REVIEW

ECONOMICS AND TROPICAL DISEASES : A RESEARCH AGENDA USING SCHISTOSOMIASIS AS AN EXAMPLE

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Abstract. There is a growing interest in health economics in developing countries. In this paper, some of the economic literature concerning schistosomiasis is reviewed and a set of economic questions is derived which could form the basis of a broad research agenda for tropical diseases. The major criterion used to identify research issues is that they should be of practical value to control programs.

INTRODUCTION

Many developing countries have experienced a period of economic stagnation since the early 1980s. The value of domestic production in terms of real Gross Domestic Product (GDP) fell in a number, and production per head of population (real GDP per capita) fell in more, including much of sub-Saharan Africa and Latin America (World Bank, 1991). This, combined with a dramatic reduction in private sector lending to developing countries, restricted the ability of governments to raise revenue. At the same time, international lending agencies put pressure on governments to make structural adjustments to their economies, partly in order to improve their external debt positions, and partly to put their economies into a sounder long term position. A major focus of structural adjustment was a reduction in the size of the government sector with corresponding incentives to stimulate an efficient private sector. Accordingly, government expenditure fell in many countries, particularly "discretionary expenditure" - the funds available after meeting essential commitments such as debt repayments (Ebel, 1991).

At the same time the demand for health care continued to rise, partly as a result of population growth, but also because of the epidemiological transition. Non-communicable diseases are replacing communicable diseases as the major cause of mortality and morbidity in the more affluent groups in developing countries, and these diseases are often technology-intensive and expensive to treat (Mosley *et al,* 1990). Yet communicable and parasitic diseases have not been controlled and remain the dominant cause of ill health among the less affluent. Governments have, therefore, had to face increasing pressures on their health budgets and growing dilemmas about the types and quantity of care to provide.

Economics, the study of the allocation of scarce resources, should have a contribution to make in these circumstances and the activities of health economists in developing countries have been growing. This paper reviews the contribution made by economic research using schistosomiasis as an example, with a view to identifying unmet research needs which would be of practical value to control. Although the focus is schistosomiasis, the issues are more generally applicable to other tropical diseases.

SCHISTOSOMIASIS

About 200 million people in 76 countries are believed to be infected with at least one of the five species of schistosomes known to infect humans (WHO, 1991). The estimated annual death toll is 200,000. The disease is, however, very focal with

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the prevalence of infection and the morbidity associated with a given level of infection varying between species, between countries for a given species, and over relatively short distances within a single country for a given species (Gryseels, 1989). Official control programs exist in a number of countries including China, Egypt and Brazil, but large parts of the endemic world, particularly in sub-Saharan Africa, are not covered by control activities.

The public health priority given to a particular disease or condition relates not only to its impact in terms of mortality, morbidity and socioeconomic costs, but also to the feasibility and affordability of control options (Gryseels, 1989). Accordingly, the lack of control activities in large parts of the endemic world may be because the disease is not perceived to have a sufficiently large impact, feasible control options do not exist, or because the existing control options are not affordable or sustainable. Technically feasible control options do exist, ranging from water and sanitation programs, to vector control activities, to chemotherapy (Leise, 1986). The questions of the impact of the disease and the affordability of the available control options are discussed in subsequent sections.

THE ECONOMIC COSTS OF SCHISTOSOMIASIS

In terms of parasitic infections, a recent WHO Expert Committee claimed that schistosomiasis was second only to malaria in its socioeconomic impact and public health importance (WHO, 1985). The disease has long been considered to be a serious impediment to economic development through its debilitating effects on the labor force (Tanner, 1989). Yet in 1979 Prescott could find little conclusive evidence to support the assertion that the disease imposed high economic costs on society. The early macroeconomic studies purporting to show high costs were flawed methodologically, while the more microeconomic studies produced conflicting results (Prescott, 1979). For example, some studies reported that infected people worked fewer hours than uninfected people, some found no difference in labor inputs by infection status, while one found that infected laborers worked longer than uninfected people. Similar inconsistencies were observed in studies reporting the impact of infection on labor productivity (output per unit of time).

These early studies focused on agricultural wage laborers rather than rural households. More recent research has considered the latter group, with the same contradictions. For example Domingo *et al* (1980) found that self reported inability to work was unrelated either to infection status or intensity in the Philippines, although the same team later identified one village where a higher proportion of infected than uninfected people reported that they were unable to work (Olveida *et al,* 1983).

Other studies have documented that the disease can have an impact on time allocations without necessarily reducing incomes. Parker (1990, 1992) noted that infected women in the Sudan spent, on average, less time in off-farm wage employment, subsistence production and personal care activities than other women, although their output per hour in off-farm employment was higher. The net effect was that their cash incomes were similar to those of uninfected women. In the Philippines, uninfected family members adjusted their activity patterns to compensate for the lower labor inputs or productivity of infected family members, so that total farm production did not fall (Herrin, 1991). On the other hand, Audibert (1986, 1991) did not consider the impact on time allocations, but found that disease reduced both labor productivity and output on family rice farms in Cameroon and Niger.

Thus, it is difficult to prove that the economic impact of the disease is substantial, and that the priority given to control in sub-Saharan Africa is inappropriate. This is probably not surprising given the focal nature of infection and disease noted earlier. Certainly it cannot be concluded that infection *per se* will have an economic impact. Intensive infections are more likely to do so, but the correlation between intense infections and morbidity does not appear to be high on an individual basis, although it may be higher on a community basis (Gryseels, 1989). Is further research of this nature warranted? It may be useful for two reasons. Firstly, control programs must be developed from an understanding of the full impact of a disease, and community perceptions of this impact. Secondly, studies showing that a neglected disease imposes large economic costs can have an advocacy effect-they can attract extra funds for control.

However, any additional research should focus on households rather than wage laborers. Unhealthy people are not likely to be hired as wage laborers, or will be dismissed if their productivity suffers, so differences in labor inputs and productivity by infection status are less likely to be observed among them (Prescott, 1989). Research should also be undertaken in communities where the prevalence of clinical disease is high or where communities have themselves identified schistosomiasis as a significant problem. A production or profit function approach may help to explore the impact of disease on labor productivity, but this requires sound economic skills and considerable time to collect appropriate data. It is equally important to examine the impact on the different factors of production, notably the area of land cultivated and total family labor inputs. Moreover, the studies of the intra-household effects suggest that the economic impact could be more complex than simply reducing total labor inputs or labor productivity.

Finally, possible longer term economic consequences might also be explored. Stephenson (1987, 1989) showed that *S. haematobium* can be associated with reversible anemia, malnutrition and growth stunting in children. This might affect economic output if stronger adults produce more than weaker people, by working longer or harder. In addition, a positive correlation between education and productivity has been shown in a variety of settings (Schultz, 1989). If schistosomiasis inhibits educational achievement it could also affect production in the long run.

THE COSTS AND AFFORDABILITY OF CONTROL OPTIONS

A number of studies on the costs of control programs have been published since the 1985 WHO Expert Committee noted the inadequacy of the available data. All have considered programs based on chemotherapy, consistent with the belief that the costs of vector control are too variable to allow general estimates, and the capital costs of water and sanitation projects are likely to be beyond the capacity of disease-specific control programs (Rohde, 1989). Gryseels (1989) reported costs from chemotherapy programs in three African countries using a variety of strategies including selective, targeted and mass chemotherapy. Two additional studies extrapolated costs observed in selected african programs to hypothetical vertical control strategies delivering praziquantel (Korte *et al,* 1986; Rohde, 1989). Total delivery costs in terms of prices prevailing in the late 1980s ranged from US$0.70 to US$5.22 per head of population per year, while costs per infected person treated were obviously higher, the minimum being US$3.00 per year. These costs are, indeed, likely to be lower bound estimates, as development costs, expatriates' salaries and the cost of failures were generally excluded (Gryseels, 1989).

It now seems unlikely that any of the available chemotherapy delivery strategies will reduce transmission in high prevalence areas (Gryseels, 1989). The objective of chemotherapy-based control is to reduce morbidity, an objective which requires programs to be sustained over long periods of time. Delivery costs like those that have been reported, most of which have exceeded US$1.50 per person, and which can rise to over US$5.00 in high transmission areas, are simply not sustainable from national resources in most endemic countries, where typically the annual per capita expenditure on all forms of primary health care is between US$1 and US$4 (Fenwick, 1989).

This conclusion is unlikely to be affected significantly by a projected fall in the price of praziquantel. In all but one of the published studies, drugs accounted for over 25% of total delivery costs, with a maximum of 65%. However, even at the extreme, if praziquantel were free, delivery costs in the vertical programs would still have exceeded US$1.50 per person in most of the estimates. Vertical delivery is, therefore, unlikely to be sustainable from domestic resources, except perhaps in small areas. Governments will be stimulated to introduce control programs where they do not currently exist only if more affordable alternatives are developed.

Some progress in the search for more affordable alternatives has been made. For example, the estimated costs of delivery through primary health care facilities using active case finding, based on Rohde's (1989) estimates, could be as low as US$0.45 per person depending on the price of praziquantel. Passive case finding using the primary health care system would reduce costs further. Indeed, Gryseels (1989) argued that if patients could be encouraged to present at health facilities

when they develop symptoms, a large part of the severe morbidity attributable to schistosomiasis might be prevented, obviating the need for vertical control. Governments would then simply have to ensure that praziquantel was available in the right areas, and that staff and patients recognized symptoms.

It may still be desirable, however, to be more proactive in areas of very high morbidity, in which case the cost of identifying high risk communities becomes the first limiting factor. Recent research has shown that the cost of identifying communities with a high prevalence of *S. haematobium* can be reduced by at least 80% using questionnaires and/or reagent strips sent to, and administered by, school teachers (Lengeler *et al,* 1991). Indeed, chemotherapy targeted at school children might also reduce the costs of delivery, and in most communities will reach the groups with the highest prevalence and intensity of infection (Savioli *et al,* 1989; Bundy *et al,* 1990). Multi-disease chemotherapy, in which praziquantel was combined with the treatment of other conditions commonly affecting children, has the potential to produce relatively large benefits for relatively small marginal costs (Warren *et al,* 1990).

A variation of chemotherapy targeted at schools, involving only one or two treatments of children toward the age of 15 years, offers another possibility of reducing the costs of intensive chemotherapy (Gryseels, 1989). The logic is that younger children in highly endemic areas usually get reinfected rapidly, while older children are not reinfected so quickly. Because lesions observed during childhood are reversible, this regimen may be as effective in reducing chronic morbidity as repeated treatments from the age of 5 years. This might also be true of treatment spaced at 2 or 3 yearly intervals compared to more frequent treatment.

COST-EFFECTIVENESS ANALYSIS

In areas in which control programs do not currently exist, the starting point of economic research must be the development and assessment of affordable and sustainable control strategies, and a number of options which warrant further study have been outlined. Recent hypothetical studies which assess the cost-effectiveness of competing vertical delivery options have limited value to countries in which there is no control, as these options can at best be implemented in a few high prevalence areas. The finding (Prescott 1987, 1989; Warren *et al,* 1990) that, at low levels of resource availability, treatment targeted at groups known to be at high risk of infection is more efficient than treatment aimed at an entire population, or that mass treatment generally is more cost-effective than any form of screening, is of more value to countries like China were these methods are used widely. Indeed, the Chinese control program's recent decision to use mass treatment in communities where the prevalence of infection is high was based on similar calculations.

However, even in such cases, cost-effectiveness studies will be of limited value unless they take into account local cost structures and practical issues which may influence effectiveness. These include the community acceptability of and compliance with the different options - for example, some communities may reject mass treatment without prior screening because they are unwilling to comply when they do not have evidence of infection or disease, and others may be suspicious of a program which targets treatment at specific groups. Field research is required to answer these questions. Furthermore, some of the more important questions requiring cost-effectiveness analyses have not yet been addressed. For example, some of the currently accepted control strategies in China, such as the dosing of domestic animals with praziquantel and focal molluscicide, incur large costs. It is important to evaluate the extent of any additional benefits which result and compare them to the costs.

Cost-effectiveness analysis has the potential to provide information of immediate practical benefit to control programs. The questions that have been asked to date, however, have had limited relevance to schistosomiasis control and much research remains to be undertaken.

WILLINGNESS TO PAY

It may be possible to convince governments or donors to introduce or support control programs in areas where they do not currently exist by providing evidence that the costs imposed by schistosomiasis are high in certain communities, or by developing more affordable strategies. There

is another option. Infected people or communities may be willing to pay for treatment (Brinkmann *et al,* 1988; Fenwick, 1989). Little documented evidence exists on people's treatment seeking behavior or their willingness to pay for treatment. Research is, therefore, warranted into the nature and determinants of treatment seeking behavior relating to schistosomiasis. Experiments aimed at determining if people would be willing to pay for praziquantel in particular circumstances would also be justified. These experiments might include delivery through primary health care or through other networks such as schools, particularly where primary health care is weak.

CONCLUSIONS

This review has not attempted to be comprehensive. The major purpose was to illustrate how research which would be of practical value to disease control could be developed, and a number of conclusions with general relevance to tropical diseases emerge.

1. It is necessary to ask the right questions. To be useful, economic research must be based on an understanding of the most important problems facing disease control. In areas where control does not exist, important questions relate to the economic burden of illness, the development of affordable control options, and the willingness of communities and individuals to pay for control measures. In countries with established control programs, questions of the cost-effectiveness of different options are particularly relevant and of immediate practical value to control.

2. Cost of illness studies can be useful adjuncts to the assessment of morbidity, mortality and the social costs of disease. They can assist in the design of interventions aimed at minimizing the burden of illness and can help to focus attention on neglected diseases. However, the issue is more complex than simply multiplying an estimate of the number of days of illness per episode by the wage rate. Disease can effect not only total labor supplies, but labor productivity and the use and productivity of other inputs such as land and capital. It could retard growth in children or their educational performance. On the other hand, complex intra- and inter-household coping mechanisms may enable households to compensate for the disability of some of their members, making the economic impact of disease difficult to observe. This research needs to be conducted carefully, and can be very time consuming. Accordingly, the potential payoffs need to be evaluated carefully. Perhaps it should be limited to diseases which are believed to have a high cost, but which are currently neglected - like schistosomiasis and lymphatic filariasis. If it is undertaken, the chances of observing these relationships should be maximized by conducting the research in areas where the prevalence of clinical disease is known to be high.

3. Cost-effectiveness studies must compare affordable options, and be based on local data and conditions. Many of the most important questions cannot be answered in the absence of field trials which allow the acceptability, compliance and effectiveness of the different options to be observed.

4. Increasing resource scarcity in the public sector requires increasing innovation on the part of disease control. Innovative financing mechanisms may provide a partial solution. This issue could be explored by observing health seeking behavior and willingness to pay for control in a variety of existing situations, or by conducting experiments using innovative delivery strategies.

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