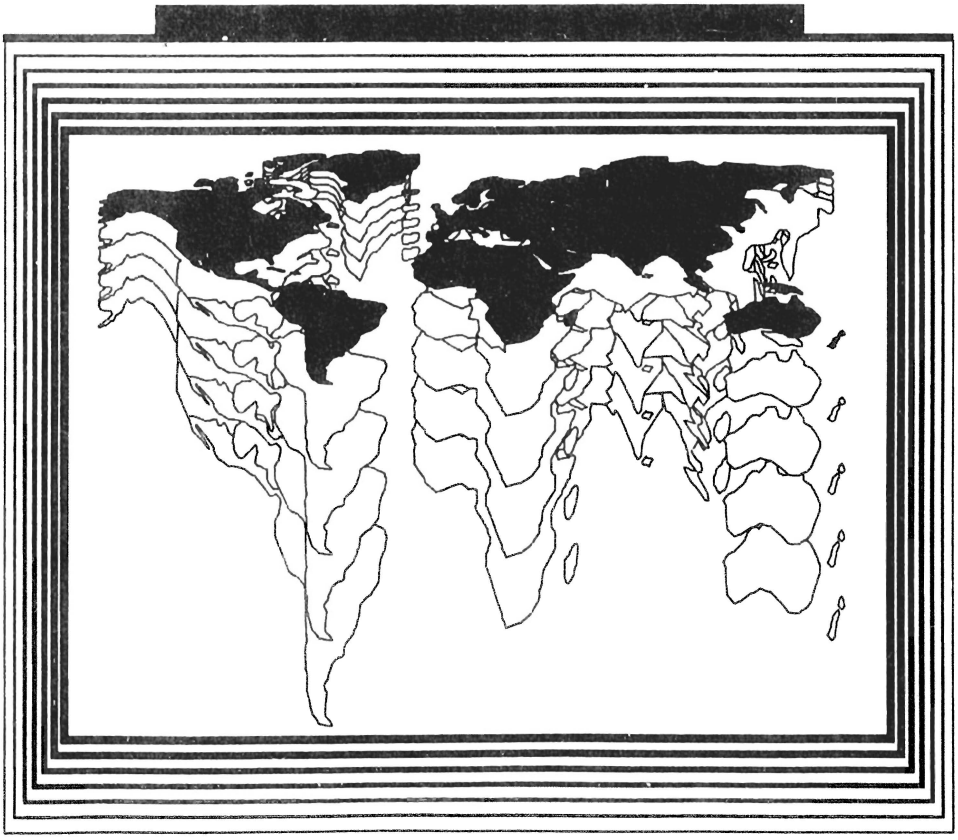
The World Bank
World Development Report 1993: Investing in Health
Background Paper Series

Background Paper Number 1

The Essential Package of Health Services in Developing Countries

Jose-Luis Bobadilla
Peter Cowley
Philip Musgrove
Helen Saxenian

October 1994



Design, Content and Financing of an Essential National Package of Health Services

José-Luis Bobadilla, MD, PhD*

Peter Cowley, MD, MPH**

Philip Musgrove, PhD***

Helen Saxenian, PhD****

* Senior Health Specialist, Population Health and Nutrition Department (PHN), The World Bank, 1818 H Street, Washington DC, 20433

** Consultant, PHN, The World Bank

*** Principal Economist, PHN, The World Bank

**** Senior Economist, PHN, The World Bank

FOREWORD

The World Bank's ***World Development Report 1993: Investing in Health***, the sixteenth in the World Development Report series, examined the interplay between human health, health policy and economic development. Underlying the conclusions of *Investing in Health* is a series of economic, epidemiological, demographic and institutional analyses. Many of these analyses present original data and interpretations; and most of them are lengthy and somewhat technical. In order to make these analyses available to the policy and scholarly community, I have asked the authors to publish them in a series of background papers; this is one paper in that series. Titles of the other background papers appear on the following page. Views and conclusions expressed in the background papers are those of the authors and do not necessarily reflect those of the World Bank group or the World Health Organization.

This background document, on "The Essential Package of Health Services in Developing Countries", contains two papers reporting the methods, assumptions, data base and main substantive conclusions on the selection of the most cost-effective health interventions to control the burden of disease in developing countries. In designing and costing an indicative minimum package of health services many assumptions needed to be made on epidemiological profiles, prices, and cost of specific inputs, among others. These assumptions may not apply to specific countries or even to the same country in different times. Decision makers and scholars interested in the design of a national package of essential health services can modify the assumptions presented in this document and identify a package that is likely to differ from the one proposed here.

The estimates of cost and effectiveness used in this document are largely derived from a recent publication by the World Bank on *Disease Control Priorities in Developing Countries*. Background Paper 8 reproduces Chapter 1 of that book, which describes the methods, uses and summarizes the volume's findings in terms of intervention cost-effectiveness. The data published in the 1993 WDR on costs and effectiveness of individual interventions were the result of the first iteration; this background paper reports the second iteration. Specific numbers in this paper will, for this reason, sometimes differ from those in the WDR.

In the work reported here, José-Luis Bobadilla, Peter Cowley, Philip Musgrove, Helen Saxenian and their many co-workers have produced an assessment of health intervention cost and effectiveness for those interventions that combine high cost-effectiveness with addressing a substantial burden of disease. The resulting interventions "packages" have been a particularly influential output of the WDR.

Dean T. Jamison
Staff Director
World Development Report 1993

October 7, 1994

Background Papers

The World Development Report 1993: Investing in Health

1. Bobadilla, Jose-Luis, Peter Cowley, Philip Musgrove and Helen Saxenian, "The Essential Package of Health Services in Developing Countries".
2. Cochrane, Susan H. and Thomas W. Merrick, "Family Planning and Health".
3. Cochrane, Susan H., David H. Guilkey and John S. Akin, "The Cost-effectiveness of Family Planning in Reducing the Mortality of Women and their Offspring".
4. Hecht, Robert M. and Vito L. Tanzi, "The Role of NGOs in the Delivery of Health Services in Developing Countries".
5. Hill, Kenneth, "Global and Regional Demographic Estimates and Projections: 1950-2030".
6. Hill, Kenneth and Abdo Yazbeck, "Trends in Child Mortality, 1960-90: Estimates for 84 Developing Countries".
7. Hill, Kenneth, Dean T. Jamison, Lawrence J. Lau, Jee-Peng Tan and Abdo Yazbeck, "The Impact of Health Status on Economic Growth".
8. Jamison, Dean T., "Disease Control Priorities in Developing Countries: An Overview of Cost-Effectiveness Assessments".
9. Jamison, Dean, Joanne Leslie and Philip Musgrove, "Protein-Energy Balance in the Diet and Human Growth".
10. Lau, Lawrence, Abdo Yazbeck, Kenneth Hill, Dean Jamison and Jee-Peng Tan, "Sources of Child Health Gains since the 1960s: An International Comparison".
11. Michaud, Catherine and Christopher Murray, "Aid Flows to the Health Sector in Developing Countries".
12. Murray, Christopher and Alan D. Lopez, "The Global Burden of Disease in 1990".
13. Murray, Christopher, Ramesh Govindaraj and Gnanaraj Chellaraj, "Global Domestic Expenditures in Health".
14. Murray, Christopher, Jay Kreuser and William Whang, "Cost-Effectiveness Model for Allocating Health Sector Resources".
15. Pritchett, Lant and Lawrence H. Summers, "Wealthier is Healthier".
16. Yazbeck, Abdo, Jee-Peng Tan and Vito L. Tanzi, "Public Spending on Health in the 1980s: The Impact of Adjustment Lending Programs".

Table of Contents

Suggested Reference:

Bobadilla, J.L., Cowley, P., Musgrove, P. and H. Saxenian. "Design, Content and Financing of an Essential Package of Health Services". *Bulletin of the World Health Organization*. 72 (4): pps 653-662. 1994.

The Essential Package of Health Services In Developing Countries

José-Luis Bobadilla, MD, PhD*

Peter Cowley, MD, MPH**

Philip Musgrove, PhD***

Helen Saxenian, PhD****

* Senior Health Specialist, Population Health and Nutrition Department (PHN), The World Bank, 1818 H Street, Washington DC, 20433

** Consultant, PHN, The World Bank

*** Principal Economist, PHN, The World Bank

**** Senior Economist, PHN, The World Bank

Abstract

A minimum package of public health and clinical interventions, which are highly cost-effective and deal with major sources of disease burden, could be provided in low-income countries for about $ 12 per person per year, and in middle-income countries for about $ 22. Properly delivered, this package could eliminate 21 to 38 percent of the burden of premature mortality and disability in children under 15, and 10 to 18 percent of the burden in adults. The cost would exceed what governments now spend on health in the poorest countries but would be easily affordable in middle-income countries. Governments should assure that at the least, poor populations have access to these services. Additional public expenditure should then go either to extending coverage to the non-poor or to expansion beyond the minimum collection of services to an essential national package of health care including somewhat less cost-effective interventions against a larger number of diseases and conditions.

Introduction

No country in the world can provide health services to meet all the possible needs of the population, so it is advisable to establish criteria for which services to provide. Two basic criteria are the size of the disease burden caused by a particular disease, injury or risk factor, and the cost-effectiveness of interventions to deal with it. The World Bank's 1993 *World Development Report: Investing in Health* applies these criteria to the design of a national package of essential health services (World Bank 1993). Because epidemiological profiles differ among countries, even at the same income level, the national package must be tailored to a country's circumstances. However, it should always include a *minimum* package of both public health measures and individual clinical services which are highly cost-effective and help resolve major health problems. Governments should assure universal access to its national package by financing them directly or, when public resources are inadequate, by promoting private expenditure on the clinical interventions in the package. This article makes a case to justify such a package. It explains what the minimum package contains and how the component services were chosen, and estimates what it would cost, how much it could improve health, and what it implies for investment in facilities, equipment and personnel. The definition of a package also clarifies the trade-off between broader coverage of the population and concentration on the cost-effectiveness of interventions that

characterizes the provision of health care, especially in poor countries.

Justification For a Package

Why is it advisable to collect various health services into a "package", and what does that mean ? Governments could and often do proceed in other ways. They can simply agree to pay for, or guarantee to provide, any of a list of services, without considering possible relations between one intervention and another. Or they could choose not to specify outputs at all, and agree to pay for, or provide, a particular collection of inputs: medical professionals would then decide which services were actually provided, whether by delivering services they thought justified or by responding to patients' demand. The second approach is incompatible with maximizing value for money, or getting the most health gain per dollar spent, because people often demand services offering little health improvement and do not always seek those which cost less or provide greater health gain. Medical professionals also commonly seek to provide, and to generate demand for, services of questionable value. In any case, it is impossible to decide which inputs to finance without some idea of what services they are meant to provide. The first approach--choosing interventions but not packaging them--takes no account of joint costs or co-morbidity, so interventions chosen in this way will cost more than they should, or reach fewer people.

The principal argument for a collection of services to be provided jointly is to minimize the total cost of the package by exploiting the shared use of inputs and reducing the cost to patients of obtaining services. Clustering of interventions improves cost-effectiveness through at least three mechanisms: synergism between treatment or prevention activities; joint production costs; and improved use of specialized resources through the screening of patients at the first level of care, assuring that a small share of high-risk cases can be recognized and referred to hospital. Sometimes a cluster of diseases can be treated together, because they share diagnostic procedures or treatment protocols, or even the same drugs. And sometimes services can be organized to reach related individuals, e.g., integration of maternal and child care. Thus the package becomes more than simply a list of interventions: properly understood, it is also a vehicle for orienting demand and improving referral.

These are primarily medical reasons why services should be packaged, directed to increasing the health gain from a given collection of inputs. Other justifications for assuring a package of care have to do more with governments' limited capabilities to set priorities and to plan investment. The national package is a starting point, a way of assuring that the highest priority services are not slighted: governments that adopt it will have a better basis for setting other priorities and deciding what else to pay for in health care. It also simplifies the task of planning investment in buildings and equipment, in training people and in

purchasing drugs and supplies. The minimum output of services defines a minimum need for inputs. And in very poor countries, concentration on a package rather than on individual inputs or outputs makes it easier to estimate the need for external assistance and to use donor resources well. Finally, the definition of an explicit package of services for government to finance establishes the boundary between the public and private sectors and may focus governments' attention on their own capacities and responsibilities. When this boundary is not clear, governments easily waste resources by trying to do too much instead of doing what matters most.

Criteria For Services To Be Included

A health package could be designed purely to deal with a country's principal health *problems*; services would then be included to treat problems in descending order of importance, as measured by the loss in Disability-Adjusted Life Years (DALYs) (Murray 1994). Unfortunately, the only solutions for some such problems may yield very small health gains or very high costs, or both. An alternative is to design the package on the basis of *interventions*, according to their cost-effectiveness. This is the ratio of the cost of providing the intervention once (where that is appropriate) or during a year (where treatment must be repeated) - to the health gain (in DALYs). The lower the cost per DALY obtained, the more cost-effective the intervention is.

Estimates of intervention cost-effectiveness used to design the package come from Jamison and others (1993). Figure 1 (In the Appendix) shows dollar costs and health gains from 47 interventions: higher points represent more effective interventions and points farther to the right represent cheaper ones, as seen in Figure 1 (In the Appendix). The diagonal lines are contours of equal cost per DALY, decreasing away from the origin. Individual interventions can differ in cost from less than one dollar to more than $ 10,000. They can differ just as widely in health gains: an intervention which saves one person's life and prevents infection of others can gain between ten and 100 years of healthy life, whereas the improvement from some other interventions may amount to only a few hours or days of complete health. There is little correlation between what an intervention costs and how much additional health it provides: neither cost nor results alone is a guide to cost-effectiveness. The cost per DALY gained also varies greatly, by much more than the likely errors of estimation or the variation in cost-effectiveness from one country or epidemiological situation to another. It matters which services are included in a package, as would not be the case if the cost per healthy-life year gained were about the same for all services.

However, some cost-effective interventions deal with problems making only small contributions to ill health because the condition is rare or the individual health loss from it is negligible. Including all such interventions would make the package very complicated to administer and might multiply the requirements for

specialized, seldom used inputs, which could raise costs and overtax health system capacities. The World Bank's report therefore proposes a package based on both problems and interventions: the services included are highly cost-effective and deal with major threats to health (The World Bank 1993). (Cost-effective interventions against health problems, which cause large losses to individuals but are so rare as to produce little overall health loss, may belong in a larger, essential national package).

Content Of The Package

In communities with moderate or high mortality, a few causes typically account for a large share of deaths. The interventions included in the minimum package address such causes and some of the risk factors that produce them. In 1990 an estimated 55 percent of the burden of disease was concentrated in children under 15 years old, with 660 million DALYs lost. Seventy-one percent of this loss is due to just ten disease conditions or clusters of diseases, as shown in Table 1. Except for congenital malformations, all these causes correspond to very cost effective interventions, at less than $100 per DALY. Indeed, potentially cost-effective interventions exist to prevent some of the congenital malformations of the nervous system and treat the most common congenital errors of metabolism, but they address only a very small fraction of the total burden due to this cluster of causes. Middle-income countries with low infant mortality would consider these interventions for inclusion in the national essential package.

Protein-energy malnutrition and vitamin-A deficiency can produce death or disability directly or through other diseases; Table 1 (In the Appendix) counts only the direct loss. The total loss attributable to these conditions is five to six times larger when their indirect effect is included.

The burden of disease in the adult population is less concentrated than that of children under 15 years old: the ten main classes of disease and injuries account for only about 50 percent of the adult burden. Although most interventions to control these diseases are quite cost-effective, the impact is moderate because they prevent or treat only a small fraction of the problem. Overall, it is estimated that only 10 to 18 percent of the adult disease burden could be reduced with the interventions in the minimum package, whereas the interventions for children could reduce their burden by 21 to 28 percent. Of course, separating interventions for different age groups is artificial, because many health services such as immunization with hepatitis vaccine are given to children but the benefits accrue throughout life. A similar but more indirect case can be made for the effect of reducing infection in childhood on improved well-being in adult life (e.g., treatment of helminthic diseases improves cognitive abilities which in turn increases educational attainment). Mosley and Gray (1993) and Elo and Preston (1992) have identified many diseases in children that affect health in adulthood. Interventions applied to adults can also produce substantial

benefits in children, as is the case with prenatal and delivery care and AIDS prevention programs.

Another way of analyzing the burden of disease is by way of risk factors. Current understanding of the attributable risk for most of the important risk factors is quite limited. There is no agreed classification of risk factors, nor is there a standard methodology to avoid double counting of deaths and disabilities when comparing disease burdens due to different risk factors. *The World Development Report 1993* estimated the DALYs lost to nine risk factors or clusters of risk factors, based on the evidence published in the scientific literature on the attributable risks. Indoor air pollution, the most important risk factor accounting for about 13 percent of the burden, cannot be matched with a cost-effective intervention, making it a high research priority. The second, inadequate water and sanitation, explaining about 10 percent of the burden, is matched with a well known intervention, but the cost-effectiveness is unfavorable, at more than $ 1000 per DALY. The reason for this somewhat counter-intuitive result is that cost-effectiveness is able to capture only the health benefits of interventions; water and sanitation produce substantial non-health improvements in the welfare of households, and their provision or facilitation could be justified on those grounds (The World Bank 1992). Protein-energy malnutrition and vitamin-A deficiency together explain about 10 percent of the DALYs in developing countries, unsafe sex 4%, alcohol abuse 3%, excess fertility 2.4%, and tobacco consumption only 1%. The interventions

available to deal with these risk factors, with the exception of food supplementation, are included in the minimum package because of their favorable cost-effectiveness.

When diseases or risk factors change rapidly, the present burden of disease is not a good indicator of the priority for their control. Tobacco consumption and AIDS transmission through unsafe sex are increasing very rapidly in many developing countries; the priority for controlling these problems is high because in the next few decades the diseases caused by tobacco and AIDS will be among the main causes of death and disability. It is estimated that deaths due to tobacco consumption will increase from three million in 1990 to ten million in about 30 years, with most of the increase occurring in developing countries. Similarly AIDS is the first cause of death in many African cities and is likely to become a major cause of death in Sub-Saharan Africa, India and other Asian countries unless action is taken soon to prevent HIV transmission.

Table 2 (In the Appendix) presents the health interventions included in the minimum package, and some basic information on their cost and potential effect in low- and middle-income countries. These scenarios were modelled with data from Sub-Saharan Africa and from Latin America and the Caribbean, respectively. The cost of labor and other health inputs, the epidemiological profile and magnitude of the burden of disease, and population age structure vary between the two cases. Low-income countries are characterized by younger populations and higher mortality and fertility rates; higher incidence of certain

diseases; and lower labor costs. Two major contributors to the potential DALY gain in low-income countries are the prenatal and delivery care cluster and the treatment of tuberculosis, both of which are largely neglected. Practically all the preventive and some of the therapeutic activities of the package involve behavioral changes. Since supplying services does not necessarily induce acceptance by the potential beneficiaries, much of the cost of these activities is dedicated to information, education and communication (IEC). These are sometimes needed not only for the consumers but also for the providers of health services.

Cost and Payment

For low-income countries, the minimum package is estimated to cost about $12 per person per year. This rises to an estimated $22 per person per year in middle-income countries. About one-third of the total would go for public health activities and the remaining two-thirds for the essential clinical services. To verify the robustness of the estimates, the costs of the package were calculated in two ways. One approach was based on the cost of specific activities, estimated from existing studies in many countries of service delivery costs by type of intervention. In the other approach, costs were estimated for a prototype district health system able to deliver the minimum package, consisting of a district hospital, health clinics, and outreach activities. (The minimum package presented in Table 2 requires about one district hospital bed per 1,000 population, 0.1 physicians per 1,000

population, and between two and four nurses per physician.) The two estimates were then compared to identify and correct errors or inconsistencies. Detailed cost estimates for specific countries must take account prevailing demographic and epidemiological conditions and input costs. And it is important to recognize that the estimates should reflect what it would cost to carry out the intervention effectively, not what the intervention costs at present. For example, a country's tuberculosis program may be treating only a small fraction of those with tuberculosis. The package should be designed not with these current program costs, but with the estimated costs of effectively reaching a much larger population. The content of the package is chosen to provide the greatest possible health gain for a limited expenditure, independently of who is to pay for it.

Countries may choose to finance the whole package, for the whole population, from public resources. If they do not, there are still two criteria for what governments should finance. One is that certain services are so nearly public goods, or provide such substantial externalities, that private markets will provide too little of them. For such interventions to be available, they must be financed by governments. The other criterion is that governments have a special responsibility for the health of the poor, who can pay for very little health care. User fees to recover part of the cost from poor people would have to be very low; they could only be justified by assuring greater technical efficiency in service provision, as for example if the revenues

were retained and used locally to guarantee supplies of drugs. The contribution to total operating costs would be insignificant. The poor also tend to suffer worse health than the non-poor, but that would not matter if they could pay for the corresponding care. It happens that the services included in the package deal with problems which particularly affect the poor, but no intervention is included simply because the corresponding problem is associated with poverty: it must also be cost-effective. Poverty, like public goods, is relevant to who pays for the package but not to what goes into it.

Beyond assuring the provision of cost-effective public health interventions to everyone, and the access of the poor to the entire minimum package of services, governments face two issues about what health services to finance. One is what to include in an ***essential national package***, which would start with the minimum package but could be much larger, including a variety of other services. Everything beyond the essential set of services is considered discretionary, and should be financed entirely from private sources (out-of-pocket or through insurance) or by way of mandated social insurance. Such services should not be subsidized from general public revenues. The other issue is how far to pay for services, even those in the minimum package, for the nonpoor part of the population. This involves the choice of where to draw the poverty line between the two groups, and how in practice to distinguish the poor from the nonpoor. For a given level of public spending, the

more the package is targeted to the poor, the more comprehensive it can be.

Most low-income countries currently need to use all their public expenditure on health, simply to pay for the minimum package for the poor. They cannot afford an essential package which includes much more than the minimum. And they may be unable to finance even the minimum package completely for the nonpoor: in low-income countries governments spend, on average, just $6 per person for health and the total health spending (both public and private) is about $14 per person. Funding the minimum package in these settings would require a combination of an increase in public spending for health, a reorientation of current government health outlays away from discretionary services, and targeting public spending on clinical services to the poor.

This situation is shown on the left side of Figure 2 (In the Appendix): choices on the essential package and on priority for the poor define four combinations of a population group with a set of health services. The vertical axis indicates the degree of public subsidy, which should be equal or close to 100 percent for the minimum package for the poor. The subsidy should fall, perhaps quite sharply, as public expenditure is extended either to the nonpoor or to interventions outside the minimum package. This condition can be stated in the form of two rules for public expenditure: it should not pay for any services for the nonpoor which it does not also assure for the poor, and it should not pay for a less cost-effective service unless and until it has paid for

all services which are more cost-effective. Anything else would be inequitable, favoring those who can afford to pay over those who cannot, or inefficient, favoring interventions which yield less value for money over those which are most justified.

The right side of the Figure 2 shows the situation of a middle-income country, where current public spending on health averages about $ 62 per capita. Such countries can afford an essential package which goes well beyond the minimum, to cover less cost-effective interventions that address a wider spectrum of diseases and injuries. The poor are a smaller share of the population, and resources are adequate even to subsidize less cost-effective services for the nonpoor. There may still be differences in the degree of public subsidy, but they can be smaller, or involve less targeting to the poor, than in low-income countries.

Implications For Public Policy

A government wishing to adopt an essential national health care package faces a number of requirements and choices: these involve needs for information, choices about how to deliver and pay for services, and questions as to how to influence decisions in the private sector or in sub-national levels of government.

Data Needs For The Design Of The Package

The analytical requirements for a rigorously designed national package are substantial. But several short-cuts exist that permit countries to design provisional packages quickly while the

analytical data base is built up. They can develop a national essential package by using proxies for the data, by adopting the minimum package described above (perhaps with some adjustments) as the preliminary national package. Over the longer term, the package is best designed from results of a national burden of disease estimation and the local level analysis of the cost-effectiveness of interventions. The national burden of disease can be calculated over a period of months if data on morbidity and mortality are available. If these data are missing, indirect estimation can be used, or, as an interim proxy, regional disease burden estimates can be adjusted for a particular country (The World Bank 1993). Local estimates of intervention costs (and assumed effectiveness) should also be developed, at least for the most important health interventions. This can also take months or years, depending on the cost data available.

Implementation Of The Package

Once a national package is designed, the challenge is how to implement it. Government budgets are not organized by disease intervention: allocations are made across organizations (Ministries of Health, affiliated foundations, governmental research institutions, third party insurers), across facilities (hospitals and health clinics), and across input categories (personnel, supplies, drugs, maintenance, training, transport, and the like).

Where governments finance and provide health services, they can use input availability, norm setting, training, and consumer

education to affect which services are utilized. It would be neither possible nor desirable for governments to supervise providers' day-to-day clinical decisions. But governments can facilitate the delivery of the package by financing the inputs needed (drugs, personnel, supplies, equipment). Similarly, not financing specialist physicians, sophisticated equipment, and drugs for discretionary services diminishes the likelihood that services outside the national package will be provided at public facilities. "Essential equipment lists" can be developed to identify equipment needs for the essential package. Norm-setting also influences what is delivered. Governments usually establish norms about what types of services should be provided in different levels of public facilities. Again, including essential services and excluding discretionary services is important. Governments can also ensure that medical and nursing curricula give adequate attention to the national essential package. In many countries, the curriculum is not up-to-date regarding diagnosis and treatment of sexually transmitted diseases, tuberculosis treatment, and even family planning methods. And in-service staff training should support the essential package, to facilitate its delivery. Finally, governments can, through education campaigns, inform the public about the package--about services guaranteed to be offered in different types of facilities, and when to seek such services.

Public Finance And Private Provision Of The Package

Governments can also choose to finance all or part of the

package through private providers. Reimbursement mechanisms can be designed in a variety of ways, including payment according to diagnosis or on a per capita basis. Governments can also contract with nongovernmental organizations or other private groups to provide care to subgroups of the population. In any event, monitoring mechanisms will be needed to ensure that the intended services are provided to the target population.

Mandating The Package

In countries where states or municipalities are responsible for service delivery but funding is largely federal, the national government can require that lower levels of government provide at least those services in the national essential package, to qualify for federal transfers. And the cost of the package can guide per capita inter-governmental resource flows. The government can influence private as well as public finance of the national package, by requiring that all private insurers provide, at a minimum, the elements of the national package. This would in no way prevent insurers from providing additional, discretionary services, but it would ensure that the national package's highly cost-effective services are included in any insurance package.

Making The Transition

In many developing countries the existing stock of health facilities, equipment, and health personnel is poorly matched to the requirements for delivery of a national essential package.

Many countries have too many tertiary public hospital beds and physicians in urban areas, while rural areas still lack health clinics and primary care providers. Because it may be difficult politically to redress this imbalance in infrastructure by closing large public facilities, it is critical that new physical and human resource investments be directed at the inputs needed to deliver the national package in order to correct this imbalance over time. And to the extent feasible, governments can improve resource allocation by redirecting *recurrent* spending toward lower-level facilities, which provide most of the cost-effective interventions.

Achieving the Potential Health Gains From The Package

Designing a cost-effective package that addresses major disease burdens, and reallocating funds for that package, does not guarantee success. Programs must also operate efficiently. The minimum package outlined in Table 3 assumes that a well-functioning referral system connects health outreach, health clinics and district hospitals. It assumes that vehicles are available to transport obstetric emergencies to district hospitals; that staff can be attracted to work in remote areas; that drugs are available when needed in the health system; and that operating rooms are available for obstetric emergencies, and are not closed because of a shortage of key supplies. Careful attention to technical efficiency is just as important as allocative efficiency to the successful implementation of the national essential package.

Discussion and Conclusions

The notion of an essential national package of health services presented here derives from a series of efforts over several decades to determine health sector priorities. The earliest attempts usually refer to interventions characterized by low cost and a low level of complexity but not to well-defined packages. These efforts to define priority health interventions in order to make more efficient use of resources include the WHO Primary Health Care approach (WHO 1978), the somewhat narrower Selective Primary Health Care proposal of Walsh and Warren (1979), directed to children's health and selected tropical diseases, the UNICEF concentration on a small number of interventions directed at mothers and children (Cash and Others 1987); and a World Bank Policy Paper on health (Golladay 1980). A more complex exercise is the PAHO health sector planning approach (Ahumada and others 1967), which starts with disease priorities and derives needs for such inputs as staff and facilities.

All these recommendations or partial packages were designed from very incomplete information on the burden of disease, particularly noncommunicable diseases among adults and other health problems that cause disability as well as, or instead of, mortality. Partly in consequence, and partly because of the emphasis on children, for whom most of the disease burden is due to premature mortality, health gains were measured chiefly or exclusively by reduction in deaths. Data on cost-effectiveness were also limited to a few childhood problems and some parasitic diseases. The minimum

package proposed here represents an advance over earlier efforts because it draws on information about all the major health problems of low- and middle-income countries and all age groups, deals with disability as well as mortality, and is based on both disease burden and cost-effectiveness rather than on such partial criteria as cost alone or complexity of interventions. It also provides guidance for expanding from a minimum collection of services to a larger essential package, and relates this choice to decisions about public finance of health care.

One limitation on cost-effectiveness for allocating health resources is that many interventions significantly improve not only health but also income and welfare. Sometimes the health benefits alone justify the interventions (e.g., the education of girls). In other cases such as water and sanitation, the cost per DALY gained is high; but consumers' willingness to pay for the associated non-health benefits may allow for part of the cost to be recovered, lowering the *public* expenditure per unit of health gain. More generally, cost-effectiveness alone is not a justification for public expenditure. Public finance needs to be justified by the additional health gains, compared to what would result from private finance, or by a reduction in costs, or because the intervention is at least partly a public good, or because the beneficiaries are too poor to pay for the intervention, even through insurance in some circumstances, cost-effectiveness may conflict with another objective of public spending on health care, which is to reduce inequities. Universal coverage with an intervention may raise

marginal costs substantially above average costs, because part of the population lives in remote areas. Since such people are more likely to be poor, concentrating public resources on the poor is a partial solution to this problem; but it still may be true that much more health gain could be achieved, even for the poor, if some otherwise cost-effective interventions were not extended to areas of very high cost. The relative importance of cost-effectiveness versus equity will then determine whether to modify the package by leaving out some interventions, providing mobile services rather than fixed facilities, concentrating on public health rather than clinical interventions for the high-cost population, or sacrificing some efficiency in order to preserve equity.

In exceptional cases paying a high marginal cost to cover the whole population may be justified on efficiency grounds, because the disease--like smallpox and perhaps polio--can be eradicated. Such dynamic arguments, which are not based only on the present burden of disease and the cost-effectiveness of interventions, also underlie the package's emphasis on reducing tobacco use and controlling the spread of AIDS. Finally, since public budgets for health reflect the inertia of past investments, adoption of an appropriate package and the corresponding allocation of spending is also a dynamic problem: how quickly and effectively an essential national package can be introduced depends on how much new investment and training may be needed and on the technical, administrative and political capacity of the existing health system to analyze health problems and respond to them.

References

Ahumada, J., et al. *Health Planning: Problems of Concept and Method, 2nd edition.* PAHO Scientific Publication No. 111. Pan American Health Organization. Washington, DC. 1967.

Cash, R., et al. *Child Health and Survival: the UNICEF-GOBI-FFF Program.* Croom Helm. Wolfeboro, NH. 1987.

Elo, I.T. and S.H. Preston. "Effects of early life conditions on adult mortality: a review". *Population Index.* 58(2): pps. 186-212. 1992.

F.L. Golladay. Health: Sector Policy Paper. The World Bank. Washington, DC. 1980.

Jamison, D.T., Mosley, W.H., Measham, A.R., and J.L. Bobadilla (eds.). *Disease Control Priorities In Developing Countries.* Oxford University Press. New York. 1993.

C. Murray. "Quantifying the Burden of Disease: The Technical Basis For Disability-Adjusted Life Years". *Bulletin of the World Health Organization.*72(3): pps. 429-445. 1994.

Mosley, W.H. and R. Gray. "Childhood precursors of adult morbidity and mortality in developing countries: implications for health programs" In Gribble J. and S.H. Preston (eds.) *The Epidemiological Transition. Policy and Planning Implications for Developing countries.* National Research Council, National Academy Press, Washington D.C. 1993.

Oregon Health Services Commission. Prioritization of Health Services: A Report to the Governor and Legislature. Portland, Oregon. 1991.

Walsh, J. and K. Warren. "Selective Primary Health Care - An Interim Strategy For Disease Control In Developing Countries". *New England Journal of Medicine.* 301: pps. 967-974, 1979.

World Bank. *World Development Report 1992: Development and the Environment.* Oxford University Press. New York. 1992.

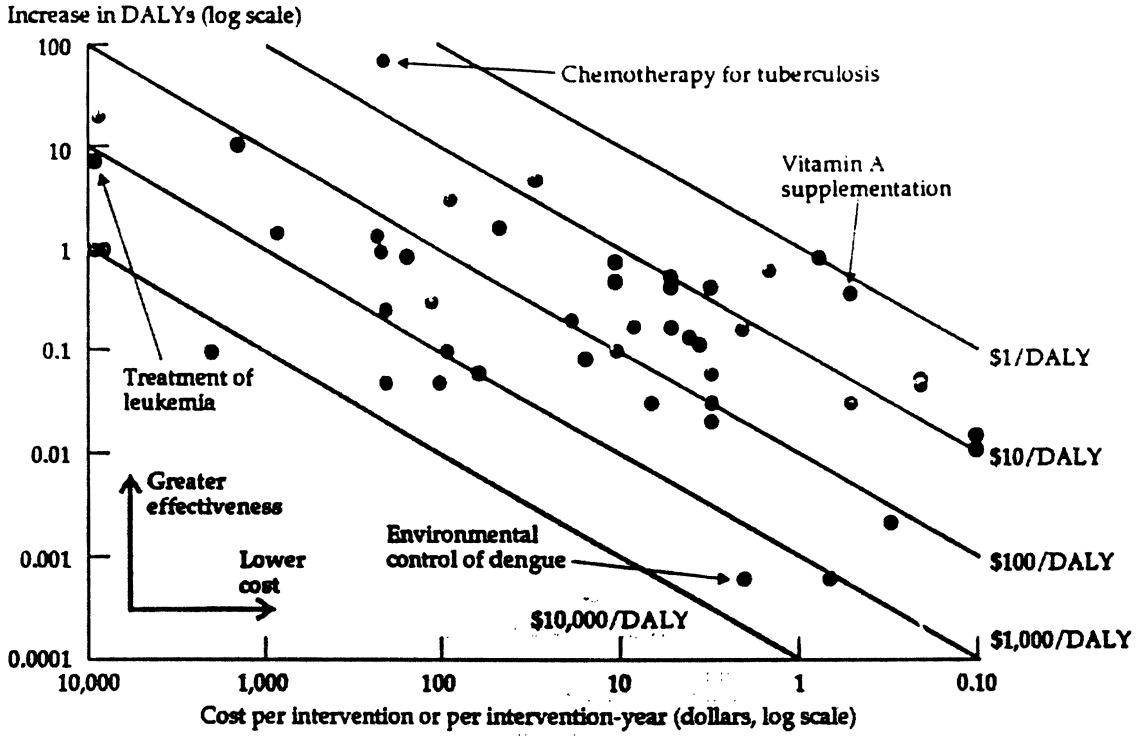
World Bank. *World Development Report 1993: Investing in Health.* Oxford University Press. New York. 1993.

World Health Organization. Report of the International Conference on Primary Health Care, Alma Ata. World Health Organization. Geneva. 1978.

APPENDIX FIGURES AND TABLES

Figure 1 Costs and Health Gains In US dollars

Benefits and costs of forty-seven health interventions



Target:

- Children under age 15
- Adults age 15 or older[a]

Note: DALY, disability-adjusted life year. Interventions are specific activities intended to reduce disease risks, treat illness, or palliate the consequences of disease and disability; an intervention-year is an intervention repeated throughout the year rather than provided only once.

a. Includes some interventions that benefit all age groups.

Figure 2 Health Care Choices In a Low- and Middle-Income Country

Three dimensions of choice in the Public Financing of Health Services: Cost-Effectiveness of Interventions, degree of Public Subsidy, and discrimination in favor of the Poor, by Country Income

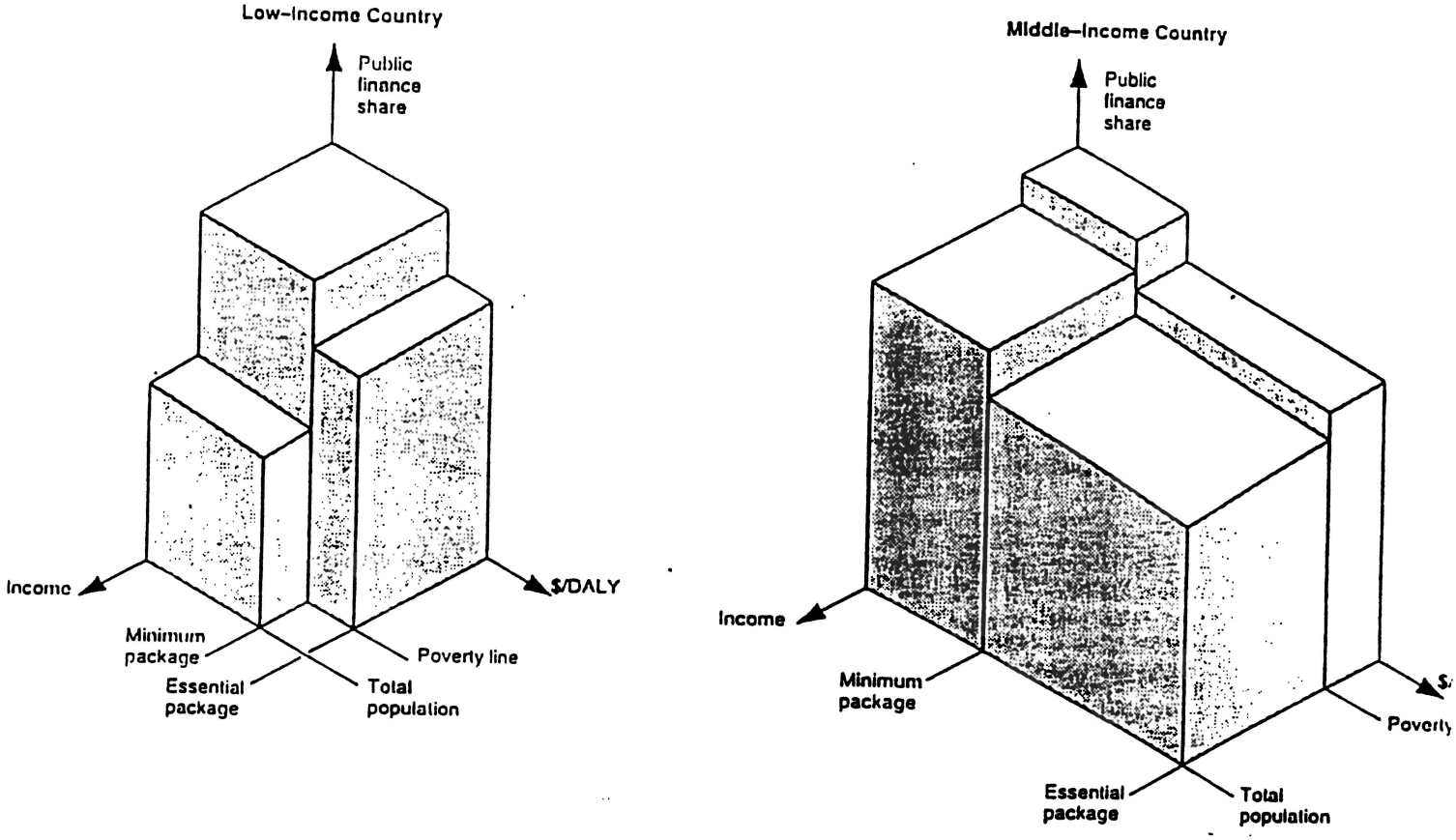


Table 1. Main Cause of Disease Burden in Children and Adults in Demographically Developing Countries in 1990 and Cost-Effectiveness of the Interventions Available for their Control

Diseases and injuries	DALYs lost No.(Million)	DALYs lost Percent	Main intervention	Cost-effectiveness $ per DALY
CHILDREN				
Respiratory infections	98	14.8	Integrated management of the sick child (IMSC)	30-100
Perinatal morbidity and mortality	96	14.6	a) Prenatal and delivery care	30-100
			b) Family planning	20-150
Diarrheal disease	92	14.0	IMSC	30-100
Childhood cluster (diseases preventable through immunization)	65	10.0	Expanded program of immunization (EPI) plus	12-30
Congenital malformation	35	5.4	Surgical operations	High-unknown
Malaria	31	4.7	IMSC	30-100
Intestinal helminths	17	2.5	School health program	20-34
Protein-energy malnutrition	12	1.8	IMSC	30-100
Vitamin A deficiency	12	1.8	EPI-plus	12-30
Iodine deficiency	9	1.4	Iodine supplementation	19-37
Sub-total	467	71.0	---	---
Total	660	100	---	---
ADULTS				
STDs and HIV	49.2	8.9	Condom subsidy plus IEC	3-18
Tuberculosis	36.6	6.7	Short course chemotherapy	3-7
Cerebrovascular	31.7	5.8	Case management	High-unknown
Maternal morbidity and mortality	28.1	5.1	Prenatal and delivery care	30-110
Ischemic heart disease	24.9	4.5	Tobacco control program	35-55
Chronic obstructive pulmonary disease	23.4	4.3	Tobacco control program	35-55
Motor vehicle accidents	18.4	3.3	Alcohol control program	35-55
Depressive disorders	15.7	2.9	Case management	500-800
Peri-endo and miocarditis and cardiomyopathy	12.4	2.2	Case management	High-unknown
Homicide and violence	12.2	2.2	Alcohol control program	35-55
Subtotal	267.5	48.6	---	---
Total	550.0	100	---	---

Table 2. Cost-Effectiveness of the Health Interventions (and Clusters of Intervention) Included in the Minimum Package of Health Services in Low- and Middle-Income Countries

Interventions	Cost per beneficary	Cost Per Capita	DALYs potentially gained (a) (per thousand population)	Effectiveness (b)	Cost per DALY (S)
LOW-INCOME COUNTRIES					
I. PUBLIC HEALTH					
Expanded program of immunization plus	14.6	0.5	45	0.77	12-17
School health program	3.6	0.3	4	0.58	20-25
Tobacco and alcohol control program	0.3	0.3	12	0.14	35-55
AIDS prevention program (c)	112.2	1.7	35	0.58	3-5
Other public health interventions (d)	2.4	1.4	-	-	-
Subtotal	-	4.2	-	-	14
II.CLINICAL SERVICES					
Chemotherapy against tuberculosis	500.0	0.6	34	0.51	3-5
Integrated management of the sick child	9.0	1.6	184	0.25	30-50
Family planning	12.0	0.9	7	0.70	20-30
STD treatment	11.0	0.2	26	0.42	1-3
Prenatal and delivery care	90.0	3.8	57	0.42	30-50
Limited care (e)	6.0	0.7	-	0.03	200-300
Subtotal	-	7.8	-	-	-
Total	-	12.0	-	-	-
MIDDLE-INCOME COUNTRIES					
I. PUBLIC HEALTH					
Expanded programme of immunization plus	28.6	0.8	4	0.77	25-30
School health program	6.5	0.6	5	0.58	38-43
Tobacco and alcohol control program	0.3	0.3	9	0.14	45-55
AIDS prevention program (c)	132.3	2.0	15	0.58	13-18
Other public health interventions (d)	5.2	3.1	-	-	-
Subtotal	-	6.9	-	-	-
II.CLINICAL SERVICES					
Chemotherapy against tuberculosis	275.0	0.2	6	0.51	5-7
Integrated management of the sick child	8.0	1.1	21	0.25	50-100
Family planning	20.0	2.2	6	0.70	100-150
STD treatment	18.0	0.3	3.7	0.42	10-15
Prenatal and delivery care	255.0	8.8	25	0.42	60-110
Limited care (e)	13.0	2.1	-	0.03	400-600
Subtotal	-	14.7	-	-	133
Total	-	21.5	-	-	-

(a) Sum of losses to premature mortality and to disability, including losses to others because of secondary transmission of disease.
(b) Calculated by multiplying efficacy, diagnostic accuracy (when applicable) and compliance.
(c) DALYs lost from AIDS include dynamic effects (probability of transmission to others) only in the first year, which understates the value of preventing cases and thus the cost-effectiveness of preventive interventions.
(d) Includes information, communication, and education on selected risk factors and health behaviors, plus vector control and disease surveillance
(e) Includes treatment of infection and minor trauma; for more complicated conditions, includes diagnosis, advice and pain relief, and treatment as resources permit.

Design, Content and Financing of an Essential National Package of Health Services

Peter Cowley, MD, MPH*

José-Luis Bobadilla, MD, PhD**

Philip Musgrove, PhD***

Helen Saxenian, PhD****

* Consultant, Population Health and Nutrition Department (PHN), The World Bank, 1818 H Street, Washington DC, 20433

** Senior Health Specialist, PHN, The World Bank

*** Principal Economist, PHN, The World Bank

**** Senior Economist, PHN, The World Bank

Introduction

Rationing of health services is inevitable in all health systems of the world. Due to the growing mismatch between health resources, recognizable health needs, demands for health care, criteria and policy instruments used for rationing have gained greater attention. This paper proposes that burden of disease and cost-effectiveness should be the main criteria used to ration health services and suggests an indicative package of essential health services that illustrates such efficiency gains.

Two general ways of rationing are always in operation, market forces that largely rely on willingness to pay and government intervention that makes decisions for the population it represents. Health services are no exception in this regard. The package and the criteria suggested for its design are proposed to improve the efficiency of financing health services by governments. Readers interested in the merits and problems of market forces to ration health care or to finance and deliver efficiently health services should refer to Arrow (1963), Pauly (1986) and Barr (1992).

Governments are the main providers of health care in most developing countries and often constitute the main source of modern health care for the poor. Future reductions in the burden of disease in developing countries will be obtained more efficiently if governments improve their allocation of resources, reduce technical inefficiency (including waste) and ensure universal or quasi-universal coverage of health services. Public health systems in most of the developing countries and to a lesser extent in

former socialist economies misallocate their resources; investing excessively in expensive health services that produce very small or no health benefits, while neglecting cost-effective interventions which are able to substantially reduce the burden of disease.

This mismatch between available resources and health needs has recently been aggravated by the combined effect of three phenomena: increasing demand due to past high rates of population growth, the reduction or very limited growth in public health expenditure resulting from the economic crisis and rising health care costs. In the next 20 years, further progress of the epidemiological transition will result in even greater demands for therapeutic health services to cope with emerging chronic and degenerative diseases in the adult and the elderly population. Governments of middle-income countries, and soon those of lower-income countries, are compelled to adapt their health system in order to respond more adequately to the increasing complexity of the demographic and health profiles of their populations. The design of the such reforms require answers to such basic questions as: what services are priority, who decides which services to be given priority, which services are discretionary and how much of the priority services can be paid for with the limited resources in the poorest countries?

This paper describes in detail the content and costs of a package of essential health services to reduce the current burden of disease in developing countries in the most cost-effective manner. The interventions composing this *minimum package* are very

cost-effective and can control the main causes of disease burden in the low income developing countries and the poorest parts of middle-income countries. The paper describes the methods, data and assumptions used to construct the costs and effectiveness for each the minimum package of essential health care services. The rationale, affordability and financing issues of the minimum package are reported in Bobadilla and others (1994). The results of the exercise are presented below in Table 1 in 1990 United States dollars and assuming a per capita Gross Domestic Product of $350 in the low-income country scenario and $2500 in the middle-income country.

Table 1 Summary Results By Low or Middle-Income Country (1 Million Population)

MINIMUM PACKAGE	*LOW-INCOME*	*MIDDLE-INCOME*
Total Cost per Capita	**$13.2**	**$18.9**
Cost as % of per Capita GDP	**3.7%**	**.8%**
Total DALYS Lost per Million Population	**574,000**	**232,000**
% Total DALY Burden Averted By Package	**27.7%**	**16.8%**

Total DALYs lost in the low-income country scenario was for the sub-Saharan Africa category in the 1993 WDR statistical appendix

and was expressed per 1000 population; for the middle-income scenario it was from the Latin America and Carribean category.

Background

Increasing concern over resource allocation has led researchers to develop methods to analyze the burden of disease and the cost-effectiveness of interventions and programs. One of the earliest efforts for developing countries was developed in 1965 by the Pan American Health Organization, in collaboration with the Center for Development Studies at Caracas, Venezuela (CENDES) (Ahumada and others 1967). Although the principles proposed were considered useful by decision makers in many countries of Latin America, the proposed method was difficult to apply because the information widely required greatly exceeded what was available and the expertise to undertake the required analysis was not available.

The primary health care (PHC) movement has had a major impact in the way health programs are organized by governments and other national and international organizations. Although in its original form the PHC approach (WHO 1978) was comprehensive, the actual programs have concentrated mainly on the control of communicable diseases in children and family planning. Nevertheless, in some countries (Indonesia, Costa Rica and Zimbabwe among others) the adoption of the PHC approach has positively influenced the allocation of resources by increasing population coverage, reducing inequities in the distribution of resources to social groups and

ultimately achieving significant gains in the reduction of child mortality and morbidity. The reproductive health problems in women and the emerging health problems of the adult population can also be tackled with the PHC approach, but fewer cost-effective and affordable interventions have been identified or applied. The approach to design packages of health services proposed in this paper moves away from age and sex population groups and analyzes the merits of interventions.

Shortly after the primary health care approach was launched, Walsh and Warren argued that the cost of a comprehensive primary health care service for many low-income countries was not affordable (Walsh and Warren 1979). They suggested a "selective" approach that included five interventions: vaccination against diphtheria/pertussis/tetanus, treatment of febrile malaria, oral rehydration for diarrhea in children, tetanus toxoid and encouragement of breast feeding in mothers. These authors based their recommendation on the available information on cost and effectiveness of the most important health interventions for the control of infectious diseases. Oriented towards the least developed countries the list of interventions proposed by these authors was kept to a minimum. Although the approach has been criticized, it has influenced some governments and international agencies. The main problem with this approach is that it ignored many diseases and health problems not associated with infectious diseases and dismissed some interventions which are not medical, such as control of tobacco consumption and alcohol abuse.

Probably inspired by this "selective" approach, UNICEF implemented the GOBI program which stands for Growth and development monitoring, Oral rehydration therapy, Breast feeding and Immunization (including all vaccines of the expanded program). Family planning was later included. Part of the international donor community has also joined this "selective approach". Three health priorities have been strongly advocated and to some extent added to the package proposed by UNICEF: AIDS, safe motherhood and micronutrients deficiencies.

Although the selective approach to primary health care is not linked with any specific delivery strategy, its implementation has been mainly through vertical programs. In low-income countries, such vertical programs have produced moderate improvements in mortality rates and have not contributed to the development of district health systems. In addition, various countries and international organizations consider it inappropriate to allocate health resources predominantly for communicable diseases in children. Two arguments are given to support this view: a) the epidemiological transition is leading to a rapid decline of communicable diseases and health problems associated with reproduction and undernutrition, while accompanied by an increase in the prevalence of noncommunicable diseases, mainly cardiovascular disease and neoplasms and injuries; and b) many of the adult diseases have serious consequences for other members of the community (including children) and can be prevented or treated with inexpensive and effective interventions.

In the past five years several major contributions have been made to document the costs and effectiveness of health interventions, as well as in the analysis of the epidemiological transition in developing countries and the implications for ill health at different ages. An example of the later is an independent international initiative called the Commission on Health Research for Development which was formed in 1987. The mandate of the commission was to "... survey current research on health problems of developing countries, identifying strengths and weaknesses, and propose improvements...". The report of the Commission discusses health priorities and provides estimates of the number of deaths by major causes. It concludes that developing countries have to address the double burden of disease, with moderate to high rates of incidence of infectious diseases and malnutrition and an emerging burden due to noncommunicable diseases and injuries.

The World Bank carried out two studies related to these issues: *Disease Control Priorities in Developing Countries*" (DCPDC), and *Adult Health in the Developing World* (Jamison and others 1993; Feachem and others 1992 (respectively)). The "Adult Health in the Developing World" book provides the most extensive review to date of adult health problems in developing countries, in turn highlighting the importance of the epidemiological transition. The authors conclude that adult health has been largely neglected by governments and international health agencies. They recommend that more attention be given to this age group, particularly with

regard to the following problems: smoking, road safety, hepatitis B, maternal mortality, sexually transmitted diseases, tuberculosis, cervical cancer and diabetes.

The DCPDC book provides a review of more than 45 diseases, including data on the size of each problem, alternative interventions to control them, and estimates of the cost and effectiveness of each intervention. The book was produced with the collaboration of more than 85 epidemiologists, clinicians and economists. It provides the most comprehensive, standardized analysis of diseases and interventions available to date. This paper draws extensively from the results of this book.

Despite the importance of using explicit criteria to set health priorities for public investment in developing countries, there is little experience with country level applications. However, an important exercise was carried out in the early 1970's in Ghana (Ghana Health Assessment Team 1981). This study assessed the health impact of diseases by estimating the number of healthy days of life lost. Five disease conditions were found to be the most important: malaria, measles, childhood pneumonia, sickle cell disease and severe malnutrition. The relevance of this analysis is that the results were actually used in the design of the Ghanian primary health care program. In addition, the method proposed has served as a yardstick in the assessment of the burden of disease in populations.

The need to use explicit criteria to set priorities is not restricted to developing countries. In Oregon, USA, a law was

passed on the application of cost-effectiveness criteria to prioritize health interventions for Medicaid. As a result of this act, the Oregon Health Services Commission ranked the cost-effectiveness of 714 condition-treatment pairs. The ones at the bottom of the list are no longer provided under this scheme (Oregon Health Services Commission 1991). The purpose of this measure was to free resources and use them to expand Medicaid eligibility to all persons below the federal poverty level.

Packaging Essential Health Services

Why is it advisable to collect health interventions (defined as a group of activities that are undertaken to control a specific disease, risk factor for a disease or rehabilitate functions lost) into a "package"? The principle argument for providing a collection of services jointly is to minimize the total cost of the package by reducing the cost to patients of obtaining services (Bobadilla and others 1994). Furthermore, packaging serves other purposes in that it can bring together interventions that are cost-effective and that can be delivered with the same level of technological sophistication and by extension through the same mode of delivery or facility. In a scenario where a health center can perform a chest sputum acid-fast bacilli microscopic examination can probably perform a urinalysis or a pregnancy test. However, the same health center would not be able to drain a subdural hematoma (collection of blood between the brain and skull usually occurring from a fall). If a patient has access to the chest

sputum examination she will more than likely also have access to a pregnancy test. This type of scaled relationship for technological sophistication and facility extension mode can be applied to other intervention inputs such as surgery or radiology. Nonetheless, this scaled relationship has little bearing on the benefit or the cost of the input (procedure, lab test, x-ray, etc.), except when such inputs are valued with cost-effectiveness in mind. If such an approach is pertinent, it may help define essential in health care vis-a-vis the use of packaging (King 1974). It has been thought that perhaps there is a 'threshold' somewhere on these scales below which everything might be included might be includes as essential.

Another integral component of packaging is that it allows for each intervention input to be defined in order to promote the intervention. For example, provision of immunization to children will have a limited impact, if promotional or educational programs are not included. Necessary non-specific items often include teaching aids, curricula, equipment and methods for assessing the epidemiological impact of said interventions. Another important aspect of packaging is that well-designed packages can in some measure help coordinate scare technical, administrative, educational and resource opportunities (King 1974). This is relevant for the estimating the input requirements and joint costs derived from such non-disease specific technical inputs.

By increasing administrative detail for a package of services, quality of services may increase. Again, a certain level of quality of services may be considered essential. Caution must be

expressed in describing this basic quality of package services depending on socio-economic conditions. In the developed world the socio-economic conditions and medical protocols may indicate that the "Sick Child" Cluster would include a chest x-ray for suspected mild pneumonia, but in much of the developing world economic conditions may direct the protocol away from chest x-rays for suspected mild pneumonias.

The benefit of packaging is that it allows for thorough cost-effective considerations of interventions inputs. As an example, a certain intervention input may be costly (and possibly cost-ineffective) such as a microscope for examining urine at a health center; however, when the microscope is provided for many medical intervention input such as sputum examination for tuberculosis, the cost of the microscope are then shared. Intervention input costs are closely clustered or associated in the sense that if one is available, another can be provided at little or no extra cost. Packaging also outlines a more complete cost-effectiveness consideration of interventions when they are "clustered" together. For instance, the addition of micronutrients to the expanded program of immunization adds little to the cost of the program and provides a feasible method of delivery - reducing the cost of both programs through joint costing than if they were offered through different programs. Clustering also allows the incorporation of increased intervention effectiveness when it is substantially enhanced by the presence of the other. This is seen in the Prenatal and Delivery Care Cluster where hospital based

intervention inputs are put to greater use in patients who have a medical need for referral since they were already screened via health center interventions.

The selection of interventions for the *minimum package* was derived in part from the aggregate burden of disease for demographically developing countries (Murray and Lopez 1994). Results obtained from Disease Control Priorities In Developing Countries (DCPDC) were used to identify those diseases that could be controlled in a cost-effective manner, at less than $100 per DALY gained. The decision to cluster diseases was based on whether there were cost-effective interventions could be provided jointly (Bobadilla and others 1994). For example, prenatal and delivery care addresses most of the specific disease conditions leading to maternal mortality and morbidity, whereas malaria and the other tropical diseases cannot be controlled jointly and therefore are treated separately.

Calculating the cost-effectiveness of health interventions requires a common currency for measuring costs and a unit for measuring health impact. Then different interventions can be compared by what it costs to achieve one additional year of healthy life. Outcomes are measured in Disability-Adjusted Life Years (DALYs), a measure that combines healthy life years lost because of premature mortality with those lost from disability. For disability, the number of life years lost was obtained by multiplying the expected duration of the condition (to remission or to death) by a severity weight that measured the severity of the

disability in comparison with loss of life. Diseases are grouped into classes of severity of disability; for example, blindness was given a severity weight of 0.6 on a scale from zero to one. After combining the death and disability losses, a discount rate of 3 percent is applied (so that future years of healthy life are valued at progressively lower levels). Age weights were applied (so that years of life lost at different ages are given different relative values): this recognizes that the worst age at which to die is not necessarily in infancy. For a more detailed description of the methods used to calculate DALY losses for burden of disease calculations see Murray and Lopez 1994; Murray 1994; Murray and others 1994). The ratio of cost and effect, or unit cost of a DALY, is called the cost-effectiveness of the intervention: the lower that number, the greater the value for money offered by the intervention

The package consists of six clinical and five public health interventions, clusters of interventions or groups of interventions. The former includes: chemotherapy for tuberculosis; the "Sick Child" Cluster for treating a variety of childhood diseases; Prenatal and Delivery Care Cluster; treatment of sexually transmitted diseases (STDs); family planning; and a series of non-specialized interventions for emergencies known collectively as limited care. The public health interventions include: immunization and supplementation with vitamin A and iodine (EPI Plus cluster); a school health program which includes treatment for intestinal parasites, micronutrient supplementation and health

education; tobacco and alcohol control; prevention of AIDS; and a group of activities called other public health. Except for the limited care interventions, the final selection included only those interventions which yield a DALY for less than $100 (in low-income countries) and were potentially able to control a substantial part of diseases or injuries that were responsible for one or more percent of the disease burden in developing countries. Only two very cost-effective interventions (or cluster of interventions) were not included: screening and early treatment of cervical cancer and cataract extraction for neither one contributed to sufficient DALYs in the aggregated analysis. Many diseases with substantial burden are not addressed through the *minimum package* because the cost-effectiveness of interventions is too low or because their cost-effectiveness is unknown as seen in Tables 2 and 3.

The cost-effectiveness of the minimum health care package is estimated from separate calculations for the costs and the effectiveness of each intervention or cluster of interventions. For each calculation, it is necessary first to explain the conceptual basis, then to describe the specific variable or inputs needed, and then to show how these are combined into algorithms or equations. The numerical data and assumptions are detailed below, under "Information and Assumptions" section.

Concepts

The framework used to calculate the cost-effectiveness of the minimum package of essential health services is outlined in Figures

1 and 2, with Figure 1 describing how costs were calculated and Figure 2 serving the same purpose for effectiveness. These concepts outlined in Figures 1 and 2 are then translated into equations, and inputs for those equations are described in detail in later sections and in Tables 5-8 (See Appendix). As Figure 1 indicates, the crux of the model is calculating the cost per intervention for a certain number of intervention participants. Some health services consist of only one intervention (Tuberculosis Treatment) while other health programs consist of multiple interventions (Limited Care). Still other interventions are provided jointly, as in the Prenatal and Delivery Care or "Sick Child" Clusters.

Interventions are provided through three levels: health post, health center and/or hospital. Activities at the health post level are made up of community outreach activities (70%) and activities carried out within the health post (30%). Figure 1 shows the framework for cost estimation at a health post; the same framework was followed for interventions provided at a health center or hospital. Since there are fixed costs to operating a facility at any of these levels, the total cost of an intervention will depend on the number of participants or users for that intervention at a facility. Determining how many intervention participants there are at a health service location depends on the percentage coverage for that health intervention (the share of potential participants who use the intervention) and the number of potential intervention participants.

The number of potential intervention participants in turn depends on intervention target disease epidemiological profiles, the demographic profile, and clinical guidelines. There are no a priori budget constraints since the object is to determine the per capita costs which would result from offering the intervention. For each health service location, the number of health intervention participants is multiplied by the number of health service location visits (or contacts, or days of hospitalization) needed to complete the intervention (e.g., two doses of tetanus toxoid are needed for pregnant women in the Prenatal and Delivery Care Cluster, requiring two visits) with this product then multiplied by the cost per health service contact. The cost per contact at each health service location is estimated considering the necessary clinical components and package design. In addition to required current inputs such as labor and drugs, interventions require the use of fixed capital (buildings and equipment).

In middle-income countries some of the capital costs necessary for the intervention have already been paid for (chiefly hospital and health center construction). In middle-income countries it is assumed that 65% of the needed fixed cost infrastructure already exists (or could readily be converted to package use). In low-income countries it is assumed that 30% of needed infrastructure exists (or could readily be converted to package use). As a note, the costs involved in providing needed infrastructure for delivering the minimum package to 100% of the population were

included using requirements outlined in previous World Bank works such as Better Health In Africa (1993).

Figure 1 Framework For Cost Estimates

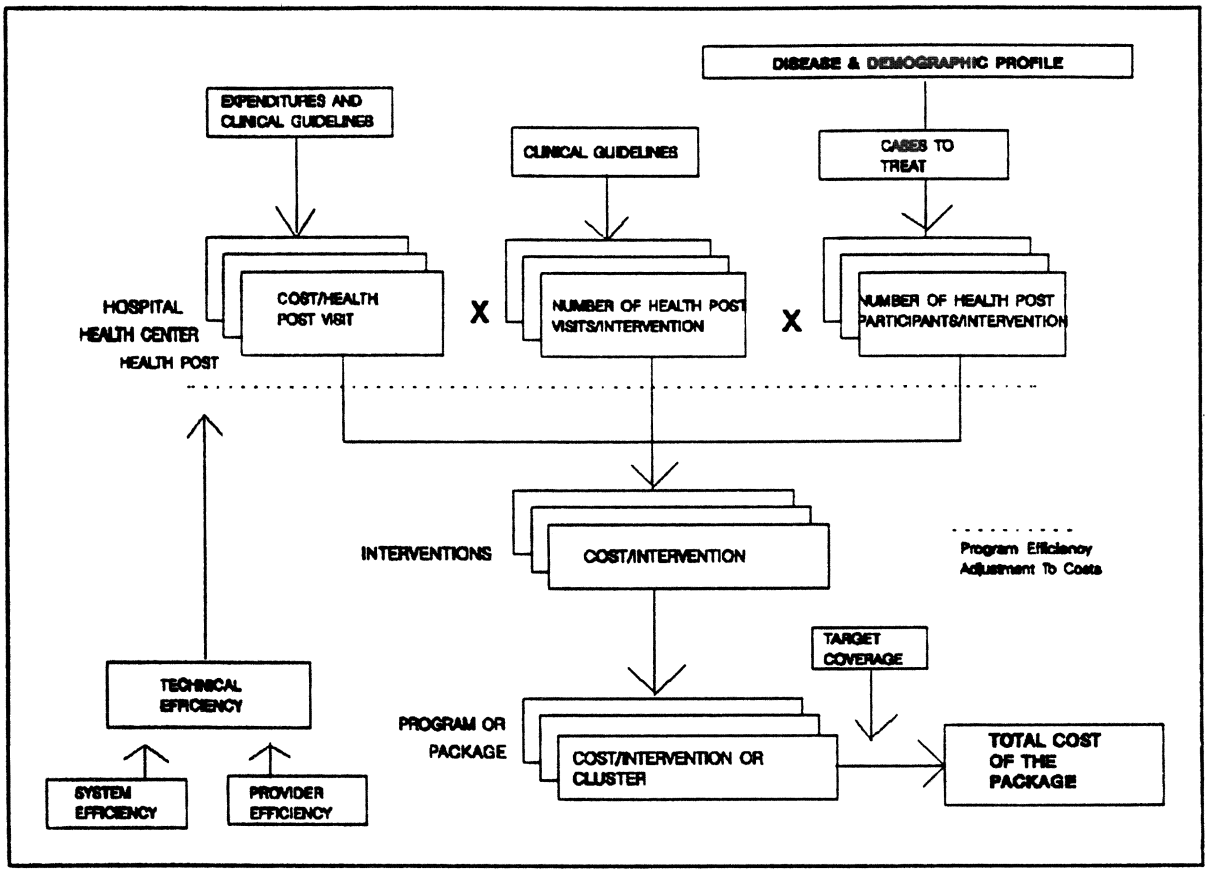
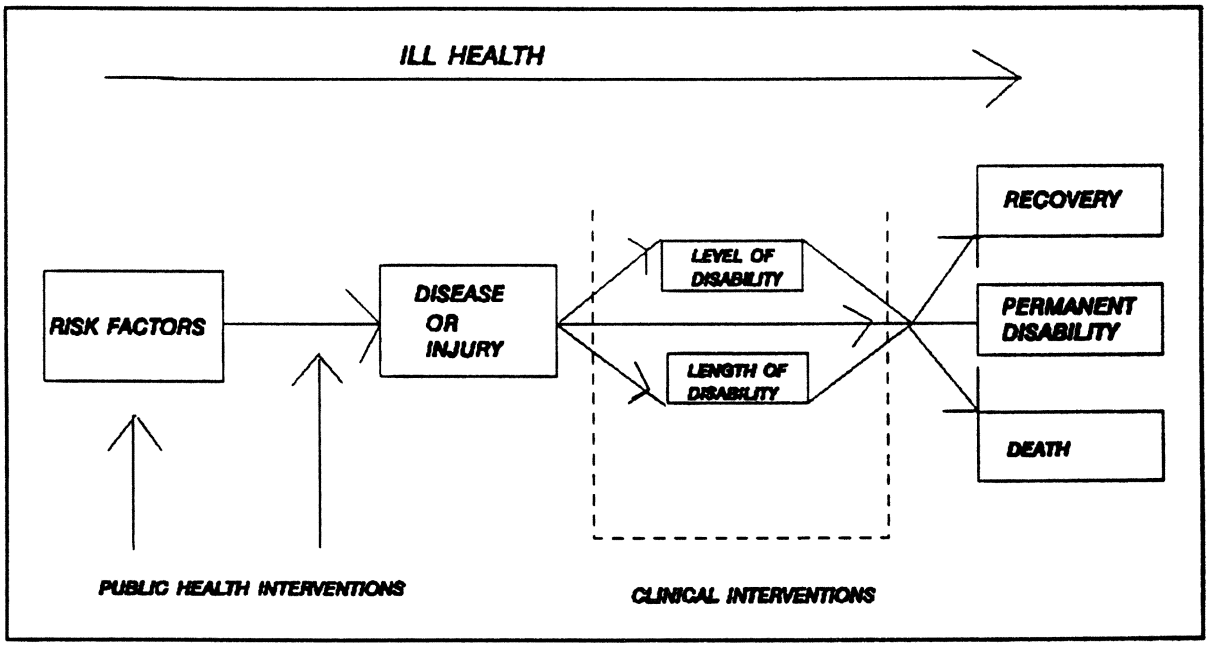


Figure 2 illustrates how the effectiveness of interventions is estimated. It portrays how the course of ill health is changed by either public health (dotted line) or clinical (dashed line) interventions. In general, disease is a result of risk factors and has three possible outcomes: recovery, disability or death. If a patient is disabled, two factors determine the amount of healthy life years lost: the length of disability and the severity of

disability. If disability is not permanent or is of a very low level (e.g., slight bone pain where a bone fracture healed), a patient is generally considered to have recovered from the disability. Conversely, if the patient dies as a result of the disease, by definition there is no more disability.

Figure 2 Framework For Effectiveness Estimates



Public health interventions in general attempt to eliminate risk factors which cause disease, or modify their effects, while clinical interventions attempt to reduce case fatality rates, amount of disability or length of disability. Some interventions prolong the length of disability by preventing a premature death due to a chronic disease. Clinical interventions cannot prevent risk factors from causing a disease in the first place except in the case where curing one individual's disease may prevent

transmission to another. For instance, curing a person with short-course TB chemotherapy (clinical interventions) will prevent that person from infecting others.

Because no health system exists without waste (e.g. theft, excess tests ordered, delay in shipment of medicine or vaccine, etc.), program cost efficiency adjustments need to be considered when calculating intervention costs. The program cost efficiency adjustment factor has two components, system and provider efficiency. System efficiency encompasses the timely availability of supplies while provider efficiency reflects in part any excess visits or inputs needed because of poor physician training. These are examples of possible system and provider inefficiencies, but not the only ones.

It is assumed that all health service costs are 30% higher than calculated (irrespective of the health intervention) in the low-income country scenario due to program inefficiencies such as theft, spoilage and unnecessary use; in middle-income countries, the upward adjustment is 20% of calculated costs. As a result, the input costs used were all multiplied by a either 1.3 (low-income) or 1.2 (middle-income) factor **(Efficiency)** to account for loses.

Since providing medical or public health treatment to a patient is often fraught with difficulties (for example, misdiagnosis, or patients not taking medicine as prescribed) a modification of the potential for an intervention to reduce the disease burden is needed. This modification includes variables for:

- Intervention Efficacy
- Targeting or Diagnostic Accuracy
- Provider Compliance
- Patient Compliance

Intervention efficacy is the maximum possible disease burden reduction from an intervention under controlled conditions. Diagnostic accuracy is the degree to which patients with a condition are correctly discriminated from those without the condition (Brenzel 1993; Tugwell and others 1985). Provider compliance is the extent to which the practices of health providers in actual field conditions replicate ideal practices under which efficacy was established in a research trial. Patient compliance is the extent to which patients follow ideal practices, again under conditions where maximum efficacy was established in a trial (Shepard and Sanoh 1986).

Methods

Minimum package costs presented in the 1993 WDR and Bobadilla and others (1994) are from this paper, except that some input values have changed, leading to slightly different results. It shall be noted that minimum package costs were calculated on the basis of covering 100% of a 1 million population, but coverage rates in terms of calculating burden of disease reductions were only 80% (except for the EPI program where it was 95%) to account for health system and patient/provider inefficiencies such as

delays in diagnosis, improper protocols and poor health system management.

Equations

Tables 3-6 (See Appendix) represent the mathematical manipulation of the concepts outlined in Figures 1 and 2. Tables 3 and 5 describe the variables and equations used, for low-and middle-income countries respectively. Tables 4 (low-income) and 6 (middle-income) show the predicted values (inputs) of these variables. Tables 3 and 5 are organized into four separate sections: cost, effectiveness, cost effectiveness and total results. The low-income scenario is based on a country with a per capita gross domestic product (GDP) of $350, while the middle-income country has a per capita GDP of $2500.

The most important aspect of the cost variable section is the equation for the cost of a particular health service costs **(Cost)** which is built up as follows. All costs are in 1991 U.S. dollars. The cost of the intervention for the entire population, assuming 100% coverage of target population, is the cost per health service participant **(Part)** times the total number of intervention participants **(N)**: The sum of health post **(nHP)**, health center **(nCENT)** and hospital participants **(nHOSP)** is sometimes greater than the total number of intervention participants **(N)**, as the same individual can visit different service locations for the same health service. For instance, all Prenatal and Delivery Care Cluster participants (pregnant women) will be seen at the health outpost level; however, some women will eventually deliver at

either the health center or hospital.

Costs

Total minimum package costs **(CostTOTAL)** equal the sum of:

CostTotal = CostCLIN + CostPUB

The total cost of clinical health services **(CostCLIN)** equals the sum of the following intervention (or cluster of intervention) costs:

Tuberculosis Treatment **(CostTB)**

"Sick Child" Cluster **(CostSICK)**

Prenatal and Delivery Care Cluster **(CostANC)**

Family Planning **(CostFP)**

STD Treatment **(CostSTD)**

Limited Care **(CostLIM)**

CostCLIN = CostTB + CostSICK + CostANC + CostFP + CostSTD + CostLIM

And the total cost of public health services **(CostPUB)** equals the sum of the following health service costs:

EPI Plus **(CostEPI)**

School **(CostSH)**

Other Public Health **(CostOTH)**

Tobacco and Alcohol Control **(CostTOB)**

AIDS Prevention **(CostAIDS)**

CostPUB = CostEPI + CostSH + CostOTH + CostTOB + CostAIDS

Intervention (or cluster of intervention) costs (Cost...) are the sum of related costs at the[1]:

The health post system **(CostHP)**

The health center system **(CostCENT)**

The hospital system **(CostHOSP)**

Cost... = CostHP + CostCENT + CostHOSP

At each health service location, the cost of a particular intervention is the product of[2]:

Cost per health service contact **(Cost...)**

Number of contacts needed for that health service **(Visit...)**

Number of participants per health service location **(n...)**

Intervention efficiency adjustment (**Efficiency**...)

Thus, the equation format for total intervention costs is:

Cost... = Efficiency * (nHP*(CostHP*VisitHP) + nCENT(CostCENT*VisitCENT) + nHOSP(CostHOSP*VisitHOSP))

---

[1] "**Cost...**" leaves room for the combination of costs for a particular intervention. For instance, **CostTB** is the cost of the tuberculosis intervention at all health service locations. In a related vein, "**...HP**" leaves room for the combination of either number of needed health post visits per intervention "**VisitHP**", cost per intervention health post visit "**CostHP**" or number of intervention participants at the health post "**nHP**".

[2] The mortality rate is generally used when public health services are considered, whereas for clinical services the case fatality rate is used. Mortality and case fatality rates are expressed as the chance the health service participant (across all health service locations and from the health service target diseases) will die if he does not receive the corresponding health service and is referred to as the target mortality in the text.

Effectiveness

Calculation of effectiveness estimates begins at the level of individual diseases and interventions dealt with at each health service location, and is summed across health service locations and intervention(s) or clusters of interventions in the included in the health program. The calculation of health service effectiveness or the reduction of Disability Adjusted Life Years (DALYs) lost to disease, starts from the mortality burden, which is the product of:

> Number of health service participants across all health service locations **(N...)** and the
>
> Mortality or case fatality rate for participants without health service[3] **(MR...)**.

To this is added the disability burden, which is the product of:

> Number of health service participants across all health service locations **(N...)** and the

[3] The mortality rate is generally used when public health services are considered, whereas for clinical services the case fatality rate is used. Mortality and case fatality rates are expressed as the chance the health service participant (across all health service locations and from the health service target diseases) will do if he does not receive the corresponding health service and is referred to as the target mortality in the text.

Probability of disability in participant without health service **(PropDISAB...)** and the

Average severity of disability **(WeightDISAB...)**.

This sum of the years losses due to mortality and disability across health intervention target diseases **((N*MR)+(N*PropDISAB*WeightDISAB))** is then multiplied by a

DALY Converter **(DC)** which is:

Life expectancy - Age of Death or Disability of the Stricken Individual[4]

And then multiplied by a Externality Factor **(Ext...)** which equals:

1 + (Secondary DALYs/Primary (Patient) DALYs)[5]

---

[4] This interval is adjusted by discounting from the time of incidence and by age weighing as described above and in Murray, 1993. It is assumed that a death or disability from health service target diseases has the same time of onset, as in an environment where the health intervention was not received. In the model it is assumed that there is no temporary disability because its effects are generally minimal compared to those from either permanent disability or death.

[5] Secondary benefits include such effects as decreased transmission of the disease. Secondary benefits must occur within 5 years of intervention in order to be considered. At times it is difficult to define what is the primary benefit; for instance, while the Prenatal and Delivery Care Cluster is costed primarily using mothers as participants, the primary benefits are expressed as reducing the perinatal mortality rate. In all calculations, the primary benefit (or primary mortality or disability rate reduction) will be clearly outlined.

This yields the total loss of DALYs from disease mortality and disability from health intervention target diseases **(Burd...)**.

Burd... = ((N*MR)+(N*PropDISAB*WeightDISAB))*DC*Ext

The actual DALY reduction achieved by health interventions (or cluster of interventions) is calculated by multiplying this loss by a Health Service Impact **(HSI...)** variable which is the product of[6]:

Diagnostic or targeting accuracy **(DiagAC)**

Health service intervention(s) efficacy **(Efficacy)**

Health service effectiveness **(Effective)**

HSI... = DiagAC * Efficacy * Effective

To equal the number of DALYs gained per intervention per Health Service **(DALY...)**.

DALY = Burd * DC * Ext * HSI

Cost-Effectiveness

Cost-effectiveness estimates are straightforward and involve dividing the cost of a health service **(Cost..)** by the number of DALYs gained from that health service **(DALY...)** . The same equation is used for determining the cost-effectiveness of clinical, public health or (Total) interventions, i.e. clinical

---

[6] The **(Efficacy)** variable acts as a proxy to determine reduced case fatality rates and probability of disability rates in the environment where the designated health service was received. Calculating this factor only once per health service per intervention(s) or cluster of interventions is equivalent to assuming that efficacy reduces mortality rates and probabilities of disability by the same percentage. Diagnostic accuracy refers to clinical interventions while targeting accuracy is tied to public health interventions **(DiagAC)**.

services **(CostCLIN)** divided by DALYS gained from clinical services **(DALYCLIN)**. **(...TOTAL)** refers to costs or DALYS gained from both clinical and public health services.

Description of Interventions

Only a brief summary of each series of interventions or cluster of interventions in a will be presented here. If further detail is required, the reader is directed to the appropriate chapters of Disease Control Priorities In Developing Countries (DCPDC) or other references as described in the "Information and Assumptions" section of this document.

Clinical Interventions

Tuberculosis Treatment

The low-income country Tuberculosis treatment program provides hospital-based care for two months of short course daily chemotherapy, followed by 4 months of outpatient (health center based) short-course chemotherapy. Hospital-based care for tuberculosis short-course chemotherapy in low-income countries would involve minimal hospital costs, as the hospitalization period exists only to ensure medication compliance and would predominantly involve nursing and hotel costs. It is assumed that the monitoring system (for weekly home visits) is less well established in the lower-income country model, which necessitates a hospitalization period to assure patient compliance. In middle-income countries where the patient compliance system is assumed to be more developed, the short-course chemotherapy treatment program is

entirely out-patient based , except in remote areas where hospitalization may be required. In low and middle-income countries, out-patient visits are scheduled for every two weeks and both tuberculosis treatment programs rely on the use of daily short-course chemotherapy such as 2 months of isoniazid, rifampin and pyrazinamide followed by 4 months of isoniazid and rifampin. The TB treatment programs depend on passive case detection, i.e. patients seeking treatment for cough, night sweats, or weight loss. Treatment will not take place without at least a preliminary diagnosis based on the detection of acid-fast bacilli on sputum smear. TB treatment protocols in middle-income countries will utilize chest x-ray for diagnosis and follow-up for low-income countries a sputum smear examination is believed to be adequate for diagnosis. Treatment of non-sputum positive cases of tuberculosis (such as TB meningitis) is not included in the model, since relevant research into these cases is still inconclusive.

"Sick Child" Cluster

The "Sick Child" Cluster provides care for a range of childhood diseases such as acute respiratory infection, diarrhea, measles or malaria according to clinical signs and a simple diagnostic algorithm. For instance, pus draining from the eye or mouth ulcers could indicate a case of measles, while intermittent fever points towards malaria (in regions of high risk for malaria). Furthermore, this algorithm can be used to estimate the severity of disease; for example, fast breathing and no chest drawing indicates a mild case of pneumonia, while chest in-drawing, stridor,

inability to drink, convulsions or abnormality sleeping or difficulty waking signifies severe pneumonia. The combination of clinical signs plus the severity of these signs enables the community health worker or nurse to make a provisional diagnosis and initiate treatment. A case of pneumonia will be treated with an antibiotic (such as an intramuscular injection of cotrimoxazole) and his or her caretaker will be told to return in two days with the child for reassessment (at the health center or health post), while the child with severe pneumonia or very severe disease is referred to the hospital after the first dose of the antibiotic. At the hospital, severe pneumonia care includes oxygen, intra-venous antibiotics, and intra-venous fluids. The algorithms specify that for cases of severe pneumonia, cerebral malaria, measles, mastoiditis or bloody diarrhea, referral to the hospital is promptly initiated.

Conversely, if the child has minor symptoms , such as those associated with a minor upper respiratory infection, the algorithms require that palliative care given (i.e. paracetamol or simple rehydration). Other important components of the program are the assessment of immunization and nutritional status, with moderate cases of malnutrition (stunting with ocular signs) given vitamin A and the mother counseled on nutrition, while severe cases of malnutrition need referral to the hospital. Finally, the "Sick Child" Cluster includes a significant Information, Education and Communication (IEC) program about the interventions themselves which is critical for inducing demand.

Prenatal and Delivery Care Cluster

The Prenatal and Delivery Care Cluster incorporates a wide range of services which are provided at the outreach (health post) level, health center or hospital. As in the "Sick Child" Cluster, there are a number of target diseases and interventions which are provided jointly. The Prenatal and Delivery Care Cluster has as an objective to reduce most of the mortality from such maternal and perinatal diseases as: ante and post-partum hemorrhages, eclampsia, abortion complications, obstructed labor, sepsis, neonatal hypoxia and neonatal hypothermia. Strategies for addressing these diseases at the health outpost level include (where clinically indicated) iron supplementation, clean delivery practices, drugs to contract the uterus, bimanual compression (for hemorrhaging) and use of antibiotics. One of the most important components of the Prenatal and Delivery Care Cluster at the health post level is the evaluation of the patient with prompt referral if necessary to either the health center or hospital levels. Stabilization often occurs at the health center where intra-venous drugs and fluids can be given. Any surgical intervention (except evacuation of the uterus which can take place at the health center) takes place at the hospital level. This includes cesarean section, repair of lacerations to uterus and surgical drainage of pelvic abscesses. Blood transfusions and intubation can take place only at the hospital. As with the "Sick Child" Cluster, the Prenatal and Delivery Care Cluster involves an important IEC component to help increase demand.

Sexually Transmitted Disease (STD) Treatment

The Sexually Transmitted Disease Treatment intervention diagnoses and treats diseases such as syphilis, gonorrhea and chancroid at the health center. An integral component of this program is the education of the patient about STD prevention, such as the use of condoms. The STD treatment program utilizes low cost immunoassay probes for diagnosis in addition to clinical signs. Treatment consists of injectable antibiotics such as benzocaine penicillin or a 10-day course of oral antibiotics such as erythromycin. A follow-up visit is advised to determine if the patient has been cured and is thus no longer infective. Since STDs facilitate the transmission of HIV no matter which partner is infected, the early diagnosis and treatment of these diseases will assist in reducing HIV transmission.

Family Planning

The family planning intervention in low-income countries is health post and health center based, with the health post component relying primarily on community-based distribution of oral contraceptives, and partially on hormonal injections, both of which require on average 3 visits per year. The outreach visits for oral contraceptive and hormonal injection interventions will monitor any side effects the medications such as hypertension or sustained irregular menses. The health center component includes intra-uterine device (IUD) placement. The middle-income country scenario includes (besides those services provided in low-income scenario)

a small proportion of women obtaining a bilateral tubal ligation (BTL) at the hospital.

Limited Care

The Limited Care interventions predominantly provide pain relief and diagnose, advise on, and sometimes treat, simple conditions such as conjunctivitis or skin allergies at the health center system. Another integral component of the program is the referral to the district hospital for non-specialized emergency care. This includes treatment of simple fractures by casting, lacerations by bandaging/suturing, appendicitis by appendectomy and pneumothorax (for a collapsed lung) by chest tube insertion. In both low and middle-income countries, the limited care intervention would also include simple diabetes care and hypertension/post heart attack management programs, utilizing diet and inexpensive medicines in both programs (such as oral hypoglycemics for diabetes and beta blockers for hypertension).

Public Health Interventions

Expanded Program Of Immunization Plus (EPI+)

EPI plus provides Diphtheria-Pertussis-Tetanus (DPT), measles, oral polio and tuberculosis (BCG) vaccination to under 1 year olds via community outreach programs. In order to immunize a child fully, 5 separate contacts between the outreach team and the patient are needed. EPI Plus refers to the addition of oral vitamin A and iodine supplementation. The EPI Plus also includes immunization against Hepatitis B and Yellow Fever in certain countries. Oral vitamin A and iodine supplementation are supplied

utilizing the same contacts needed for immunization, with vitamin A supplementation requiring two contacts and iodine supplementation only one.

School Health

Because school-aged children harbor the most intense infections with *Ascaris*, *Trichuris* and other helminths, the primary component of the school health program is the provision of anti-helmintics (for intestinal helminths and schistosomes) to children once a year at school. Schools are chosen as the primary distribution point because children are easily accessible in schools and schools are often convenient points for distribution of anti-helmintics to children not in school. The primary anti-helmintics used in the program are albendazole (every year) and praziquantel (every other year). Vitamin A and iodine are given, utilizing the same contact, in regions with high deficiency levels. In addition, the School Health intervention utilizes the same contacts to provide basic health education which emphasizes prevention of unwanted pregnancies, sexually transmitted diseases, alcohol abuse and tobacco use.

Other Public Health

Other Public Health interventions are divided into four major categories: IEC, epidemiological surveillance, vector control, water and food monitoring. For regions of high malaria, dengue or yellow fever incidence, vector control utilizes chemical insecticides active against mosquitos. Water and food monitoring is designed for potable water supplies and restaurants and certain

open-air food stalls (where licensing is needed). Information, Education and Communication (IEC) concentrates in part on hygiene education, while epidemiological surveillance concentrates on detecting outbreaks of such diseases as cholera.

Tobacco and Alcohol Control

Tobacco and alcohol control focuses on raising taxes on cigarettes and alcohol, warning labels, education programs targeting potential smokers and drinkers (to the harmful effects of tobacco use and the products of alcohol abuse) and the regulation of purchases of tobacco and alcohol by minors. A comprehensive package which includes all of these interventions and highlighting IEC will be much more effective than isolated action.

AIDS Prevention

AIDS prevention targets one of the highest HIV risk groups, commercial sex workers (CSWs). The program utilizes contacts every two months to promote condom use (condoms will be provided during these visits) and to provide sexually transmitted disease education (physical signs of STDs and their need for treatment) to commercial sex workers. The program will roughly distribute 100 condoms per month per CSW. The AIDS prevention contacts are out-patient based and consist of CSWs organized into small intensive HIV prevention groups led by trained CSWs.

Information and Assumptions

The data and assumptions used for determining the values of the variables used in the cost-effectiveness equations are outlined in

Table 4 for a 1 million reference population.

Table 4 Epidemiological and Demographic Parameters in Constructing a Package

INDICATOR	**LOW-INCOME**	**MIDDLE-INCOME**
% Population per Age Group	Under 5:16% 5-15:24% 16-59:55% 59+:5%	Under 5:12% 5-15:23% 16-59:58% 59+:8%
% General Population Who Are Women Age 15-59 In Union	18%	23%
% of Women Age 15-59 In Union and With Need For Family Planning	15%	40%
Crude Birth Rate (per 1000 population)	45	30
Perinatal Mortality Rate (per 1000 births)	60	30
Infant Mortality Rate (per 1000 live births)	90	35
Crude Death Rate (per 1000 population)	16	12
% HIV Seroprevalence (in Age 15-59)	7%	0.4%
% STD Prevalence (In Age 15-59)	6%	3%
Tuberculosis Incidence (per 100,000 General Population)	117	54
% of School-Aged Children Needing De-Worming	30%	15%
Percent Cigarette Smokers or Alcohol Abusers (In Age 15+)	20%	30%

While every effort has been made to obtain values as accurate as possible, it must be remembered that the values are only representative of average estimates for a low or middle-income country and are not based on an operating essential health package in any specific country.

Low Income Country Scenario/Clinical Interventions

Tuberculosis Treatment

The number of tuberculosis (TB) treatment participants is the product of the 117/100,000 incidence rate of smear positive tuberculosis in sub-Saharan Africa times the general population (DCPDC-TB)[7]. As previously described, smear positive TB patients in low-income countries will be hospitalized for the first two months of treatment resulting in a 60 day input for. In the low-income country scenario it is further assumed that 1 out-patient visit is needed to diagnose TB and 8 outpatient visits are needed afterward (2 per month after hospitalization) causing an input of 9. The cost of a health center visit assumes that a 4 month supply of short-course chemotherapy costs $60, which when divided by the number of outpatient visits equals $7 per outpatient visit for drug costs. Another $3 is added per health center visit for the visit itself (salary, fixed costs, etc.), resulting in a $10 cost per health center visit (Management Science For Health 1992). For inpatient TB short course chemotherapy (2 month supply) results from a $.50 cost for short course chemotherapy per day, which is

[7] "DCPDC-TB" is the Tuberculosis chapter in the World Bank book *Disease Control Priorities In Developing Countries*; "DCPDC-ARI" is the acute respiratory infection chapter in the same book, etc.

added to a $5 cost per day for feeding and housing the tuberculosis patient for an estimate of a $5.50 cost per patient day for short course chemotherapy. It is assumed that short course tuberculosis chemotherapy drugs cost the same at the health center as in the hospital.

The 80% diagnostic accuracy reflects the fact that over 90% of patients with smear-positive pulmonary tuberculosis have objective symptoms, such as cough, fever, loss of weight, sputum or hemoptysis (blood in sputum) (DCPDC-TB)). The 80% TB cure rate for short course chemotherapy has been established in sub-Saharan Africa conditions (Murray and others 1991). The 80% rate is an estimate allowing for the likelihood that a short-course chemotherapy program will not be as efficacious as the ones mentioned in the literature. The 70% case fatality rate is for smear positive TB and serves as the targeted mortality. The externality factor takes into consideration that the prevention of one case of TB will after a few transmission cycles prevent approximately 3 other cases of TB within a 10 year period. The DALY converter is 29 and is based on an average age of death of 30 and including the effects of age weighing as seen in Murray (1993)[8].

"Sick Child" Cluster

---

[8] Because Murray and others (1993) expresses the number of DALYs lost per death by male and female, it was assumed that deaths across all package targeted interventions were equally distributed among males and females (except in the case of pregnancy-related maternal mortality) and an equally sex-weighted average DALYs lost per death was used.

It is estimated that 16% of the general population is under the age of 5, with each under 5 year old utilizing the package, at either the health outpost or health center, once during the year and modeling that all under 5 year olds have an equal probability of seeking care. The model assumes that one-half of the intervention participants are first seen at the health center and one-half at the health outpost. The number of children seen at the hospital is based on data showing that 17% of children seen at the health center or health post for either acute respiratory infections, diarrhea or malaria need to be referred to the district hospital for supportive care (Preliminary Data From World Health Organization Control of Diarrheal Disease and Acute Respiratory Infections Programs (WHO/CDD-ARI)). It is assumed that a "Sick Child" Cluster participant who needs hospitalization will be referred at the same rate from either the health center or health outpost system and it is estimated that 1 health outpost or health center visits is needed for the "Sick Child" Cluster, considering that some children will not return to the health outpost/center after the initial visit because they have the common cold; others will obviously need more visits (WHO/CDD-ARI). Data indicate that approximately 3 days are needed in the hospital for treatment of severe pneumonia, severe diarrhea or cerebral malaria. Costs per contact at either the health post or health center is based on a $2.50 cost for the "Sick Child" Cluster consultation, which includes education for mothers and checking of immunization records, plus $.50 for antibiotics or palliative medicine (DCPDC-

ARI; WHO-CDD/ARI). The $12 cost per hospital day reflects preliminary World Health Organization Data. The 60% diagnostic accuracy figure is derived from the assumption that diagnosis is by simple algorithm only. Because efficacy information on "Sick Child" Cluster interventions is still preliminary; however, efficacy is modeled to be 60%, although preliminary WHO data indicate it may be higher. The 60% effectiveness measure is lower than for many other programs, because the "Sick Child" Cluster relies on algorithms which have to be well understood and strictly followed in order to be effective. Targeted mortality assumes that 40 out of a thousand clinic visits will result in death if untreated and is based on preliminary WHO data. The DALY converter considers the average age of death is 2.

Prenatal and Delivery Care Cluster

The number of intervention participants is based on a crude birth rate of 45/1000, and a consideration that pregnant women will use Prenatal and Delivery Care Cluster services even though they do not give birth, resulting in 50,000 participants (WDR Statistical Appendix 1993). Some (equal to about 10% of women who deliver) will utilize services, but not give births as a result of false positive pregnancies, abortions and miscarriages. It is assumed that all participants are first seen at the health outpost level, with 10% of women delivering at the health center level for moderately severe complications and high risk pregnancies that are easy to manage, and 10% at the hospital for severe complications and complex high risk pregnancies. The remaining women deliver

either at home or at the health outpost assuming it costs the same to deliver at home or at the health outpost. It is estimated that on average at least 4 ante-partum, 1 partum and 1 post-partum visits are needed at the health post for non-complicated events. This count of 6 visits is lowered to 5 in total, considering that pregnant women who are referred to either the health center or hospital do not utilize all the health post visits. Because women who utilize the health centers for pregnancy care are those with complications, it is believed they need at least 5 visits in addition to those utilized at the health post. The lack of concrete data leads to a conservative (high) estimate that 5 hospital days are needed for high risk cases or complicated births. The cost per health post visit is estimated to be $6, and includes two-dose tetanus toxoid vaccination (TT2) and daily iron supplementation for the length of the pregnancy at a $5 cost per pregnancy for iron supplementation (DCPDC-Micronutrient Deficiency). The cost per health center visit is double that of the health post visit, because of the greater utilization of comparatively expensive labor (doctors) or drugs (anti-seizure medication, intra-venous fluids, etc.) (World Health Organization/Mother Baby Package (WHO/MB), Forthcoming). The cost per hospital day is a result of cost estimates for predominantly surgical management of high risk or complicated pregnancies, since uncontrolled hemorrhage or obstructed labor patients are referred to hospital (WHO/MB).

The 95% diagnostic accuracy figure is derived from an estimate of the percentage of women who utilize the Prenatal and Delivery

Care Cluster and are or became pregnant, the percentage of women who will use services to determine if they are pregnant. The 50% efficacy measure is the maximum perinatal mortality and chronic disability reduction under ideal conditions for the Prenatal and Delivery Care Cluster as described (Greenwood and others 1990; van Roosmalen 1989). Because compliance rates may be low and provider education can be so variable, effectiveness is estimated to be 75%. The targeted mortality considered is the perinatal mortality rate and is 60/1000 births (WDR Statistical Appendix 1993). The proportion of births which would result in chronic disability from problems in the perinatal period is assumed to be 5% with an average 5% disability resulting from cerebral palsy, mild hearing loss, mild cognitive dysfunctions, etc. The DALY Converter assumes the average age of onset of death or disability of Prenatal and Delivery Care Cluster target diseases is at birth.

The Prenatal and Delivery Care Cluster also averts disease burden from maternal mortality/morbidity, neonatal tetanus and low birth weight associated mortality. Background calculations undertaken for *The 1993 World Development Report* have shown that approximately 65% of the entire DALY burden from childbirth is from perinatal mortality and morbidity. Thus, 35% of the DALY burden is due to maternal, neonatal tetanus and low birthweight related morbidity and mortality in the post-infant period which is suspected to be substantial. To account for these non-perinatal DALY losses, an externality factor of 1.5 is used which is derived from a ratio of the entire DALY burden from childbirth/DALY burden

from perinatal disease.

STD Treatment

The number of intervention participants is the same as the number of health center participants, because the Sexually Transmitted Disease (STD) Treatment intervention is entirely health center based. The number of participants assumes a 6% prevalence of "classic" STDs (syphilis, gonorrhea or chancroid) in the 15-59 adult population, which is then divided by two to convert to a 3% STD annual incidence rate assuming a two year duration. Since the adult population is 55% of the total population, it is estimated that approximately 16,500 persons will acquire a classic STD per year. The model assumes that 1.5 visits are needed for the STD intervention estimating that one-half of the clients treated will return for a follow-up visit. The cost for each of these STD treatment health center visits incorporates $1 for antibiotics (injectable or oral), $2 for diagnosis (inexpensive DNA probes) and $3 for the consultation (salary, fixed costs, etc (Moses and others 1991; DCPDC-STDS and AIDS).

The modeled diagnostic accuracy results from a lowering of reported DNA probe diagnostic accuracy from above 85% to 70%, assuming that some facilities will have to diagnose classic STDs on physical signs alone. Antibiotic efficacy against gonorrhea, syphilis and chancroid is approximately 80%, but it is lowered to 70% considering the higher prevalence of penicillin-resistant strains of Gonorrhea in many areas. Program effectiveness is predominantly based on estimates of patient compliance with oral

antibiotics. The proportion of patients who are disabled incorporates the assumption that 7.5% of classic STD cases who present to the health center will proceed, if they have not received treatment, to either chronic pelvic inflammatory disease, urethra stricture or infertility, with an average disability of 0.2. The DALY converter assumes the average age of onset of an STD is 28, but the average age of onset of AIDS is age 38. Because most cases of AIDS will die without treatment within a year or two of onset, the average age of AIDS onset is assumed to be the same as the average age of an AIDS death. Since the prevention of AIDS is the predominant DALY saving influence of the STD Treatment interventions, the later age of onset is utilized (DCPDC-HIV and AIDS). It is assumed that STDs cause approximately 30% of HIV transmission; thus, if HIV incidence is 7/1000 a year, approximately 2/1000 incidence of HIV is due to STDs, assuming 7% HIV seroprevalence in age 15-59 year olds and a 10 year duration of HIV/AIDS (Stanecki and Way 1993; Cowley 1993)[9]. When the averted HIV/AIDS burden from treated STD cases is converted to DALYS (utilizing average age of onset or death of 38) the DALY burden is 7 times that of STDs alone (utilizing an average age of onset or death of 28), which results in an externality factor of 8.

Family Planning

The number of intervention participants, is based on an estimate that 18% of the general population are women aged 15-49

[9] Extrapolated from Odds Ratios for HIV in commercial sex workers from Abidjan, Côte d'Ivoire with and without STDs (Marie Laga 1993).

and in union; and assuming that 5% of these women receive family planning at the health center and 10% obtain family planning at the health outpost (Bos and others 1992). The total 15% contraceptive prevalence rate for women in union reflects in part desire for family planning and social obstacles to such. It is estimated that approximately 3 visits a year are needed for the family planning intervention, taking into account the effects of injectable contraceptives which are efficacious for 3-6 months, implants lasting 2-3 years and daily oral contraceptives (for which multi-month supplies can be given at a single visit). The cost per health post visit utilizes a $3 cost for oral contraceptives (the predominant mode of family planning at the outpost) per health outpost visit (every 4 months) and $2 per clinic visit for salaries and overhead (DCPDC-ARI; Management Sciences for Health 1992). The number of visits needed at the health center is two-thirds a visit, considering that it takes one visit for IUD insertion, one visit for removal and the normal IUD can be used for 3 years without interruption. The $10 cost per visit for IUD placement and removal is an estimate based on local labor costs and a minimal cost for the IUD itself.

The 95% targeting accuracy is relatively high because it relies on an estimate of the percentage of women in union who are fertile. Program efficacy is 95% which is the oral contraceptive efficacy rate; oral contraceptives are the dominant component of the family planning program and in any case injectable and implant contraceptive have efficacy rates above 90% (DCPDC-Excess

Fertility). Conversely, because oral contraceptives are the dominant component, effectiveness is only 80% due to the high possibility of taking oral contraceptives incorrectly. The target mortality associated with the family planning intervention is linked to the increased infant mortality rate from too short birth spacing and is estimated to be 15% of an Infant Mortality Rate of 90/1000 and it is assumed that if there were no family planning, the participant would have a live birth every other year. Because family planning can also decrease the risk for mothers mortality and for late fetal deaths, it was estimated in background calculations for the 1993 WDR that using the infant mortality rate as the target mortality will capture two-thirds of all the DALY losses associated with excess fertility, as a result, the externality factor is 2.0 which equals the total DALY lost from excess fertility/DALY losses from excess fertility related infant mortality. The DALY converter is 32, incorporating an average age of death of under 1 year (assuming that averted maternal morbidity and mortality due to excess fertility has a small effect on the total number of DALYs lost).

Limited Care

The number of intervention participants is based on the assumption that on average 1 out of every 10 individuals over the age of five will benefit each year from one of the following services delivered at the health center: pain management, diagnosis of simple conditions (including simple bone fracture), diagnosis of conditions requiring surgery (appendicitis), and management of non-

complicated diabetes, and hypertension or post heart attack conditions (children under 5 are not included in the Limited Care Program because the majority of their immediate health needs are met by the Sick Child Package). It is further estimated that 3% of the individuals seen at the health center level will need referral to a hospital for complications giving the number of hospital participants. The cost per each health center visit estimate includes a $3 cost for the clinic consultation itself and $.50 cost per consultation for drugs such as simple anti-hypertensives (Beta blockers) or pain pills (DCPDC-Cardiovascular Disease). The $30 cost per day of hospitalization is an estimate based on an average cost of treating a hypertensive crisis, complicated diabetes or essential surgeries such as an appendectomy. The number of needed clinic visits of 1.3 is based 1 visit every three months (4 visits per year) for interventions such as simple diabetes or post heart attack management which are needed by 10% of limited care patients with 90% of limited care patients utilizing only one visit per year. Approximately 3 hospital days will be utilized by patients needing hospitalization in the Limited Care series of interventions, considering hospital stay averaged across the myriad interventions included.

The 75% diagnostic accuracy figure relies on an estimate of the percentage of the clients who actually benefit from limited care services, incorporating the expectation that most individuals would benefit at least from pain management or advice. The 10% efficacy measure is an average across interventions; for example,

diabetes management is 30% efficacious, surgery for appendicitis is 80% efficacious, therapy for cancer or severe stroke is only 1% etc. The efficacy measure is low, since the Limited Care interventions do not cover all diseases; many patients will get little or no benefit, corresponding to zero efficacy. The effectiveness estimate of 70% is also low, because some of the limited care interventions require difficult patient or provider compliance and the need for optimum technical efficiency. The targeted mortality of 8/1000 is the crude death rate in the general population (16/1000) minus mortality from diseases covered by other services besides those in Limited Care interventions (8/1000) and is a conservative estimate considering the high case fatality rates from some limited care target diseases (WDR Statistical Appendix 1993). Without the Limited Care interventions, it is assumed that 1% of the target population would suffer chronic disability such as a hypertensive stroke or diabetic ulcers at a 10% level of disability across all possible disabilities from Limited Care targeted diseases, with a 40 year average age of onset, with a DALY converter of 23.

Low-Income Country/Public Health Interventions

EPI Plus

The number of intervention participants is the number of infants surviving to receive every needed EPI vaccination. There are 45,000 births in the general population (crude birth rate of 45/1000), of which approximately 41,000 infants survive to receive EPI vaccination, given an Infant Mortality Rate of 90/1000 and the

effects of stillbirths and late fetal deaths. Approximately 5 health outpost visits are needed to achieve a fully immunized child and it is assumed that Iodine and Vitamin A are given when vaccination occurs; thus no new contacts are needed for the micronutrient deficiency component of the program (World Health Organization/Expanded Program of Immunization (WHO/EPI), 1991). The average cost of a fully immunized child has been reported to be $13; when considering the cost of micronutrient distribution, this cost will rise to $15. This $15 cost is then divided by 5 visits to give a $3 cost per health post visit (Brenzel 1990; DCPDC-Micronutrient Deficiency).

The 95% targeting accuracy adjusts for vaccination of children who have already been vaccinated (Shepard and Sanoh 1986). The combined efficacy of EPI plus is approximately 90%, while effectiveness is estimated to be 90% considering that there is a simple treatment protocol involved in immunizing children, but incorrect doses and improperly stored vaccine are still given on occasion. The targeted mortality rate assumes no vaccination program exists and multiplies the infant mortality rate (IMR) of 90/1000 times the sum of the portions believed to be due to vaccine preventable diseases (.20) and micronutrient disorders (.02). This portion of the IMR due to vaccine preventable and micronutrient deficiency related disease is an average, and in some environments this portion may be much higher. The chances of a child in a non-immunization environment acquiring either severe paralysis from polio, blindness from vitamin A deficiency or a

profound learning disability from Iodine deficiency is 1% and serves as the proportion of the target population who will become disabled without the intervention. The average severity of such disability is 50% and takes into account the three non-weighted permanent disabilities (DCPDC-Polio; DCPDC-Micronutrient Deficiency). Since some vaccine-preventable deaths or disability occur after infancy, a 1.2 externality factor is used and is considered a conservative estimate. Because it is under 2 year olds who die or are disabled from vaccine preventable diseases, the DALY converter is 32 years.

School Health

The number of school aged children who will be de-wormed on an outpatient basis assumes 24% of the population is age 5-14. It is estimated that only 20% of those need de-worming worldwide; however, this percentage was elevated to 30% in this scenario considering that many low-income countries have a greater worm burden than the global average (WDR Statistical Appendix 1993; Berkley and Jamison 1991). The $3 cost per outreach visit for the school health program considers one visit per year and is based on an approximate doubling of reported costs for one school health outreach visit which was modeled on de-worming costs alone (DCPDC-Helminth Infections). The 95% targeting accuracy is derived from the assumption that virtually all school aged children benefiting from some aspect of the School Health interventions. The 80% efficacy measure is predominantly derived from the efficacy of the de-worming component, while the 80% effectiveness figure was also

based on the de-worming component and took into account probable slightly diminished capacity to reduce ill health due to general problems with drug supply or incomplete record keeping. The 0.5/1000 targeted mortality rate is the case fatality rate among children with worms assumes that 50% of schistosome and 100% of intestinal helminth deaths occur in school-age children in the 40% most at risk (DCPDC-Helminth).

The proportion disabled estimate of 5% is derived from 45% of school-age children having mild-to-moderate intestinal helminthiasis infection and 15% having Schistosomiasis infection with an average disability of 10% (DCPDC-Helminth). The DALY converter of 36 reflects the average age of onset of death or disability of 10 years. Both mortality and disability measures include only the burden from worms; any benefits accrued from health education and micronutrient education are not included, although their costs are.

Other Public Health

The number of intervention participants assumes 60% of the population will be targeted for either vector control, water monitoring, beverage monitoring or basic sanitation education. The other 40% of the general population are assumed to live in inaccessible places or to have private water supplies. The total intervention cost is not calculated via the number of health service location visits needed, but by estimating the total costs of each intervention component as shown below:

Component	Assumptions
Vector Control - ($300,000)	Assumes one-half of target population will need yearly vector control spraying at $6 per house served per year with 6 people per household.
Water/Beverage - Monitoring ($600,000)	Assumes a costs of $1.00 per person served every year for the 60% of the population covered by the Other Public Health series of interventions.
IEC - ($300,000)	$1.00 per person served every year for 60% of the population covered by the Other Public Health series of interventions.

Total Cost ($1,500,000)

No DALY gains are attributed to the Other Public Health program, even though they are estimated to improve health, because no data exist from which to estimate them.

Tobacco and Alcohol Control

All individuals will benefit since everyone is either a potential smoker or heavy drinker or will feel the ill effects of such behavior (such as drunk driving or second hand smoke, etc.) making the target population the entire population. While it may be true that all individuals may not benefit from a tobacco and alcohol control program (i.e., some muslim countries), a conservative estimate of costing the control program for everyone is made. The total cost of the intervention is $300,000, with a breakdown as follows:

Information/Education/Communication -	$150,000
Labeling -	$150,000

The 100% targeting accuracy of the program assumes that all individuals are potential smokers or alcohol abusers. Data on

program efficacy has as its source, estimates that 20% of smokers or alcohol abusers will be sensitive to taxes and educational messages (DCPDC-Cancers)[10]. Because there is a large potential for diminished program efficacy due to illicit selling of cigarettes or alcohol, program effectiveness is modeled to be only 75%. The targeted mortality estimate considers that 25% of all smokers and alcohol abusers will die due to tobacco or alcohol attributable reasons, the prevalence of either smoking or heavy alcohol consumption is 20% in the adult population, and the adult population is 60% of the total population. These assumptions result in 30,000 deaths out of a population of 1 million which are assumed to occur over a 10-year period (3,000 deaths per year). The mortality rate is derived by adding the disease burden from certain cancers such as lung cancer, cirrhosis and Chronic Obstructive Pulmonary Disease (COPD), then applying the attributable risk from smoking or alcohol abuse to each disease category (United States Preventive Services Task Force 1992). Each attributable risk fraction was reduced to account for the less developed world's lower prevalence of smoking and alcohol abuse as compared to industrialized countries from which the attributable risk fractions come. The DALY converter assumes that mortality from smoking and alcohol abuse occurs at age 65, resulting in 10 DALYs lost; however, the cost of the program takes place

[10] Approximately 10-15% reduction in cigarette sales resulted in some developing countries when excise tax were doubled, and this does not take into consideration the benefits of education programs or limiting of cigarette or alcohol advertising.

approximately 25 years before death and when the 25 years of discounting are applied to the 10 DALYs lost, the result is only 5 DALYs lost per death. A relatively high externality factor of 1.5 takes into account the benefits from avoiding death or disablement due to passive smoking or alcohol attributable accidents.

AIDS Prevention

The number of intervention participants is the same as the number of health outpost participants, since the AIDS prevention intervention is entirely outreach based. The AIDS prevention intervention is based on 2.5% of the adult population aged 15-59 classified as commercial sex workers, who need bi-monthly AIDS prevention visits. The cost per AIDS prevention visit depends on a $10 condom cost per outreach visit and a $5 cost for the visit itself (DCPDC-AIDS and STDs). The $10 condom cost per outreach visits is derived from a $.06 cost per condom with 4 condoms used a night for 240 nights out of the year, resulting in a $57 cost for condoms per year which is then divided by the number of outreach visits per year. The comparatively high cost for the visit itself results from the assumption that the outreach visits will be highly intensive and focused.

The targeting accuracy considers that 95% of participants included in the AIDS prevention intervention would be commercial sex workers. Because condoms sometimes break, it is assumed that efficacy is 95%, and is a measure for the potential of condoms to prevent the spread of STDs and HIV (United States Public Health Service 1992). Effectiveness is assured to be only 60% considering

the potential of not using condoms with every sexual encounter (Moses and others 1992). The mortality rate associated with AIDS assumes a 7% HIV seroprevalence in the general population with a 10 year duration of HIV/AIDS till death resulting in an HIV incidence rate of .07% per year and a 100% fatality rate from AIDS (Stanecki and Way 1983). The average age of death is 38 for HIV/AIDS; however, the discounted conversion DALY converter of a 38 year old age of death, which is 25 years, is discounted again for 10 years because the benefits occur 10 years from the time the interventions is paid for, lowering the (DC) from 25 to 18. The DALY gain from preventing HIV infection is much more important than that from STD treatment, even though condom usage will also prevent STDs, and it is estimated that 40% of commercial sex workers will acquire an STD during the year and of that 40%, approximately 15% will have permanent disability at a 20% level of disability. A greater percentage of commercial sex workers then of individuals in the general population are expected to have a sexually transmitted disease-based permanent disability, because these commercial sex workers have a greater chance of repeat episodes of pelvic inflammatory disease (PID), increasing the risk of chronic disability (Wasserheit and others 1992). An AIDS prevention intervention in one commercial sex worker can prevent many more cases of AIDS in clients; in fact, the externality factor is based on the ratio of 7 prevented HIV cases for one year's condom use by a commercial sex worker in an HIV/AIDS epidemic situation (DCPDC-AIDS and STDs).

Middle Income Country/Clinical Interventions

The input data and assumptions in the middle-income scenario will be described only when they differ from those in the lower-income model. The cost per outreach visit, health center visit and hospital day were calculated in middle-income countries by multiplying the cost for these health service location visits in low-income countries by 1.7. This multiplication factor is a result of:

i. Calculating the percentage of costs which were due to labor in lower-income countries (roughly 30%) and multiplying by 2.5 to adjust for a roughly 7 times greater per capita GDP in middle-income countries. The assumption is that labor costs in the health sector will not rise proportionally with per capita GDP, but only about one-third as much.

ii. Multiplying the percentage of input costs due to training and management or supervision (usually 10%) by 2.5 also, because labor accounts for most of these costs.

iii. Assuming that the annualized capital costs for building and equipment are 1.5 times greater in middle income countries than in lower income ones. This takes into account the assumption that capital probably exists in greater supply in middle-income countries, but for which depreciation and maintenance costs may be extremely high.

iv. Assuming that all other inputs such as drugs and supplies are freely traded on the world market, so the cost does not change from low income countries to middle-income countries.

When the corrections due to factors 1-4 are summed, they result in costs for outreach, clinic or hospital 1.7 times those in low income countries and assuming that the inputs needed per intervention are roughly the same in low and middle-income countries.

Tuberculosis Treatment

The number of intervention participants results from the TB incidence rate of 54/100,000 in the Latin America and Caribbean Region (DCPDC-TB). As opposed to the Tuberculosis short-course chemotherapy program in the lower-income country scenario, all TB patients in the middle-income scenario are assumed to be treated on an out-patient basis. It is assumed that there is a lessened risk of TB transmission in the middle-income country due to less crowded housing conditions, so the externality factor is lowered from 5 to 2.

"Sick Child" Cluster

The number of intervention participants is based on 12% of the population being under 5, one-half of which will utilize the "Sick Child" Cluster at least once at either the health outpost or health center levels, in equal numbers. The number of hospital participants is a result of estimating that only 5% of health center or health post visits will result in hospitalization. Targeted mortality estimates are from case fatality rates for "Sick Child" Cluster targeted diseases and which take into account that out of 1000 clinic visits, the lack of said visits would result in 10 deaths.

Prenatal and Delivery Care Cluster

The number of intervention participants is based on a crude birth rate of 30/1000, but it is assumed that 10% of pregnancies will result in an abortion or miscarriage, so there will be 33,000 participants all of whom will have at least one visit at the health

post system (WDR Statistical Appendix 1993). It is assumed that 70% of deliveries occur at the hospital, 15% at the health center and 15% at the health post. There are only 2 prenatal and delivery Care visits needed at the health post considering that most births occur at the hospital, all intervention participants are first seen at the health post and some prenatal and delivery care cluster participants will receive all of their care at the health post. The same rationale applied to the 3 visits estimated to be needed at the health center system. Since most normal deliveries occur at the hospital, there are only 2 hospital days needed on average. The targeted mortality figure is based on a perinatal mortality rate of 30/1000. Efficacy is assumed to be 30% since the perinatal mortality rate is already low and much of this mortality would be due to congenital malformations which are not amenable to prenatal and delivery care services as designed.

STD Treatment

The 8,700 health center participants is based on the STD incidence rate. It was calculated by multiplying the percentage of the population which is age 15-59 (58%) by the STD incidence rate of 150/1000 (DCPDC-HIV/STDs). The externality factor relies on an HIV seroprevalence rate of 0.4% in the age 15-59 population, which results in an incidence of .4/1000, assuming that the duration from HIV seropositivity to AIDS to death is 10 years. The .4/1000 HIV incidence rate is multiplied by 0.3, supposing that 30% of HIV transmission is caused by STDs. When this STD-attributable HIV incidence is converted to DALYs (assuming average age of death is

38 and occurs 10 years in the future) the resulting externality factor is 1.8.

Family Planning

It is estimated that approximately 40% of fertile age women in union (who form 23% of the general population) will desire some form of contraception (Bos and others 1992). Approximately one-half of the women desiring contraception will utilize outreach provided oral contraceptives; one-quarter will have an IUD inserted at the health center and one-quarter will undergo a bilateral tubal ligation at the hospital for a one-half day visit costing $100/day. The mortality targeted by the intervention is based on assuming that 10% of the 35/1000 infant mortality rate is due to close spacing of births and assuming that if the participant did not engage in family planning, she would have a live birth every third year.

Limited Care

Because chronic disease is more prevalent in middle-income countries, it is assumed that 12.5% of the middle-income country general population will utilize the Limited Care interventions as opposed to 10% in lower income countries. Serious chronic disease is also more prevalent in the middle-income country model, so it is assumed that 8% of the limited care intervention pool is hospitalized once per year, which results in 1% of the general adult hospitalized for Limited Care Program target diseases. The targeted mortality rate in the general population is 8/1000, considering that the crude death rate is 12/1000 for which two-

thirds is due to diseases not covered by other package interventions (WDR Statistical Appendix 1993). Because there are three times the number of patients hospitalized in middle-income countries as compared to lower-income ones and hospital care is expected to be more efficacious than care at lower levels, efficacy was doubled to 20% while effectiveness was increased to 80%.

Middle-Income Country/Public Health Interventions

EPI Plus

The number of intervention participants at the health post level reflects a crude birth rate of 33/1000, adjusted to consider a 35/1000 infant mortality rate leaving 31,000 individuals needing vaccination. It is assumed that approximately 2% of the infant mortality rate is due to vaccine preventable diseases, while .5% is due to micronutrient deficiencies. It is further modeled that .05% of infants who do not receive EPI Plus will develop a permanent disability.

School Health

The number of participants assumes that 23% of the general population is between 5-14 and of these, 15% need to be dewormed (WDR Statistical Appendix 1993). The mortality rate is lowered from .5/1000 in the low-income scenario to .2/1000 due to a suspicion of better nutrition and overall health in school-aged children in the middle-income scenario.

Other Public Health

The estimated total intervention cost is 40% greater per component than in lower-income countries, as it is modeled that the

greater cost of providing other public health services, as compared to lower-income countries, is partially offset by the lesser percentage of the population needing vector control, water/beverage monitoring and basic sanitation education.

Tobacco and Alcohol Control

The total intervention cost was estimated by multiplying the Tobacco and Alcohol Control costs from the lower-income country scenario by 2.5, which takes into account that labor is the essential cost input and that health service labor costs are approximately 2.5 times greater in middle-income countries than in lower income ones. The target mortality estimate considers that 25% of all smokers or alcohol abusers will die from smoking or alcohol abuse causes and the prevalence of smoking or alcohol abuse is 30% in the adult aged 15+ population, which results in approximately 49,000 deaths out of a general population of 1 million. This 49/1000 mortality rate is divided by 10 assuming that the deaths occur over a 10-year time period. Roughly the same estimated mortality rate was obtained by adding all the disease burden from certain cancers such as lung cancer, cirrhosis and COPD, then applying the attributable risk from smoking or alcohol abuse to each disease category (U.S. Preventive Services Task Force 1992). The externality component in middle-income countries is expected to 3.0 considering the greater risk for vehicle or machinery accidents because of a higher degree of industrialization.

AIDS Prevention

The number of health post (outreach) participants relies on the assumption that approximately 2.5% of the adult population are commercial sex workers and adults constitute 58% of the adult population (WDR Statistical Appendix 1993). Because HIV seroprevalence is estimated to be .4%, the incidence rate is calculated to be .4/1000. The duration of illness is 10 years; and since all HIV cases eventually result in death, a (MR) of .00004 results.

Overall Results

Taking all interventions together, the minimum package would save over a third of a million DALYs per million population in a low income country, at a $13 per capita cost as seen in Table 9. In a middle-income country, the total cost for the package would rise to nearly $20 per capita and would save approximately 100,000 DALYS in a million population. It must be remembered that the DALYs gained in Table 9 include dynamic benefits. These dynamic benefits are expressed in the externality factor and which predominantly calculate DALY gains from mortality and morbidity occurring outside of the current year. Dynamic benefits for the vast majority would not be captured in a yearly burden of disease calculation; therefore, with regards to Table 1, the **(Ext)** factor in the spreadsheets was set to one, negating dynamic benefits and the

total DALYs gained was then expressed as a percentage of total DALYs lost. While a consideration of the dynamic component of disease is important, it must be stressed that an accurate estimation of these benefits is extremely difficult.

Table 9 Average Costs and DALYs Saved By Health Intervention(s) and Income-Group

HEALTH SERVICE	LOW-INCOME		MIDDLE-INCOME	
	COST	DALYS	COST	DALYS
CLINICAL	$8,689,000	213,000	$12,603,000	30,500
TUBERCULOSIS TREATMENT	$685,000	36,500	$200,000	4,800
SICK CHILD" CLUSTER	$2,001,000	51,600	$1,062,000	4,800
PRENATAL/DELIVERY CARE	$4,290,000	74,100	$6,356,000	20,300
STD TREATMENT	$257,000	41,200	$188,000	2,900
FAMILY PLANNING	$429,000	8,400	$1,632,000	5,000
LIMITED CARE	$1,027,000	1,500	$3,165,000	2,700
PUBLIC HEALTH	$4,489,000	97,500	$6,288,000	59,500
EPI PLUS	$799,000	32,000	$930,000	10,500
SCHOOL HEALTH	$280,000	8,900	$207,000	4,000
OTHER PUBLIC	$1,500,000	N/A	$2,000,000	N/A
TOBACCO/ALCOHOL CONTROL	$300,000	1,800	$750,000	11,000
AIDS PREVENTION	$1,608,000	54,900	$2,401,000	34,000
TOTAL	$13,178,000	310,900	$18,891,000	90,000

One of the most important assumptions involved in constructing these models is that of a certain level of technical efficiency. Because the actual technical efficiency of health interventions is unknown for much of the world, a "reasonable" level of such proficiency was assumed. For instance, there is expected to be little delay in diagnosis of patients, and drug supply lines are

essentially reliable. Closely related to assumptions of technical efficiency are estimates of quality of care parameters (effectiveness and diagnostic or targeting accuracy influences). It was again assumed that a "reasonable" quality of care was provided, partly as a result of an assumed "reasonable" level of technical efficiency. For example, cesarean sections would only be performed on the patients who were clinically indicated to need them. If quality is actually adequate but the target population does not perceive that a reasonable quality of care is being provided by the essential health package, costs would rise as a greater emphasis (with more funding) would need to be devoted to promotion of the package.

There are limitations to a essential health package cost-effectiveness exercise such as those presented here. Chief among them are assumed levels of "reasonable" levels of technical efficiency and quality of care measures. Furthermore, the cost-effectiveness exercise presented needs to be refined via local adaptations of the model. By melding theoretical cost-effectiveness exercises such as the ones presented here with local inputs of data and experience, the methods used will become more valuable for determining health service priorities.

Conclusions

While estimating the costs and impact - in terms of reducing the burden of disease - of an essential health services package has tremendous potential for amplifying and diversifying the health policy debate, this potential has economic, political and methodological limitations. Despite these limitations, an exercise such as the one presented here can advance thinking on how to maximize available health resources, using a single explicit output indicator which reflects undesirable states of health such as disability or death.

Although the process of priority setting in the health field is poorly understood, in developing countries a discrete number of factors determine largely the allocation of public spending on health.

i. The most important single determinant of the annual health budget and its composition, for most countries, is the previous year's expenditure pattern with some marginal additions to compensate for inflation. This creates a financial inertia that perpetuates the deficiencies of the current system, particularly the distribution of public resources by socioeconomic groups and by levels of care and the content of services (type and scale of interventions).

ii. Governments of developing countries are also usually sensitive to international initiatives and fashions as to what deserves priority in the health sector. External assistance through the earmarking of loans and grants influences country spending patterns. In addition, countries are influenced by the moral or technical authority of some international agencies.

> Unfortunately, health priorities stemming from international agencies are not derived from a thorough or comprehensive study of the options, but often are derived from implicit criteria.

Other considerations that may influence the definition of health priorities are: the perceived pattern of the burden of disease, the interest of the medical profession and other parts of society in having access to complex medical technology and training and research activities, and ideological standpoints of the government and the medical profession as to issues of equity and freedom of choice for patients and providers.

Despite the forementioned influences on the health planning policy context, over the past 10 years, major progress has been made in evaluating the health needs of human populations and the appropriateness of alternative interventions to meet them. More refined epidemiological indicators and methods are now available to assess the burden of disease. Economic evaluation of interventions and programs, mainly through cost-effectiveness analysis, has been introduced and applied more widely. More importantly, the rationale of economic evaluation has permeated the process of decision making in health in many health institutions, national and international. In fact, it is the aim of this paper to explain in detail the data and assumptions used to calculate the costs, effectiveness and

cost-effectiveness of the minimum package. By doing so it can only further the process of defining inputs (costs) and outputs (numbers of DALYs saved) which may be considered in the health planning process. Unfortunately, much of the policy debate is concentrated around a natural narrow focus of either saving life without a consideration of how much it costs or only funding the cheapest interventions as examples. By engaging in essential health packaging, individual or group foci can intermingle in turn highlighting a greater area for policy debate.

Since the essential health services package presented here assumes a "reasonable" level of quality of care, technical efficiency and approximates for mortality and disability rates, some may argue that it is impractical to consider the presented package. It has never been proposed that the presented costs and effectiveness of an essential health package be used for allocation's purposes. The variance in costs, disease profiles and intervention effectiveness between countries (or regions within a country) absolve the presented work of that task. By presenting various scenarios such as the low-income and middle-income ones as well as incorporating estimates of technical inefficiencies and effectiveness, it is hoped that a more realistic "average" policy

context picture, for which the essential health care package may evolve, is portrayed.

The methods currently available are far from perfect. Some of the most important technical problems that need attention are briefly described below. The list of interventions analyzed in the DCPDC study is not exhaustive, so it is necessary to undertake further studies. Two groups of interventions deserve special attention: those that are idiosyncratic to countries; for example, acupuncture in China, quarantine for AIDS patients in Cuba, symphysiotomy in some African countries, ambulatory surgery in Colombia and those that have been only recently designed for community-based delivery (such as delivery of phenobarbital for epilepsy, or chemotherapy for scabies or taeniasis).

Many of the estimates were obtained from studies undertaken in developed countries under controlled conditions, especially those targeted towards noncommunicable diseases. All the estimates however, are only approximations, since several conditions that are country specific, like wages, amount of inefficiently used infrastructure, availability of hard currency, incidence of the disease, available infrastructure and quality of care, alter the ultimate cost-effectiveness of a given intervention or program. Identifying the main factors that influence cost-effectiveness of

interventions would help policy makers make better use of the estimates currently available. The following list shows the main factors that need to be considered: availability of foreign exchange, prices of private goods and services, professional wages, subsidies for other public services, incidence and prevalence rates of diseases, desired coverage, size and density of the population, education of the population and cultural acceptability of the intervention.

Finally, and possibly most importantly the costs utilized in these calculations assumed a certain pre-existing infrastructure component which was not costed out. The reason for the not costing out of the pre-existing infrastructure component is that the portion of these costs which are currently utilized or could easily be converted to package interventions is impossible to calculate. Furthermore, these infrastructure costs are probably an over-estimate, due to health system inefficiencies such as inappropriate referrals or untimely and unproductive use of relatively expensive infrastructure.

One of the most important determinants of effectiveness and cost is the scale of the program. Point estimates of cost effectiveness can be misleading if they do not specify the scale of the intervention. What is required are functions of cost-

effectiveness that permit planners to make decisions as to what is the optimal scale of the particular intervention in question. This is a critical issue fcr community-based interventions, since they are likely to yield economies of scale up to a certain limit. Universal coverage however, may surpass that limit and produce diseconomies. On the other hand effectiveness can, in some situations, be negatively affected with large scale programs.

These limitations can only be overcome through an exercise that integrates the current information and methods in a real health system and permits planners to test the feasibility of the approach and assess the extent to which it assists in the process of allocating resources. Moreover, this exercise will facilitate the study of the missing estimates, namely, other interventions, the cost and effectiveness of packages of interventions and scale functions instead of point estimates. The next logical step in the use of quantitative methods for resource allocation in the health sector, is to apply them in different real settings, test their appropriateness, collect the missing information and make the necessary adaptations. Finally, only by testing the essential health package in a real health system will answers be found as to the political and economic feasibility of a package come to light. Indeed, issues such as existing budgetary limitations at both the

macro level, i.e. amount of government expenditures for health and at the micro level and how many registered nurses will be needed, are considerations which can only fully be incorporated at the local level.

References

Ahumada, J., et al. *Health Planning: Problems of Concept and Method, 2nd edition*. PAHO Scientific Publication No. 111. Pan American Health Organization, Washington, D.C., 1967.

K. Arrow. Uncertainty and the Welfare Economics of Medical Care. *American Economic Review*. 53: pps. 941-973. 1963.

N. Barr. Economic Theory and the Welfare State: A Survey and Interpretation". *Journal of Economic Literature*. 30: pps. 741-803. 1992.

Berkley, S., and D.T. Jamison. "Summary Report". Conference on the Health of School-Age Children, sponsored by the United Nations Development Program and the Rockefeller Foundation, Bellagio, Italy. 1991.

Bobadilla, J.L., Cowley, P., Musgrove, P. and H. Saxenian. "Design, Content and Financing of an Essential Package of Health Services". *Bulletin of the World Health Organization*. 72 (4): pps 653-662. 1994.

Bos, E., Vu, M.V., Levin, A., and R. Bulatao. *World Population Projections 1992-93 Edition: Estimates and Projections with Related Demographic Statistics*. Johns Hopkins University Press. Baltimore, Maryland. 1992.

L. Brenzel. *Selecting An Essential Package of Health Services Using Cost-Effectiveness Analysis: A Manual For Setting Priorities In Developing Countries*. Forthcoming for The World Bank.

L. Brenzel. "The Costs of EPI". John Snow Inc. Arlington, Virginia. 1990.

P. Cowley. "A Preliminary Cost Effectiveness Analysis of an AIDS Vaccine In Abidjan, Ivory Coast". *Health Policy*, (24): pps. 145-153. 1993.

Feachem, R., Kjellstrom, T., Murray, C., Over, M., and M. Phillips (eds.). *The Health of Adults in the Developing World*. Oxford University Press. New York. 1992.

Ghana Health Assessment Project Team. "Quantitative Methods of Assessing Health Impact of Different Diseases in Less Developed Countries." International Journal of Epidemiology, 10 (1): pps. 73-80.

Greenwood, A., Bradley, A., Byass, P., Greenwood, B., Snow, R., Bennett, S. and A. Hatib-n'Jie. "Evaluation of a Primary Health Care Program in The Gambia. I. The Impact of Trained Traditional Birth Care Attendants On The Outcome Of Pregnancy." *Journal Of Tropical Medicine and Hygiene*. (93): pps 58-66. 1990.

Jamison, D.T., Mosley, W.H., Measham, A.R., and J.L. Bobadilla (eds.). *Disease Control Priorities In Developing Countries*. Oxford University Press. New York. 1993.

M. King. "Personal Health Care: The Quest For a Human Right" *In Human Rights In Health*. Elsevier Publishing. Amsterdam. 1974.

M. Laga. Institute of Tropical Medicine (Antwerp, Belgium). Preliminary Data From Commercial Sex Workers In Ivory Coast Presented at Berlin AIDS Conference. 1993.

Management Sciences For Health, "The International Price Indicator Guide, 1991".
Management Sciences For Health. Boston, Mass. 1992.

Moses, S., Manji, F., Bradley, J., Nagelkerke, N.J.D., Malisa, M., and F. Plummer. "Impact of User Fees On Attendance At a Referral Centre For Sexually Transmitted Diseases In Kenya". *The Lancet*. (340): pps. 463-466. 1992.

Murray, J.L., DeJonghe, E., Chum, H.J., Nyangulu, D.S., Salomao, A., and K. Styblo. "Cost effectiveness of Chemotherapy for Pulmonary Tuberculosis in Three sub-Saharan African countries". *The Lancet*. (338): pps. 1305-1308. 1991.

C. Murray. "Quantifying the Burden of Disease: The Technical Basis for Disability Adjusted Life Years". *Bulletin Of The World Health Organization*. 72(3): pps. 429-445.

Murray, C. and A. Lopez. "Quantifying Disability: Data, Methods and Results". *Bulletin Of The World Health Organization*. 72(3): pps. 481-494.

Murray, C., Lopez, A., and D. Jamison. "Global Burden of Disease in 1990: Summary Results, Sensitivity Analysis and Future Directions". *Bulletin Of The World Health Organization*. 72(3): pps. 495-509.

M.V. Pauly. "Taxation, Health Insurance and Market Failure in the Medical Economy. *Journal of Economic Literature*. 24: pps. 629-675. 1986.

Shepard, D.S., and L. Sanoh. "Cost Effectiveness of the Expanded Program of Immunization in the Ivory Coast: A Preliminary Assessment". *Social Science and Medicine*, 22(3): pps. 369-377. 1986.

Stanecki, K.J., and P. Way. "Trends and Patterns of HIV/AIDS Infection In Selected Developing Countries". Country Profiles; Research Note: No. 10, Health Studies Branch, Center for International Research, U.S. Bureau of Census. 1993.

Tugwell, P., Bennet, K., Sackett, D., and R. Haynes. "The Measurement Iterative Loop: A Framework for the Critical Appraisal of Need, Benefits and Costs of Health Interventions". *Journal of Chronic Diseases*. 38(4): pps. 339-351. 1985.

United States Preventive Services Task Force. *Clinical Preventive Service Report*. Washington, D.C. 1992.

United States Public Health Service. *Guide to Clinical Preventive Services*. Washington, D.C. 1992.

J. van Roosmalen. "Perinatal Mortality In Rural Tanzania". *British Journal Of Obstetrics and Gynaceology*. (96): pps. 827-834. 1989.

Walsh, J. and K. Warren. "Selective Primary Health Care - An Interim Strategy For Disease Control In Developing Countries". *New England Journal of Medicine*. 301: pps. 967-974, 1979.

Wassherheit, J. and K.K. Holmes. "Reproductive Tract Infections." *In Reproductive Tract Infections: Global Impact and Priorities for Women's Reproductive Health*. New York. 1992.

WHO/CDD-ARI. Data on costs of "Sick Child" Initiative From Control of Diarrheal Disease and Acute Respiratory Infections Programs (unpublished). WHO. Geneva. 1993.

WHO/EPI. Data on Global Average Costs For Fully Immunized Child From Expanded Program of Immunization (unpublished). WHO. Geneva. 1991.

WHO/MB. *Mother-Baby Package: A road-map for implementation in countries*. Forthcoming from Division of Family Health. WHO. Geneva.

The World Bank. *The World Development Report 1993. Investing in Health*. Oxford University Press for The World Bank. New York. 1993.

The World Bank. Better Health In Africa. World Bank Report No. 12577-AFR. Washington, DC. 1993.

APPENDIX TABLES

Table 2 The ten main causes of disease burden in children in demographically developing economies

	Children under five				Children, 5-14 years old			
	Female		Male		Female		Male	
Total disability-adjusted life years lost (millions)	250		267		67		75	
Diseases and injuries /a	Rank	Percent	Rank	Percent	Rank	Percent	Rank	Percent
		100.0		100.0		100.0		100.0
Communicable and perinatal		*73.2*		*74.6*		*57.1*		*52.1*
Infectious and parasitic		*37.9*		*37.8*		*48.5*		*45.3*
Tuberculosis		0.5		0.5	5	5.7	5	4.1
STDs and HIV	9	1.7	8	2.2		0.1		0.0
Syphilis		0.8		0.8		0.0		0.0
Human immunodeficiency virus		0.4		0.5		0.3		0.2
Diarrheal diseases	3	16.0	3	15.4	4	7.1	4	6.1
Childhood cluster	4	10.6	4	10.5	2	8.6	2	8.1
Pertussis		1.8		1.9		1.6		1.4
Polio		0.3		0.4		2.0		2.5
Measles		5.6		5.4		4.1		3.4
Tetanus		2.9		2.8		0.8		0.7
Malaria	6	4.7	6	4.7	6	4.9	7	4.3
Intestinal helminths		0.0		0.0	1	12.3	1	11.4
Ascaris		0.0		0.0		7.6		7.1
Trichuris		0.0		0.0		4.6		4.2
Respiratory infections	1	18.3	2	17.3	3	7.9	3	6.9
Perinatal	2	17.0	1	19.5		0.0		0.0
Noncommunicable		*21.2*		*19.9*		*28.4*		*27.2*
Nutritional/endocrine		*6.5*		*6.1*		*3.7*		*2.4*
Protein-energy malnutrition	7	2.4	9	2.1		0.3		0.2
Iodine deficiency	10	1.3	10	1.2		0.2		0.2
Vitamin A deficiency	8	2.3	7	2.2		0.0		0.0
Anemias		0.3		0.3	8	0.3		1.9
Neuro-psychiatric		*1.1*		*1.0*		*7.5*		*9.1*
Epilepsy		0.2		0.3	9	2.6	8	3.5
Respiratory		*2.0*		*1.8*		*3.2*		*4.0*
Asthma		0.2		0.2	10	2.3		2.6
Congenital	5	*6.5*	5	*6.6*		*1.2*		*1.0*
Injuries		*5.7*		*5.5*		*14.5*		*20.7*
Unintentional		*4.6*		*4.6*		*12.6*		*18.1*
Motor vehicle injuries		0.4		0.4	7	3.7	6	4.4
Falls		1.2		1.0		1.9	10	3.1
Drowning		0.6		0.7		1.7	9	3.2
Intentional		*0.9*		*0.8*		*2.0*		*2.7*

/a The rankings refer to health interventions priorities; disease groups are ranked only when there is a single intervention or accepted cluster of interventions for controlling the diseases included in the group.

Diseases that can be substantially controlled with cost-effective intervention ; less than $100 per DALY saved.

Diseases that can be partially controlled with moderately cost-effective interventions; $250 to $999 per DALY saved; There are few or no interventions in the range of $100 to $250 per DALY saved.

Diseases that cannot be controlled in a cost-effective manner; over $1,000 per DALY saved.

Diseases for which preventive and therapeutic interventions have not been evaluated in terms of cost-effectiveness.

Table 3 The ten main causes of disease burden in the adult and elderly populations in demographically developing economies

	Young adults, (15–44 years old)				Mature adults, (45-59 years old)				Elderly, (60+ years old)			
	Female		Male		Female		Male		Female		Male	
Total disability-adjusted life years lost (millions)	151		153		49		65		60		63	
Diseases and injuries /a	Rank	Percent	Rank	Percent	Rank	Percent	Rank	Percent	Rank	Percent	Rank	Percent
		100.0		100.0		100.0		100.0		100.0		100.0
Communicable and maternal		*48.5*		*25.9*		*13.2*		*14.9*		*8.4*		*9.6*
Infectious and parasitic		*27.4*		*23.4*		*10.6*		*13.4*		*3.8*		*5.5*
Tuberculosis	3	7.2	1	8.6	2	5.6	1	9.3	8	1.9	5	4.0
Sexually transmitted diseases	2	9.1		1.5		0.3		0.2		0.0		0.0
Human immunodeficiency virus	5	3.9	3	6.4		0.3		0.5		0		0.1
Respiratory infections	9	2.6	8	2.5		2.0		1.5	5	4.6	6	4.0
Maternal	1	*18.5*				*0.5*				*0.0*		
Noncommunicable		*38.7*		*38.0*		*81.6*		*75.9*		*87.8*		*86.5*
Malignant neoplasms		*4.6*		*4.5*		*16.7*		*15.9*		*10.4*		*14.5*
Stomach		0.3		0.3		1.4	9	2.2		1.3	8	2.3
Trachea/bronchus/lung		0.1		0.2		0.9	10	2.0		0.8	9	2.3
Cervix		0.6			10	2.6				1.0		
Diabetes mellitus		0.5		0.5	8	2.8		1.6	7	2.4		1.5
Nutritional/endocrine		*3.7*		*3.7*		*2.4*		*1.4*		*1.4*		*0.9*
Anemia	8	2.6		1.5		1.3		0.9		0.7		0.5
Neuro-psychiatric		*12.2*		*12.5*		*6.9*		*8.5*		*6.7*		*7.1*
Depressive disorders	4	6.0	9	3.0		2.2		0.9		0.5		0.2
Psychoses		2.0	10	2.2		0.1		0.1		0.1		0.1
Alcohol dependence syndrome		0.1		0.1		2.2		1.7	4	4.8	4	4.1
Alzheimer's disease and other dementias	7	2.7		0.4	4	3.6		0.7	10	1.6		0.2
Sense organ		*0.2*		*0.2*		*4.6*		*3.0*		*2.1*		*2.0*
Cataracts		0.2		0.2	6	3.1	8	2.3	10	1.6		1.7
Cardiovascular		*6.1*		*6.7*		*25.2*		*23.8*		*44.2*		*39.2*
Ischemic heart disease		0.7		1.6	3	4.7	2	7.6	2	11.6	2	11.7
Cerebrovascular		1.6		1.6	1	8.7	3	6.7	1	16.5	1	13.8
Peri-, endo- and myocarditis		1.2		1.6	5	3.2	5	3.4	6	3.6	7	3.6
Respiratory		*2.4*		*2.4*		*5.4*		*4.5*		*10.5*		*11.7*
Chronic obstructive pulmonary		0.3		0.3	7	2.8	6	2.7	3	8.1	3	9.6
Digestive		*2.8*		*4.1*		*5.8*		*7.2*		*3.8*		*4.8*
Cirrhosis		0.8		2.0		2.4	4	4.2		1.2	10	2.1
Genito-urinary system		1.5		1.2		3.1		4.2		2.5		2.4
Benign prostatic hypertrophy				0			7	2.5				0.4
Musculo-Skeletal		*3.3*		*1.1*		*3.9*		*2.1*		*2.3*		*1.2*
Osteoarthritis	10	2.2		0.7	9	2.7		1.5		1.5		0.6
Injuries		*12.8*		*36.1*		*5.2*		*9.1*		*3.8*		*4.0*
Unintentional		*6.6*		*21.4*		*3.4*		*6.4*		*3.0*		*3.1*
Motor vehicle injuries	10	2.2	2	8.5		0.9		1.8		0.3		0.6
Falls		0.4	7	2.9		0.8		1.5	9	1.8		1.2
Intentional		*6.1*		*14.7*		*1.9*		*2.7*		*0.8*		*0.9*
Self-inflicted	6	3.3	6	4.1		1.1		1.3		0.5		0.6
Homicide and violence		1.0	4	6.3		0.3		1.0		0.1		0.2
War		1.8	5	4.3		0.4		0.5		0.1		0.1

/a The rankings refer to health interventions priorities; disease groups are ranked only when there is a single intervention or accepted cluster of interventions for controlling the diseases included in the group.

Diseases that can be substantially controlled with cost-effective interventions; less than $100 per DALY saved.

Diseases that can be partially controlled with moderately cost-effective interventions; $250 to $999 per DALY saved. There are few or no interventions in the range of $100 to $250 per DALY saved.

Diseases that cannot be controlled in a cost-effective manner; more than $1,000 per DALY saved.

Diseases for which preventive and therapeutic interventions have not been evaluated in terms of cost-effectiveness.

TABLE 5 VARIABLES FOR COST-EFFECTIVENESS CALCULATIONS IN LOW-INCOME COUNTRIES

COST VARIABLES

N	Number of Health Service Participants	Population	Population Served	VisitHP	Number of Post Visits/Participant
nHP	Number of Health Post Participants	CostHP	Cost per Health Post Visit	VisitCENT	Number of Center Visits/Participant
nCENT	Number of Health Center Participants	CostCENT	Cost per Health Center Visit	VisitHOSP	Number of Hospital Visits/Participant
nHOSP	Number of Hospital Participants	CostHOSP	Cost per Hospital Day	Efficency	Technical Efficency
Cost	Cost of Intervention(s)	Efficency*(nHP*(CostHP*VisitHP)+nCENT*(CostCENT*VisitCENT)+nHOSP*(CostHOSP*VisitHOSP))			
Part	Cost per Intervention Participant	Cost..(Health Service)/N..(Health Service)			
Capita	Cost per Capita of Intervention(s)	Cost..(Health Service)/Population			

Clinical Interventions		Intervention Cost	Public Health Interventions		Intervention Co
CostTB	Tuberculosis Treatment	$684,450	CostEPI	EPI Plus	$799,50(
CostSICK	"Sick Child" Cluster	$2,000,960	CostSH	School Health Program	$280,80(
CostANC	Prenatal and Delivery Care Cluster	$4,290,000	CostOTH	Other Public Health Program	$1,500,00(
CostSTD	STD Treatment	$257,400	CostTOB	Tobacco & Alcohol Control Program	$300,00(
CostFP	Family Planning	$429,203	CostAIDS	AIDS Prevention Program	$1,608,75(
CostLIM	Limited Care	$1,027,000			
CostCLIN	**Cost of Clinical Services**	**$8,689,013**	**CostPUB**	**Cost of Public Health Services**	**$4,489,05(**
CapitaCLIN	**Cost/Capita Of Clinical Services**	**$8.7**	**CapitaPUB**	**Cost/Capita of Public Health Services**	**$4.5**

EFFECTIVENESS VARIABLES

DiagAC	Health Service Diagnostic/Targeting Accuracy	DC	DALY Converter	Life Expectancy - Age of Death or Disability without Intervention
Efficacy	Health Service Efficacy			(Discounted at 3%, weighted for age values)
Effective	Health ServiceEffectiveness			
Ind	Incidence of Target Disease	Ext	Externality Factor	1 + (Secondary DALYs/Primary (Patient) DALYs)
MR	Mortality or Case Fatality Rate			
PropDISAB	Proportion of Cases With Disability	Burd	1 Year DALY Loss	(N*MR)+(N*PropDisab*WeightDISAB)
WeightDISAB	Disability Weight			
		HSI	Health Service Impact	DiagAC * Efficacy * Effective
DALY	Total DALYs Gained per Health Service(s)			Burd * HSI

Clinical Services		DALYS Gained	Public Health Services		DALYS Gaine
DALYTB	Tuberculosis Treatment	36,482	DALYEPI	EPI Plus	31,92
DALYSICK	"Sick Child" Cluster	51,610	DALYSH	School Health	8,90
DALYANC	Prenatal and Delivery Care Cluster	74,100	DALYPH	Other Public Health	N/
DALYSTD	STD Treatment	41,234	DALYTOB	Tobacco & Alcohol Control	1,80(
DALYFP	Family Planning	8,421	DALYAIDS	AIDS Prevention	54,94
DALYLIM	Limited Care	1,570			
DALYCLIN	**DALYS Gained From Clinical Services**	**213,416**	**DALYPUB**	**DALYS Gained From Public Health Services**	**97,58**

COST-EFFECTIVENESS VARIABLES

Cost-Eff	Cost/DALY Gained per Health Service(s)	Cost/Daly			
Clinical Interventions		Cost/DALY Gained	Public Health Interventions		Cost/DALY Gaine
Cost-EffectTB	Tuberculosis Treatment	$19	Cost-EffEPI	EPI Plus	$2
Cost-EffSICK	"Sick Child" Cluster	$39	Cost-EffSH	School Health	$3
Cost-EffANC	Prenatal and Delivery Care Cluster	$58	Cost-EffOTH	Other Public Health	N/
Cost-EffSTD	STD Treatment	$6	Cost-EffTOB	Tobacco & Alcohol Control	$16
Cost-EffFP	Family Planning	$51	Cost-EffAIDS	AIDS Prevention	$2
Cost-EffLIM	Limited Care	$654			
Cost-EffCLIN	**Cost/DALY Gained From Clinic Services**	**$41**	**Cost-EffPUB**	**Cost/DALY Gained From Public Health Services**	**$4**

TOTAL RESULTS

CostTOTAL	**Cost of All Health Services In Package**	**$13,178,063**	**DalyTOTAL**	**Total DALYS From Package**	**310,99**
CapitaTOTAL	**Cost/Capita Of Package**	**$13**	**Cost-EffTOTAL**	**Average Cost/DALY Of Package**	**$4**

TABLE 6 INPUTS FOR COST-EFFECTIVENESS CALCULATIONS IN LOW-INCOME COUNTRIES

POPULATION: 1,000,000

	CLINICAL BASED						*PUBLIC HEALTH BASED*				
	Tuberculosis	Sick Child	Prenatal & Delivery	STD Treatment	Family Planning	Limited Care	EPI Plus	School Health	Other Public Hlth	Tobacco/ Alcohol	AIDS Prevention
N	1,170	160,000	50,000	16,500	27,000	100,000	41,000	72,000	600,000	1,000,000	13,750
nHP	0	80,000	50,000	0	18,090	0	41,000	72,000	0	0	13,750
nCENT	1,170	80,000	5,000	16,500	8,910	100,000	0	0	0	0	0
nHOSP	1,170	27,200	5,000	0	0	3,000	0	0	0	0	0
CostHP	$0	$3	$6	$0	$5	$0	$3	$3	$0	$0	$15
CostCENT	$10	$4	$12	$8	$10	$4	$0	$0	$0	$0	$0
CostHOSP	$6	$12	$60	$0	$0	$30	$0	$0	$0	$0	$0
VisitHP	0	1	5	0	3	0	5	1	0	0	6
VisitCENT	9	1	5	1.5	0.66	1.3	0	0	0	0	0
VisitHOSP	60	3	5	0	0	3	0	0	0	0	0
Efficency	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Cost	$684,450	$2,000,960	$4,290,000	$257,400	$429,203	$1,027,000	$799,500	$280,800	$1,500,000	$300,000	$1,608,750
Part	$585.0	$12.5	$85.8	$15.6	$15.9	$10.3	$19.5	$3.9	$2.4	$0.3	$117.0
Capita	$0.7	$2.0	$4.3	$0.3	$0.4	$1.0	$0.8	$0.3	$1.5	$0.3	$1.6
MR	0.70000	0.04000	0.06000	0.01000	0.01350	0.01200	0.01980	0.00050	N/A	0.00300	0.07000
PropDISAB	0	0	0.05	0.075	0	0.01	0.01	0.05	N/A	0	0.06
WeightDISAB	0	0	0.1	0.2	0	0.1	0.5	0.1	N/A	0	0.2
DC	29	32	32	30	32	23	34	37	N/A	2	18
Ext	3.0	1.0	2.0	8.0	2.0	1.0	1.2	1.0	N/A	2.0	5.0
Burd	71,253	204,800	208,000	99,000	11,664	29,900	41,485	14,652	N/A	12,000	101,475
DiagAC	0.80	0.60	0.95	0.70	0.95	0.75	0.95	0.95	N/A	1.00	0.95
Efficacy	0.80	0.70	0.50	0.70	0.95	0.10	0.90	0.80	N/A	0.20	0.95
Effective	0.80	0.60	0.75	0.85	0.80	0.70	0.90	0.80	N/A	0.75	0.60
HSI	0.51	0.25	0.36	0.42	0.72	0.05	0.77	0.61	N/A	0.15	0.54
DALY	36,482	51,610	74,100	41,234	8,421	1,570	31,923	8,908	N/A	1,800	54,949
Cost-Eff	$19	$39	$58	$6	$51	$654	$25	$32	N/A	$167	$29

TABLE 7 VARIABLES FOR COST-EFFECTIVENESS CALCULATIONS IN MIDDLE-INCOME COUNTRIES

COST VARIABLES

N	Number of Intervention Participants	Population	Population Served	VisitHP	Number of Post Visits/Participant
nHP	Number of Health Outpost Participants	CostHP	Cost per Health Outpost Visit	VisitCENT	Number of Center Visits/Participant
nCENT	Number of Health Center Participants	CostCENT	Cost per Health Center Visit	VisitHOSP	Number of Hospital Visits/Participant
nHOSP	Number of Hospital Participants	CostHOSP	Cost per Hospital Day	Efficency	Technical Efficency
Cost	Cost of Health Service(s)	Efficency*(nHP*(CostHP*VisitHP)+nCENT*(CostCENT*VisitCENT)+nHOSP*(CostHOSP*VisitHOSP))			
Part	Cost per Health Service Participant	Cost..(Health Service)/N..(Health Service)			
Capita	Cost per Capita of Health Service(s)	Cost..(Health Service)/Population			

Clinical Services		Intervention Cost	Public Health Services		Intervention Cost
CostTB	Tuberculosis Treatment	$199,584	CostEPI	EPI Plus	$930,000
CostSICK	"Sick Child" Cluster	$1,062,000	CostSH	School Health	$207,000
CostANC	Prenatal and Delivery Care Cluster	$6,355,800	CostOTH	Other Public Health	$2,000,000
CostSTD	STD Treatment	$187,920	CostTOB	Tobacco & Alcohol Control	$750,000
CostFP	Family Planning	$1,631,880	CostAIDS	AIDS Prevention	$2,401,200
CostLIM	Limited Care	$3,165,000			
CostCLIN	**Cost of Clinical Services**	**$12,602,184**	**CostPUB**	**Cost of Public Health Services**	**$6,288,200**
CapitaCLIN	**Cost/Capita Of Clinical Services**	**$12.6**	**CapitaPUB**	**Cost/Capita of Public Health Services**	**$6.3**

EFFECTIVENESS VARIABLES

DiagAC	Health Service Diagnostic/Targeting Accuracy	DC	DALY Converter	Life Expectancy - Age of Death or Disability without Intervention
Efficacy	Health Service Efficacy			(Discounted at 3%, weighted for age values)
Effective	Health ServiceEffectiveness			
Ind	Incidence of Target Disease	Ext	Externality Factor	1 + (Secondary DALYs/Primary (Patient) DALYs)
MR	Mortality or Case Fatality Rate			
PropDISAB	Proportion of Cases With Disability	Burd	DALY Loss	(N*MR)+(N*PropDisab*WeightDISAB)*DC*Ext
WeightDISAB	Disability Weight			
		HSI	Health Service Impact	DiagAC * Efficacy * Effective
DALY	Total DALYs Gained per Health Service(s)	Burd * HSI		

Clinical Services		DALYS Gained	Public Health Services		DALYs Gained
DALYTB	Tuberculosis Treatment	4,811	DALYEPI	EPI Plus	10,584
DALYSICK	"Sick Child" Cluster	4,838	DALYSH	School Health	4,036
DALYMB	Prenatal and Delivery Care Cluster	10,327	DALYPH	Other Public Health	N/A
DALYSTD	STD Treatment	2,935	DALYTOB	Tobacco & Alcohol Control	11,025
DALYFP	Family Planning	4,960	DALYAIDS	AIDS Prevention	34,033
DALYLIM	Limited Care	2,717			
DALYCLIN	**DALYS Gained From Clinical Services**	**30,587**	**DALYPUB**	**DALYS Gained From Public Health Services**	**59,678**

COST-EFFECTIVENESS VARIABLES

Cost-Eff	Cost/DALY Gained per Health Service(s)	Cost/Daly			
Clinical Services		Cost/DALY Gained	Public Health Services		Cost/DALY Gained
Cost-EffectTB	Tuberculosis Treatment	$41	Cost-EffEPI	EPI Plus	$88
Cost-EffSICK	"Sick Child" Cluster	$219	Cost-EffSH	School Health	$51
Cost-EffANC	Prenatal and Delivery Care Cluster	$615	Cost-EffOTH	Other Public Health	N/A
Cost-EffSTD	STD Treatment	$64	Cost-EffTOB	Tobacco & Alcohol Control	$68
Cost-EffFP	Family Planning	$329	Cost-EffAIDS	AIDS Prevention	$71
Cost-EffLIM	Limited Care	$1,165			
Cost-EffCLIN	**Cost/DALY Gained From Clinic Services**	**$412**	**Cost-EffPUB**	**Cost/DALY Gained Public Health Services**	**$105**

TOTAL RESULTS

CostTOTAL	**Cost of All Health Services In Package**	**$18,890,384**	**DalyTOTAL**	**Total DALYS From Package**	**90,265**
CapitaTOTAL	**Cost/Capita Of Package**	**$19**	**Cost-EffTOTAL**	**Average Cost/DALY Of Package**	**$209**

TABLE 8 INPUTS FOR COST-EFFECTIVENESS CALCULATIONS IN MIDDLE-INCOME COUNTRIES

POPULATION: 1,000,000

	CLINICAL BASED						PUBLIC HEALTH BASED				
	Tuberculosis	Sick Child	Prenatal & Delivery	STD Treatment	Family Planning	Limited Care	EPI Plus	School Health	Other Public Hlth	Tobacco/ Alcohol	AIDS Prevention
N	540	60,000	33,000	8,700	92,000	125,000	31,000	34,500	600,000	1,000,000	14,500
nHP	0	30,000	33,000	0	36,000	0	31,000	34,500	600,000	0	14,500
nCENT	540	30,000	4,125	8,700	18,000	125,000	0	0	0	0	0
nHOSP	540	6,200	24,750	0	18,000	10,000	0	0	0	0	0
CostHP	$0	$5	$9	$0	$9	$0	$5	$5	$0	$0	$23
CostCENT	$22	$7	$20	$12	$35	$7	$0	$0	$0	$0	$0
CostHOS	$0	$25	$90	$0	$100	$50	$0	$0	$0	$0	$0
VisitHP	0	0	2	0	3	0	5	1	0	0	6
VisitCENT	14	2	3	1.5	0.33	1.3	0	0	0	0	0
VisitHOS	0	3	2	0	0.1	3	0	0	0	0	0
Efficency	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Cost	$199,584	$1,062,000	$6,355,800	$187,920	$1,631,880	$3,165,000	$930,000	$207,000	$2,000,000	$750,000	$2,401,200
Part	$369.6	$17.7	$192.6	$21.6	$17.7	$25.3	$30.0	$6.0	$3.3	$0.8	$165.6
Capita	$0.2	$1.1	$6.4	$0.2	$1.6	$3.2	$0.9	$0.2	$2.0	$0.8	$2.4
MR	0.30000	0.01000	0.03000	0.00000	0.00350	0.00800	0.00088	0.00020	N/A	0.00490	0.00004
PropDISAB	0	0	0.01	0.075	0	0.01	0.05	0.05	N/A	0	0.06
WeightDISAB	0	0	0.05	0.2	0	0.1	0.2	0.1	N/A	0	0.2
DC	29	32	32	30	32	23	34	37	N/A	5	18
Ext	2.0	1.0	1.5	1.8	2.0	1.0	1.2	1.0	N/A	3.0	20.0
Burd	9,396	19,200	48,312	7,047	6,869	25,875	13,755	6,638	N/A	73,500	62,849
DiagAC	0.80	0.60	0.95	0.70	0.95	0.75	0.95	0.95	N/A	1.00	0.95
Efficacy	0.80	0.70	0.30	0.70	0.95	0.20	0.90	0.80	N/A	0.20	0.95
Effective	0.80	0.60	0.75	0.85	0.80	0.70	0.90	0.80	N/A	0.75	0.60
HSI	0.51	0.25	0.21	0.42	0.72	0.11	0.77	0.61	N/A	0.15	0.54
DALY	4,811	4,838	10,327	2,935	4,960	2,717	10,584	4,036	N/A	11,025	34,033
Cost-Eff	$41	$219	$615	$64	$329	$1,165	$88	351	N/A	$68	$71