adapted for many other important areas of health-related research and development.

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Economics and the Argument for Parasitic Disease Control

David B. Evans and Dean T. Jamison

Infectious and parasitic diseases still account for well over half the total burden of morbidity and mortality in Sub-Saharan Africa, India, and much of the rest of Asia, excluding China (*1*). Governments of countries where these diseases are endemic face increasingly difficult choices. Economic recession coupled with depressed commodity prices has led to falling levels of real income per capita, reducing the ability of governments to raise domestic resources for public expenditure. Pressure to reduce macroeconomic imbalances and unsustainable levels of government debt has resulted in economic stabilization and adjustment policies to reduce reliance on public intervention and to encourage development of the private sector. As a result, real government health expenditure per capita declined in the 1980s in many of the countries where these diseases are the most endemic (*2*). This added to the burden imposed on private households which already contributed a greater proportion to total health expenditures than those in industrialized countries. There is some evidence that government health expenditures recover more quickly in countries undertaking adjustment programs, but even with recovery, resource availability will remain tightly constrained in most countries, necessitating hard choices about disease control priorities (*1*).

Donors, too, are facing economic constraints, and official development assistance to the health sector in developing countries stagnated in the 1980s (*1*). In response to these circumstances, a vigorous debate has ensued in both donor and endemic countries about the appropriate size and nature of government expenditure, the priority that should be given to the social sectors, and within the health sector, the priority that should be given to different types of programs including parasitic disease control. Three types of economic argument have been used to justify continued or increased support for parasitic disease control, and they are discussed in turn.

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The Economic Cost Imposed by Parasitic Diseases

Parasitic diseases impose an economic burden on households. Scarce resources must be used to ameliorate the consequences of infection, both as direct costs—for example, for diagnosis and treatment—and as indirect costs in the form of morbidity and mortality that can reduce the time available for productive pursuits and the productivity of the time so allocated. These costs can be considerable. For example, in a group of four African case studies from an area in which average daily earnings were approximately $0.20, these costs averaged $9.80 ($1.80 direct, $8 indirect costs, 1985 U.S. dollars) per episode of malaria (*3*). Significant indirect costs have also been estimated for leprosy [where earnings of infected people were one-third of those of uninfected controls (*4*)], schistosomiasis (*5*), and dracunculiasis (*6*).

These household costs are sometimes translated into societal costs by multiplying the costs of an episode of disease by the estimated annual incidence of disease in a country. Applying this method to a set of African malaria studies (*3*), researchers have argued that, in 1985, malaria imposed total costs equivalent to 0.6% of the value of all goods and services produced in those countries (gross domestic product), a very substantial cost. This type of extrapolation should be interpreted carefully for a variety of reasons. For example, observed cross-sectional differences in average earnings by disease status do not necessarily reflect the macroeconomic benefits that would result from reducing, as opposed to eliminating, a disease. In addition, research has shown the existence of coping mechanisms for disease, including the reallocation of the time of some household members to compensate for illness of other members (*7*). Because of this, even at the household level there may be little observable change in economic production as a result of disease, although the forced reallocation of time away from preferred uses is a clear opportunity cost to the household. Certainly, the mechanisms are far more complex than simply assuming that a duration of illness of, for example, 6 days reduces societal output by the equivalent of 6 days average productivity.

Nonetheless, studies of the relation between national economic growth rates and measures of health status of population suggest genuine costs of poor health in the form of reduced economic growth potential (*1*). The strength of this literature is in highlighting such costs and the fact that illness forces changes in activity patterns, thereby reducing economic potential. In addition, there is growing evidence that the economic impact of parasitic disease, particularly helminth infections, can be more subtle—retarding physical growth, development of cognitive skills, and educational participation and performance (*1*, *8*). This reduces the longer term economic potential of individuals and, perhaps, of society: A positive and strong correlation between educational attainment and labor productivity has been demonstrated in a variety of settings (*9*).

The incidence of parasitic disease is greatest among the poorest people in the poorest countries. By restricting economic potential, parasitic infections exacerbate existing inequalities in society to a much greater extent than noncommunicable diseases. This is an excellent reason for intervention. However, ranking diseases strictly according to the total economic burden they place on society, as has been done for the United States (*10*), would not be of great value in setting priorities for parasitic disease control. It is not the size of the problem which alone should determine the priority of intervention from an economic viewpoint, but the extent to which the problem could be reduced for the available resources.

The Cost-Effectiveness of Intervention

Cost-effectiveness analysis is a powerful aid to setting intervention priorities within the health sector. Interventions can be ranked according to the size of the health improve-

ment that can be "purchased" per unit of expenditure, and priority given to those that offer the largest health improvement. The most comprehensive comparison of potential interventions in terms of cost-effectiveness was funded by the World Bank (*1, 11*); this comparison used the number of disability-adjusted life years (DALYs) gained as the indicator of health improvement. Years of death prevented are given a weight of 1. Years of morbidity prevented are given a weight between 0 and 1, depending on the extent of the disability prevented. Total years affected by the intervention are then summed and discounted over time. Age-dependent weights, giving explicit priority to DALYs saved during the ages in which working adults would be supporting dependents, were also included in the Bank's studies.

The results suggest that a large number of clinical and preventive interventions commonly subsidized by governments in developing countries are very expensive ways of improving health, costing over U.S.$1000 per DALY gained. Such interventions include medical treatment for hypertension and many activities of tertiary care institutions. On the other hand, many interventions that are not fully funded are very efficient ways of improving health, producing benefits at less than $25 per DALY. Among these are a large number of interventions aimed at parasitic diseases—mass anthelminthic treatment targeted at school children, BCG (bacillus of Calmette and Guérin) vaccinations, short-course treatment for tuberculosis, multidrug therapy for leprosy, and in some situations, intradomiciliary spraying for malaria. Research also suggests that impregnating bed nets with insecticide is a very efficient use of scarce health resources for malaria control in some environments (*12*).

The exact cost per unit of benefit in any given country will depend on factors including the level of endemicity, cost structures, and the scale of the intervention. However, the orders of magnitude involved in these estimates suggest that selected interventions against parasitic diseases are among the most efficient ways of improving health, certainly more efficient than a number of interventions currently funded by donors and governments in countries with endemic parasitic diseases. Interventions against parasitic diseases can be made even more efficient if they are delivered as part of a package of essential clinical or public health interventions (*1*). This is, perhaps, the most powerful economic argument for reallocating funds to parasitic disease control. On the other hand, drug resistance is reducing the cost-effectiveness of some interventions, particularly for malaria, and no cost-effective interventions exist for certain other parasitic diseases, for example. Hence, there is still a need for a strong research and product development agenda.

Equity and the Role of the Public Sector

Economists argue that markets should be left to work where they work efficiently. Governments should intervene where markets fail to work adequately (*1, 13*). Virtually every type of market failure exists in the health sector and can be used to justify public subsidy (though not necessarily provision) of certain forms of parasitic and infectious disease control. For example, the control of malarial mosquitoes has the characteristics of a public good in that one person benefits without excluding others from benefiting. In a free market, suboptimal levels of public goods are produced (*1*).

Smear-positive tuberculosis is transmitted from person to person. Each untreated smear-positive case will result in between 20 to 28 new infections, of which perhaps 6 to 10% will develop some type of clinical tuberculosis (*14*). Even if these infected people could afford to pay for treatment, individual decisions about how much to purchase would be made on the basis of the potential private benefit to the individual. If the extra benefits (the positive "externalities" of reduced transmission) were ignored, suboptimal tuberculosis control would result without government involvement.

But perhaps the strongest argument for government involvement concerns equity and poverty eradication. Even where markets work efficiently, they work efficiently for a given income distribution. In virtually all societies, governments recognize that a proportion of the population cannot afford to purchase a minimum acceptable level of care, and a legitimate role for government is to ensure access for this group. Because parasitic diseases still account for a high proportion of ill health among the "poorest of the poor," access to a minimum package of services for these people would require access to forms of parasitic disease control (*1*). Investing in the health of the poor would directly address their welfare and, in addition, provide them with more of the "human capital" required for a long-term escape from poverty.

Conclusions

Parasitic diseases continue to impose a substantial burden on the poorest people in the poorest countries. The economic literature suggests that parasitic infections reduce both long- and short-term productive potential, reinforcing poverty and inequality. It suggests that governments can intervene efficiently to reduce poverty, and that ensuring access to a minimum package of health services which includes parasitic disease control would contribute to this aim. The literature further suggests that the provision of certain types of interventions against parasitic diseases represents a very efficient use of scarce public resources. Finally, continued evolution of microbes and vectors, along with gaps in the current menu of control options for parasitic diseases, suggests the need for continued major investments in research and development. If they were targeted more on parasitic diseases, current health expenditures of both donors and governments of countries in which parasitic diseases are endemic could be reallocated to improve overall levels of public health while at the same time reducing poverty.

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