

Disease burden in India

Estimations and causal analysis*

Disease burden estimations based on sound epidemiological research provide the foundation for public policy. Which diseases and what interventions does public policy need to focus upon are normally derived from such evidence. Well researched, longitudinal data can enable judicious targeting and help decide what needs to be done where, for whom, and when. Conversely, the absence of such good quality empirical data can affect programme designing and consequently outcomes. India has ample evidence of such impacts, often due to the mismatch between disease burden and its causal factors, and the interventions adopted and priorities in resource allocation.

Besides the need to avert disease for enhancing the quality of life, neglect can have adverse consequences on the well-being of affected families—social, psychological as well as economic. Diseases that are heavily concentrated among working age adults or the poor, as is the case with HIV/AIDS, cardiovascular disease (CVD), tuberculosis (TB), etc., can have a ruinous impact as such diseases are extremely expensive to treat, especially due to lack of insurance mechanisms. For example, in the case of HIV/AIDS, the out-of-pocket expenditure on treatment and services was reportedly Rs 6000 per HIV-positive person over a six-month reference period, while for clients on antiretroviral treatment (ART), the expenditures were markedly higher, nearly Rs 18,150 per person over a six-month period. Roughly 40%–70% of these expenditures are financed by borrowing. The devastating impact of TB, asthma, chronic obstructive pulmonary disease (COPD), heart diseases, etc. on individual household is similar, with children having to discontinue schooling and/or take up employment to provide an additional source of income. Analysis of data from the 1995–96 survey round of the National Sample Survey (NSS) undertaken by the National Commission on Macroeconomics and Health (NCMH) suggests that the out-of-pocket expenditure by individuals hospitalized on account of heart disease was roughly Rs 11,000 per person, or 120% of the average

annual per capita expenditure of the households they belonged to. Likewise, roughly Rs 32,000 is the annual cost of treatment for acute cases of COPD that involve hospitalization. Therefore, it is clear that the onset of disease needs to be averted and when it occurs it should be treated quickly. For policies to ensure this, it is necessary that we have an evidence-based understanding of the extent of disease burden, the population groups that are the most vulnerable, and what interventions are needed to avert premature death or needless suffering.

With the above objectives in mind, the NCMH undertook an exercise to (i) identify major health conditions in terms of their contribution to India's disease burden; (ii) estimate the incidence and prevalence levels of the diseases/conditions at present and in 2015; (iii) list the causal factors underlying the spread of the diseases/conditions; (iv) suggest, based on the available evidence, the most cost-effective and low-cost solutions/strategies, both preventive and curative, for reducing the disease burden, particularly among the poor; and (v) indicate what interventions should be provided where and by whom. For assisting us in this onerous task, the help of leading experts was taken.

The experts identified 17 priority health conditions (Table 1) which they felt to be significant public health problems, affecting all segments of the population. Identification of these conditions was based on three criteria: first, the likelihood of the burden of a specific health condition falling on the poor, such as infectious and vector-borne conditions, TB and many maternal and child health conditions; second, in the absence of interventions, the probability of a listed health condition continuing to impose a serious health burden on the Indian population in the future, say by 2015, such as cancers, cardiovascular conditions and diabetes, or new infections such as HIV/AIDS; and third, the possibility of a health condition driving a sufficiently large number of people into financial hardship, including their falling below the poverty line.

*This overview is based on a paper entitled 'Choosing Investments in Health' prepared by Dr Ajay Mahal, Assistant Professor, Harvard School of Public Health, USA, for the National Commission on Macroeconomics and Health.

Table 1. Health conditions and disability-adjusted life-years (DALYs) lost in India, 1998

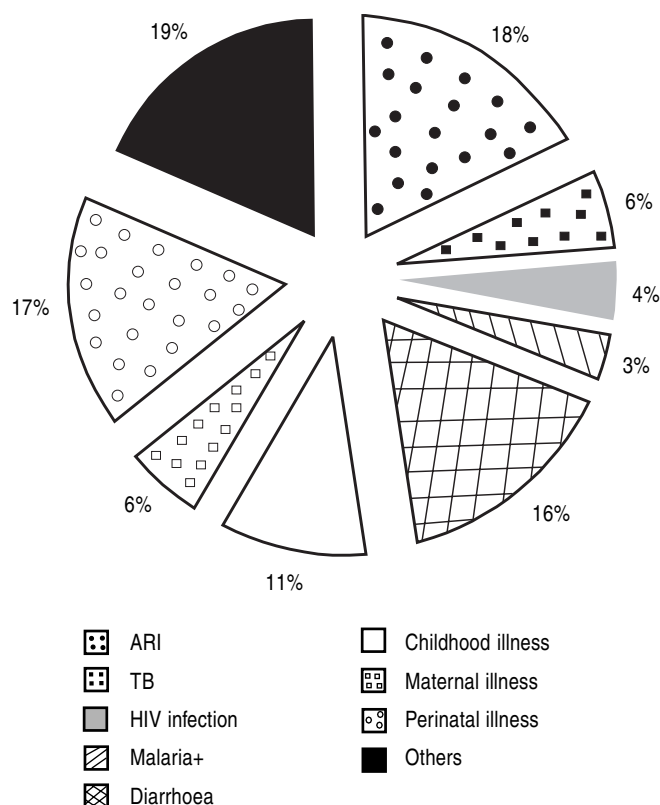
Disease/health condition	DALYs lost (x 1000)	Share in the total burden of disease (%)
<i>Communicable diseases, maternal and perinatal conditions</i>		
Tuberculosis	7,577	2.8
HIV/AIDS	5,611	2.1
Diarrhoeal diseases	22,005	8.2
Malaria and other vector-borne conditions	4,200	1.6
Leprosy	208	0.1
Childhood diseases	14,463	5.4
Otitis media	475	0.1
Maternal and perinatal conditions	31,207	11.6
Others	49,517	18.4
<i>Non-communicable conditions</i>		
Cancers	8,992	3.4
Diabetes	1,981	0.7
Mental illness	22,944	8.5
Blindness	3,699	1.4
Cardiovascular diseases	26,932	10.0
COPD and asthma	4,061	1.5
Oral diseases	1,247	0.5
Others	18,801	7.0
<i>Injuries</i>	45,032	16.7
<i>All listed conditions</i>	200,634	74.6
<i>Others</i>	68,319	25.4

COPD: chronic obstructive pulmonary disease

Source: Peters *et al.* 2001

Baseline estimates and projections of priority health conditions

Exhaustive review of the available literature brought forth two factors of critical importance to public policy: (a) for almost all diseases/conditions identified, and more particularly the National Health Programmes in which government investment was substantial, namely, malaria and other vector-borne diseases, TB, leprosy, reproductive health and childhood conditions, there is a paucity of high-quality epidemiological information and validated data for arriving at any baseline estimations on prevalence or incidence. In the absence of operational research there was also weak evidence regarding the type of interventions that would be most cost-effective in the different settings in the country; and (b) a literature review threw up evidence of a large number of diseases which were considered to be lifestyle-related and affecting the rich were seen to be affecting the poor as well, and increasingly so. The non-availability of good quality data has been a major handicap in arriving at reliable estimations of the disease burden, affecting our ability to formulate appropriate policies and provide adequate budgets.

**Fig. 1** Priority communicable maternal and child health conditions in India, by share in the burden of disease, 1998

ARI: acute respiratory infection; TB: tuberculosis; HIV: human immunodeficiency virus

Source: Peters *et al.* 2001

Category I: Communicable diseases, maternal and child health conditions

Category I health conditions include HIV, TB, malaria, diarrhoea, acute respiratory infections, maternal and perinatal conditions (Fig. 1). These accounted for nearly half of India's disease burden in 1998. It is expected that the burden on account of most of these pre-transition diseases, and deaths on account of malaria, TB, diarrhoea and other infectious diseases will reduce and leprosy be eliminated. However, HIV/AIDS and opportunistic infections such as TB and drug-resistant malaria are likely to increase. It is estimated that currently there are 51 lakh adults with HIV (adults being defined as the age group of 15–49 years for this purpose), a little less than 1% of the total population in this age group (Kumar *et al.*, unpublished). A conservative set of projections suggests that an estimated 3% of people in the age group of 15–49 years, i.e. about 5 crore people, are likely to be HIV-positive by the year 2025; and around 1.5–1.8 crore by 2015 (Kumar *et al.*, unpublished). These huge numbers of people with HIV at any given point in time do not, of course, include people who may have previously died of AIDS-related causes, and thus only a partial picture is available of the

cumulative future disease burden from HIV/AIDS. Due to lack of data and information, projection of the incidence of TB on account of a rising number of HIV/AIDS cases has not been possible.

Nearly 40% of the Indian population of all ages has *Mycobacterium tuberculosis* infection; and there are about 85 lakh people with TB at any given time. With more than 400,000 dying each year (Yajnik *et al.* 2002; Tuberculosis Research Centre [TRC] 2004), TB is the single most important cause of death in India at present (Yajnik *et al.* 2002).

Maternal, perinatal and childhood conditions account for another significant percentage of the disease burden, of particular importance for the poor. Although no direct estimates of the prevalence/incidence of these health conditions are available, we can indirectly assess their importance by looking at the neonatal, infant, under-5 and maternal mortality rates, which continue to be unacceptably high. While IMR was estimated to be about 66 per 1000 live-births, the under-5 mortality rate was estimated at 95 per 1000 live-births in 1998–99 as per the National Family Health Survey. The maternal mortality ratio (MMR) was estimated at 440 per 100,000 live-births in 1992–96. While no projections are available for MMR, a simplistic set of projections assume that rates of decline in the infant and under-5 mortality would be 46 and 62, respectively by the year 2015, lesser than the goals laid down under the Millennium Declaration. These forecasts are, however, not reliable as these ignore trends in and interplay with factors that underlie changes in the rates of infant, under-5 and maternal mortality (Deolalikar, forthcoming).

Malaria, dengue and other vector-borne conditions were estimated to account for 1.6% of India's total disease burden (WHO 1998). Unfortunately, these estimations lack credibility as reliable population-based data on these conditions do not exist in India. With most information 'reported' by officials, there are strong reasons to suspect underreporting and incomplete reporting of data. Underreporting occurs when a large number of patients visit private health care providers who are under no obligation to report cases to the public health authorities, and when record-keeping and case-finding are done by poorly monitored employees who may receive incentives for underreporting to demonstrate the success of a programme. Household survey methods are also not very useful to fill any gaps in this regard since many of these diseases, especially malaria, are likely to get recorded as 'unspecified fevers'.

Category II: Non-communicable conditions

This category of health conditions accounts for the second-largest share, after communicable health conditions, of the disease burden in India and includes cancers, CVD, diabetes, respiratory conditions such as asthma and COPD, and mental health disorders (Fig. 2). Available data suggest that these conditions will account for a fairly sharp increase in India's disease burden in the future.

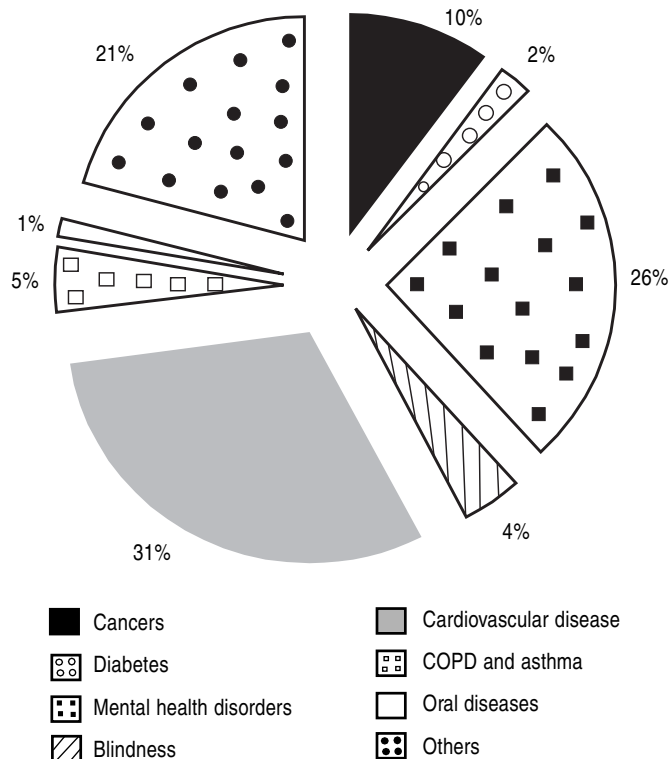


Fig. 2 Priority non-communicable health conditions in India, by share in the burden of disease, 1998

COPD: chronic obstructive pulmonary disease

Source: Peters *et al.* 2001

Cardiovascular disease

According to recent estimates, cases of CVD may increase from about 2.9 crore in 2000 to as many as 6.4 crore in 2015, and the number of deaths from CVD will also more than double. Most of this increase will occur on account of coronary heart disease—a mix of conditions that includes acute myocardial infarction, angina pectoris, congestive heart failure and inflammatory heart disease, although these are not necessarily mutually exclusive terms. Data also suggest that although the prevalence rates of CVD in rural populations will remain lower than that of urban populations, they will continue to increase, reaching around 13.5% of the rural population in the age group of 60–69 years by 2015. The prevalence rates among younger adults (age group of 40 years and above) are also likely to increase; and the prevalence rates among women will keep pace with those of men across all age groups.

Diabetes

Diabetes is also associated with an increased risk for CVD, and is emerging as a serious health challenge in India. Even though it accounted for only about 0.7% of India's disease burden in 1998, data suggest a significant load of diabetes cases in India—rising from 2.6 crore in 2000 to approximately 4.6 crore by 2015, and particularly concentrated in the urban population. The data also reveal that

the prevalence of diabetes is significant even among the 30–39 years' age group (6%), rising sharply to 13% in the 40–49 years' age group, and to nearly one-fifth of the population of those 70 years and above. Moreover, its prevalence among women above the age of 40 years is high.

Cancers

Cancers are a third area of concern. They refer to a group of diseases associated with uncontrolled cell growth that can affect normal body functions, often with fatal outcomes. Worldwide, cancers account for about 5.1% of the disease burden and 12.5% of all deaths. In India, cancers account for about 3.3% of the disease burden and about 9% of all deaths. These estimates will, however, change as many of the common risk factors for cancers, such as tobacco and alcohol consumption, continue to become more prevalent in India. Fairly conservative assumptions show that the number of people living with cancers will rise by nearly one-quarter from 2001 to 2016. Nearly 10 lakh new cases of cancer will be diagnosed in 2016, compared to about 800,000 in 2001. The incidence of cancers common to both men and women will also see a sharp increase during this period; nearly 670,000 people are expected to die of cancer in India in 2016.

Mental health disorders

Mental health was a much neglected field until recently. There is, however, increasing realization that conditions such as schizophrenia, mood disorders (bipolar, manic, depressive and persistent mood disorders) and mental retardation can impose a marked disease burden on Indians. This was confirmed by a study conducted for the NCMH which stated that at least 6.5% of the Indian population had some form of serious mental disorder, with no discernible rural–urban differences; women had slightly higher rates of mental disorder than men. If one were to include some other 'common' mental disorders and alcohol and drug dependency, the estimates would be substantially higher. With the increasing size of the population, these numbers are expected to grow substantially by 2015; the population with serious disorders is expected to grow to more than 8 crore in that year, and even higher if the category of 'common mental disorders' in the population was included in the projections.

Asthma and COPD

Estimates and projections for COPD and asthma show an equally alarming picture. COPD refers to a group of disorders that are persistent and largely irreversible, such as chronic bronchitis and emphysema. It is associated with an abnormal inflammatory response of the lungs to noxious particles or gases, especially tobacco smoke and air pollution—both indoor and outdoor. Asthma is a chronic disease of the airways, characterized by sudden attacks of laboured

breathing, chest constriction and coughing. Although asthma can occur at all ages, in about half of the cases it occurs before the age of 10 years. It is estimated that there are around 1.49 crore chronic cases of COPD in India in the age group of 30 years and above, and these are projected to increase by nearly 50% by the year 2016, including 'severe' cases, some of whom may require greater levels of care, including hospitalization. It is also estimated that there were roughly 2.5 crore cases of asthma in 2001 which may increase by nearly 50% by 2016.

Blindness

Data on the current prevalence and future projections for blindness show that the number of blindness cases is expected to remain more or less the same during the next two decades. The projection, however, is based on extremely optimistic projections on cataract treatment that may not be realized.

Oral and dental diseases

Available data on the current prevalence and future projections for oral health conditions suggest an increase by 25% over the next decade.

These data, together with other evidence presented previously on non-communicable diseases, suggest a major future health policy challenge for India. With the continuing burden of communicable conditions, India is in the classic bind of facing a 'dual' burden of disease.

Category III: Accidents and injuries

The third category of health conditions has a significant impact on the overall disease burden. It is estimated that around 9% of the global mortality and 12% of the global disease burden is due to injuries, intentional or unintentional (WHO 2004). Unintentional injuries include road traffic injuries, poisoning, drowning, falls, etc.; whereas intentional injuries include suicide, homicide and war-related violence. Analysis suggests that the share of injuries and accidents in India's disease burden may be even greater, at about 16.7%.

It is estimated that the number of deaths from accidents and injuries in 2005 would range from 730,000 to 985,000, with projections that deaths from injuries will increase by as much as 25% over the next decade. The injury mortality estimates for the year 2000 suggest that about 9% of all deaths in India were accounted for by injuries, a share similar to the global share of deaths due to injuries (WHO 2004). These estimates do not include the health impact of injuries with non-fatal outcomes (including permanent disability), which tend to be heavily underreported in India and could well be in the region of about 5 crore cases per year. Available evidence from India also shows that much of the mortality from injuries due to road traffic accidents, occupational accidents and suicide is concentrated among

adults in their peak work ages, i.e. 15–44 years, and among children.

Identifying cost-effective interventions

A summary of causal analyses of different diseases/health conditions carried out by experts engaged by the NCMH is given in Annexure A. In most cases, disease occurrence and progression can be avoided or significantly reduced/contained *if access to right information and/or early treatment is assured*.

In countries such as India where there are limited resources and competing demands, not all conditions can be treated and not every intervention provided at public expense. At some point prioritization of interventions or population groups that need to be supported with public funding becomes inevitable. The issue then arises as to the criteria that ought to be used for identifying such publicly supported interventions. There could be two:

- those that are technically effective in substantially ameliorating a major health problem; and
- those that are financially inexpensive (i.e. cost-effective) relative to the outcome gains achieved.

The first ensures that the intervention markedly reduces the burden of disease, and does not simply result in a token improvement in the health status. The second ensures that the intervention is good value for money. Thus, policy-makers can focus on several extremely cost-beneficial and cost-effective interventions that simultaneously yield large gains in outcomes for several major health conditions.

While the probability of death beyond a certain age, say 70 years, tends to be high and is not very dissimilar across developed and developing nations, the largest gains in mortality reduction are likely to be achieved at younger ages. Jha and Nguyen (2001) show that whereas 18% of all Indians can expect to die before the age of 40 years, only 2% of residents of the UK expect to do so. A less marked difference exists in 'middle age', with 51% of all Indians expecting to die before the age of 70 years compared to 23% for residents of the UK. An understanding of why these differences exist at younger ages offers the possibility of identifying cost-effective interventions, particularly among children and younger adults.

In the case of childhood diseases, India presents wide regional disparities—while in Kerala, the IMR is 14 per 1000 live-births, it is 96 in Orissa and 5 more States have an IMR of more than 75 (Deolalikar, forthcoming). Given Bangladesh's rapid advances in recent years, large reductions in the IMR appear feasible even within resource-poor settings as in India. If India could achieve an IMR of about 26 per 1000 live-births as implied by the MDGs (double the rate achieved by Kerala), it could enable India to avoid nearly 10 lakh infant deaths per year, with huge reductions in the overall disease burden.

Achieving such declines requires looking at a range of key interventions that address the major causal factors—tetanus injections during pregnancy, professional attendance with appropriate access to referrals during childbirth, improvement in the mother's nutrition to avoid low birth weight infants, etc. Similarly, malnutrition makes a child susceptible to diarrhoeal diseases and respiratory infections which, when untreated, can be fatal. Beyond the phase of infancy, immunization becomes critical in warding off potentially fatal conditions. The enormous cross-state variations in immunization rates and the low rates of immunization in several States suggest great potential for reducing the mortality from vaccine-preventable conditions.

Apart from these medical and nutritional interventions, there are other non-health interventions that also need to be considered in policy design, such as reducing discriminatory practices towards the girl child, enhanced schooling of females, better roads, access to clean drinking water, electricity and other infrastructure, as these are known to have a beneficial impact on the IMR, widening access to timely care, etc.

Overall, the potential gains from these interventions can be massive. According to NCMH estimates, a reduction in childhood mortality may raise the life expectancy at birth of an Indian by as much as 3.1 years, and India's Gross Domestic Product (GDP) from 4% to 12%.

Similarly, with the likelihood of 18% of all Indians dying before the age of 40 years (Jha and Nguyen 2001; Deolalikar, forthcoming), about 8.5% of a cohort born in any given year can expect to die between the ages of 5 and 40, in contrast to the UK's 1.5% (Jha and Nguyen 2001; World Bank 2004).

Several factors contribute to this difference. First, the MMR in India is substantial. The mortality from HIV/AIDS and associated infections such as TB, injuries, especially road traffic accidents, and cancers is high and expected to increase given risky heterosexual activity and the factors that promote it—mobile populations, rising incomes and income inequality, the low status of women and the presence of high-risk vulnerable groups; current tobacco consumption patterns among young adults; and increase in traffic and lax enforcement of traffic regulations, etc.

To address the above conditions a combination of interventions will be needed. Most can be effectively countered by implementing a range of low-cost solutions; for example, peer education, access to condoms, a climate of destigmatization, use of antiretroviral drugs to reduce the risk of mother-to-child transmission of HIV infection, and treatment of sexually transmitted diseases (STDs) appear to be extremely cost-effective options for tackling HIV/AIDS. Vaccination against TB infection, effective identification of smear-positive cases of TB before they can infect others, and strict implementation of an appropriately designed Directly Observed Treatment, Short-course (DOTS) are effective methods for reducing the mortality rate from smear-positive TB as well as the rates of transmission.

According to the Commission on Macroeconomics and Health (CMH) estimates, properly administered DOTS can reduce case-fatality rates resulting from smear-positive TB from 60%–70% to 5%. Rough calculations undertaken by the NCMH suggest that a reduction in mortality due to TB in India by one-half would raise the life expectancy of an Indian by 0.12 years and India's overall GDP by as much as 0.5%.

Huge gains in mortality reduction among young adults are likely by reducing smoking and tobacco use. Analysis of the National Sample Survey data by the NCMH showed that nearly 40% of Indian males smoke. Tobacco consumption and smoking have been linked to lung and oral cancers, and TB. Shah (unpublished) suggests that India's current patterns of tobacco use and smoking is likely to sharply increase the incidence of oral cancer in the future. Cost-effective interventions to address smoking include: ending advertising for cigarettes, *beedis* and other tobacco products, enhanced taxes on cigarette sales and production, and dissemination of health messages. The NCMH estimates that a 50% reduction in mortality rates due to CVD can raise the life expectancy at birth of an average Indian by 1.3 years and India's GDP by 2%–5%.

The issue of road traffic accidents is gaining attention as these are major killers of young, and often poor, adults in India. Many of the measures to address accidents and their impact lie outside the realm of the health sector, and may often have to do with urban planning, road designs (including pedestrian and bicyclist access), vehicle quality and design features, driving skills, lack of helmets and control of speed. These require improved regulatory design as well as better enforcement of the law against traffic rule violators. Besides, addressing alcohol consumption, which may impair response time and the overall ability to drive safely, needs far greater attention than has been the case so far. Estimates from Bangalore, Haryana and Punjab suggest that nearly 40% of truck-related accidents and 60% of those involving cars are alcohol-related. Interventions to address alcohol consumption may include tax increases since price elasticity of demand for alcohol in India appears to be high, accompanied by health messages. Another factor that ought to worry policy-makers is the huge burden of disease on account of mental health disorders. These require a range of skills that India does not have in adequate number as well as access to drugs, which are expensive.

The older age groups are typically more vulnerable to chronic diseases and are also at high risk for CVD. As obesity, hypertension and diabetes are linked to the onset of CVD, health education programmes that promote exercise and weight reduction; screening for hypertension as another pathway to both influence exercise and dietary behaviour; early treatment; reduced smoking; selective taxation of foods, etc. need to be accorded high priority. The actual treatment of cancers and procedures for CVD

(angioplasties and coronary artery bypass graft are considerably less likely to be cost-effective while their adverse financial implications to affected households could be extremely large.

An important element of the intervention strategy must be to identify the mechanism through which such services are to be delivered. Annexure B presents a schematic framework on how some of the preventive and curative interventions are to be provided at different levels of care—at the community level, subcentre level, primary health centre, community health centre, and ultimately, at the district hospital. The framework of Annexure B is intended to be suggestive rather than prescriptive in that it does not imply that the concerned services have to be provided only by the public sector, or that they ought to be free for everyone.

A key lesson that has emerged from this effort is the acute paucity of good data and the absence of community-based studies, which have made it impossible to come up with any credible estimates of the disease burden in India. This has, in no small measure, been further worsened by the wide diversity and disparities that characterize this country, making it difficult to extrapolate the data of small, localized studies to the entire country. India should urgently undertake operational research, establish good surveillance systems and develop validated data banks. The data gaps need to be bridged, high priority accorded to operational research and adequate resources allocated.

References

- Deolalikar A. *Attaining the Millennium Development Goals in India: Role of public policy and service delivery*. Washington, DC: The World Bank, South Asia, Human Development Unit; forthcoming.
- Jha P, Nguyen S. *Avoidable mortality in India*. CMH Working Paper series, WG5:1. Geneva, Switzerland: WHO, Commission on Macroeconomics and Health; 2001.
- Kumar R, Jha P, Arora P, Dhingra N, India Studies of HIV/AIDS Working Group. HIV-1 trends, risk factors and growth in India. *NCMH background papers—burden of disease in India*. New Delhi: Ministry of Health, Government of India; unpublished.
- Peters D, Yazbeck A, Ramana G, Sharma R, Pritchett L, Wagstaff A. *Raising the sights: Better health systems for India's poor*. Washington, DC: The World Bank; 2001.
- Shah N. Oral and dental diseases: Causes, prevention and treatment strategies. *NCMH background papers—burden of disease in India*. New Delhi: Ministry of Health, Government of India; unpublished.
- Tuberculosis Research Centre (TRC). *Estimation of the burden of pulmonary tuberculosis in India for the year 2000*. Chennai: TRC; 2004.
- WHO. *World Health Report 1998*. Geneva, Switzerland: WHO; 1998.
- WHO. *World Health Report 2004*. Geneva, Switzerland: WHO; 2004.
- World Bank. *World Development Indicators Database 2004*. Washington, DC: The World Bank; 2004.
- Yajnik K, Chakraborty A, Jochem K. A mathematical model for determining the effect of tuberculosis control programmes on its prevalence in India (draft report). New Delhi: The World Bank; 2002.