's worth as a human being but rather on measures that people are willing to undertake (such as buying safer cars or choosing safer occupations) that can reduce the statistically expected number of deaths by one. To assess the economic burden of TB, we first must ask: how many people will die of TB in the 22 high-burden countries from 2006 to 2015? The WHO epidemiological models consider three scenarios:

- No DOTS: the program was never introduced, case detection rates are variable, rates of cure are low;

- Sustained DOTS: case detection and treatment success rates are sustained at the 2005 level to 2015; and
- Global Plan to Stop TB 2006–2015: DOTS coverage is expanded, programs address TB-HIV co-infection and drug-resistant TB, and infections are targeted with new diagnostics, medicines, vaccines, and educational efforts.
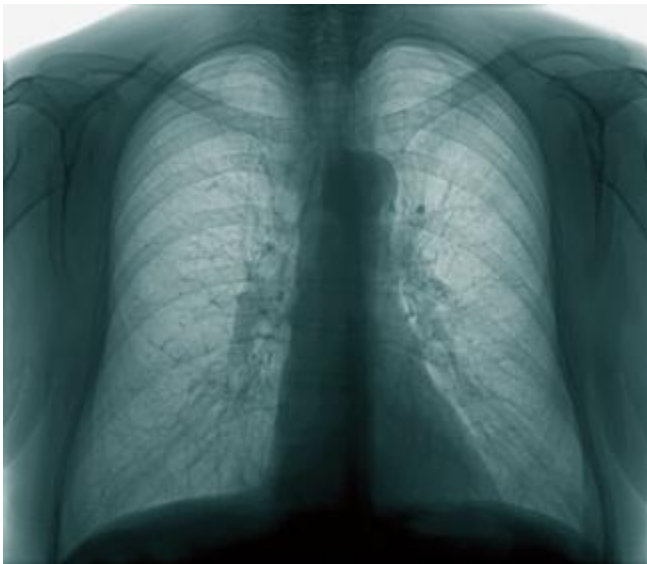
We estimated the economic cost of proj infection cases, and so forth. We also ca raising the necessary funds from nationa

With No DOTS, we found that the econo roughly $3 trillion, including $1.175 trilli implemented in all TB-endemic countrie

Sustained DOTS would cost $18.3 billion to implement but deliver a dramatic economic gain of $1.6 trillion. The benefit-cost ratio of moving from No DOTS to Sustained DOTS is about 10 to 1—a very healthy return on the investment.

In the final scenario, the full Global Plan version of DOTS would cost $33.2 billion to implement and yield a gain of about $1.9 trillion compared with No DOTS. This is a relatively small incremental

improvement over Sustained DOTS, but the benefits still exceed the costs in the African countries.

The economic burdens of TB deaths and the benefits of TB control are greatest in China and India, where the combination of growing incomes and high numbers of TB deaths multiply into a significant economic effect. Although more TB deaths occur in the African countries, the economic benefit of either Sustained DOTS or Global Plan DOTS is more modest here, partly because incomes are expected to grow more slowly than in Asia, and partly because the benefits of treatment in Africa slip away when HIV claims lives that would otherwise be saved from TB. Nevertheless, the benefits of the Global Plan are highest in the African countries with high levels of HIV. Because the economic burden of TB in Africa is significant, the benefits of either DOTS strategy are large and exceed the costs by a wide margin.

While progress is being made, challenges such as funding gaps, higher-than-expected incidence rates through the 1990s, HIV co-infection, and multi-drug resistance point to the urgent need for more comprehensive action to control TB. Fortunately, the state of our knowledge means that TB control is not a question of whether, but of *how and how much* we will commit to do. The significant economic benefits of taking action indicate that there is no reason we cannot do more to tackle this disease— the upfront costs are more than outweighed by the decades of not only health but of productivity and prosperity that follow.

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<div align="center">Views expressed are those of the author. RFF does not take institutional positions on legislative or policy questions.</div>

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Further Readings

Laxminarayan, R., E. Klein, C. Dye, K. Floyd, S. Darley, O. Adeyi. 2007. "Economic Benefit of Tuberculosis Control." Washington DC, World Bank Policy Research Working Paper No. 4295. August.

Dye, C. 2006. "Global epidemiology of TB." *Lancet* 367: 938-40.

Dye, C. and K. Floyd. 2006. *Tuberculosis. Disease Control Priorities in Developing Countries* (2nd Edition). D. T. Jamison. New York, Oxford University Press. : 289-312.

Aldy, Joseph E. and W. Kip Viscusi. 2008. "Adjusting the Value of a Statistical Life for Age and Cohort Effects." *Review of Economics and Statistics*. Vol. 90. No.3. pp. 573-581. Related RFF Discussion Paper 06-19.