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Impact of HIV/AIDS on the national economy of India

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Abstract

Background information: Human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) is a major public health problem in India. In general, it affects mainly young people who are at their most productive part of life. Despite initial fears that AIDS will be disastrous for the economy, recent experience and estimations have shown that there is a need for reappraisal of its economic impact on society. *Research question:* From the viewpoint of the society of India, what is the total cost and equivalent annual cost of HIV infections for the period 1986–1995 (10 years) in India? *Methods:* Type of analysis: Cost-descriptive based on predictive modelling cohort analysis using human capital approach. A discount rate of 5% was used. The cost of HIV infections include (i) loss of productivity among HIV patients due to sickness and death, (ii) productivity loss due to caregivers of AIDS patients, and (iii) cost of management of AIDS patients. To estimate the loss of productivity due to premature death attributable to AIDS, a life table approach using two cohorts, one with and one without HIV/AIDS infection at assumed rates was used. The demographic data of 1991 census were used. The difference in the person-years lived in the two scenarios gave the person-years lost due to HIV/AIDS. This was calculated separately for rural and urban areas. To convert this to monetary terms, national per capita income for 1992–93 of Rs. 5529 was used. The data on the days of inpatient care and the cost of management of AIDS patients were based on currently available data and ‘expert opinion’. We analysed, using three different sets of assumptions for determination, the low, medium

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and high estimates of the impact of HIV/AIDS in India. Some of the costs were not included in the present analysis: (i) use of antiviral AZT, (ii) cost of retraining of new workforce, (iii) cost of strengthening of health care system, (iv) cost of research and development, (v) cost of communication activities, (vi) cost of prevention of vertical transmission, and (vii) the intangible cost of pain and suffering to the patients and their families. *Results:* The total cumulative number of HIV-infected persons in India until 1995 was estimated to be 1.5 million (low estimate), 2.5 million (medium estimate) and 4.5 million (high estimate). The estimated total annual cost (in billion Rupees) of HIV/AIDS in India under low, medium and high assumptions was 6.73, 20.16 and 59.19, respectively. Cost of treatment of AIDS and loss in productivity were the two major components of the cost. *Conclusions:* The estimated annual cost of HIV/AIDS appears to be about 1% of the GDP of India if based on high assumptions. However, as mentioned earlier, all costs of HIV have not been taken into account. Its significance has to be assessed in the context of annual growth of GDP (3.5%) and cost of other major diseases in India. © 1999 Elsevier Science Ireland Ltd. All rights reserved.

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1. Introduction

HIV/AIDS unquestionably has an economic impact. AIDS causes the death of young and able-bodied people in the most productive part of their life. Thus it was expected that AIDS would have a powerful negative economic impact. In the initial years of the HIV/AIDS epidemic, it was widely believed that the epidemic would have a catastrophic impact on economies of all countries, especially those of developing countries. Now, a decade later, there is need for reassessment of the economic impact of HIV/AIDS on the national economy.

We had previously estimated the productivity loss due to HIV/AIDS infections acquired in one year (1991) as Rs. 1014 billion [1]. If the infection rate assumed in this study remains stable for the lifetime of the cohort, i.e. the next 60 years, this estimate would be the annual loss of productivity of HIV/AIDS as well. However, the infection rate is unlikely to remain stable for such a long period. The assumed incidence rates were on the higher side and we had not estimated the other costs of the HIV/AIDS disease.

In this paper, we try to estimate the cost of HIV/AIDS acquired during the period 1986–1995 to the Indian economy. We have tried to estimate other costs of HIV as well. In addition, we have also assumed different incidence rates (low, medium and high), as there is still no consensus on the magnitude of HIV/AIDS problem in India.

2. Methodology

The standard procedure of identification, measurement and then evaluation of the costs was followed.

2.1. Identification of costs

HIV/AIDS has an impact on different aspects of economy. Some of the major economic consequences are shown in Table 1.

The costs included in the present study are the loss of productivity among HIV/AIDS patients both due to premature death and sickness, productivity loss due to caregiver of an AIDS patient, cost of management of HIV/AIDS patient, cost of strengthening blood banks. The costs not included in the present study are use of anti-retroviral (AZT) therapy, cost of retraining of new unskilled workers, cost of strengthening of health system, cost of communication strategies, cost of research and development, cost of prevention of vertical transmission, and the intangible cost of pain and suffering to the patients and their families.

2.2. Measurement of cost

2.2.1. Measuring loss of productivity due to premature death of an HIV-infected person

A life table approach was followed to calculate the person-years of productivity lost due to HIV/AIDS. A cohort of 100 000 was followed up to death in two scenarios. The first scenario was when there was no HIV/AIDS in the cohort and the second included those with HIV/AIDS. Based on life table approach, the person-years lived by the cohort in both the scenarios were calculated. The difference between the two scenarios gave the person-years lost due to HIV/AIDS. The general approach for measurement was same as in our earlier paper [1].

Table 1
Economic consequences of HIV/AIDS: identification of cost items

No.	Cost items
1	Productivity loss due to: <ul style="list-style-type: none"> premature death of infected persons sickness among the infected persons time lost due to the care giver
2	Cost of treatment of HIV/AIDS patients
3	Loss of skilled work force and the resultant cost of retraining a new work force
4	Cost of strengthening the health care system to prevent spread of AIDS
5	Costs of screening of blood products
6	Cost of prevention of vertical transmission
7	Cost of research and development
8	Cost related to information education and communication about HIV/AIDS
9	Intangible cost of pain and suffering

2.2.1.1. Incidence assumptions. At present there is no consensus among the experts on the incidence/prevalence rates of HIV in India. The National AIDS Control Organization (NACO) has instituted sentinel surveillance which includes rural sites as well. Information is also available from three community-based surveys from Tamil Nadu. The surveillance data from hospital based antenatal clinics from cities indicate a prevalence rate varying from 0 to 5.5% (personal communication). The total number of HIV-positive adults in the country has been estimated to be between 1.5 and 4.5 million [2]. The NACO currently estimates that about 3.5 million HIV-positive adults are present in the country. This estimate is based on surveillance reports and projection of a previous estimate of 1.78 million in 1994 [3].

Based on these estimates, we calculated backwards to derive the likely prevalence and incidence rates which amount to the above-mentioned number of cumulative seropositive individuals. The low incidence assumption would give, over a period of 10 years, about 1.5 million seropositive individuals, medium level assumptions are around 2.5 million, and high assumptions would amount to about 4.5 million seropositive individuals by 1995.

Other assumptions include a perinatal transmission rate of 25–30%. HIV incidence was restricted to the reproductively active population (20–45 years) only. The incidence rates in young adults (20–35 years) was assumed to be twice that of older adults (35–45 years). The rural incidence was assumed to be about one-fourth of the urban incidence. Median survival of 10 years after the onset of infection was assumed based on a previous cohort study by Bacheti and Moss [4]. The proportion of deaths in each successive quartile was assumed to be 20, 30, 30 and 20%, respectively. The onset of HIV infection in the country was assumed to be from January 1986.

Thus there were two 5-year cohorts to be followed-up until the end point (1995), i.e. 1986–1990 and 1991–1995; and, thus, all the incident cases of HIV in the first cohort would be followed up for 10 years and the subsequent one for only 5 years.

The calculations were initially done for a cohort of 100 000. The objective of the present study was to calculate the loss in productivity due to infections acquired during the period 1986–1995. Therefore, we took the population of the mid decade (1986–1995), i.e. 1991. The age distribution of the population was based on 1991 census. The estimates were calculated separately for urban and rural areas. Adding the two estimates provided the total loss for India.

2.2.2. Productivity loss due to sickness of the HIV/AIDS patient

It was assumed that a patient with HIV infection leading to AIDS needs six admissions for HIV-related illness during their life time before death. Each admission is about 2 weeks with a longer terminal admission. Thus, each person with AIDS would need about 100 hospital days ($14 \times 5 + 30 \times 1$). This estimate is much lower than the one used in Thailand (20–35 days per episode at the rate of 1.5 episodes per year) which comes to about 350 days in 10 years [5]. In USA the estimates have varied between 35 and 168 days [6]. The duration of stay of an AIDS patient in hospital is dependent on many factors. The important ones are: (i) history of drug abuse; (ii) presence of concomitant infections like tuberculosis, *P.*

carinii pneumonia, etc.; and (iii) availability of domiciliary care services which are well developed in western countries. We, therefore, based our estimate on a low assumption of 100 days of admission, and a high assumption of 200 days.

Multiplying the person-days lost due to admission of HIV/AIDS patient in their lifetime with the number of cases, provided the total productivity loss due to hospital admission of HIV/AIDS cases. As the study period was only for 10 years and the median survival was assumed to be 10 years, we took only half of this cost as to have been incurred during 1986–95. This estimate did not include the cost of sickness which could lead to loss of productivity but need not necessarily result in hospital admission.

2.2.3. Productivity loss due to care giver of a sick HIV/AIDS patient

For the period that the patient is admitted, he/she will require a full-time care giver. Thus the productivity loss will be the same. Again we did not include productivity loss due to a care giver at domiciliary level.

2.2.4. Cost of management of a HIV/AIDS patient

This should include the overhead cost of hospital bed, cost of palliative treatment like fluids, analgesics, etc, cost of treating concomitant infections like tuberculosis, and the cost of anti-retroviral therapy. However, the cost of anti-viral therapy was not included as it is unlikely that it will ever be used on a sufficiently large scale in India.

The cost per bed per day varies widely. It has been estimated as Rs. 200 in a secondary level to Rs. 600 in a tertiary level government hospital (PC Choubey, personal communication). The medicine costs of one hospital bed day in a tertiary hospital in Bombay was estimated by SR Salunke, Director Health Services, Maharashtra, as Rs. 250 in 1997 (personal communication). Though AIDS patients are more likely to be managed at tertiary level, we have used a low estimate of Rs. 200 per bed per day and a high assumption of Rs. 600 per day. In Thailand, the cost per inpatient day was estimated as 550 Baht in the high scenario and 450 Bahts in the low scenario [5]. Multiplying the number of days admitted with the cost per day gives the cost of admission of one patient. Multiplying this by the number of expected cases gives the total cost of HIV/AIDS patients. Again, for the reasons mentioned above, only half of this estimate is used for calculations for the cost during the period 1986–95.

The cost of palliative care and treatment of opportunistic infections, including tuberculosis, is difficult to estimate as we do not have any data on the cost of the management of AIDS patients. On average, the drug cost of a short course of chemotherapy for tuberculosis in India is about Rs. 2000 for 6 months. In Thailand, the annual cost of management of AIDS patients has been estimated as 1500 Bahts (equivalent to about Rs. 2000) per year in the low scenario and 2250 Bahts (equivalent to about Rs. 3000) for the high scenario [5]: assuming a survival of 10 years this comes to 15 000 and 22 500 Bahts, respectively. Converted to Rupees at 1992 levels this comes to roughly Rs 20 000 and 30 000, respectively. For the present study, we have assumed a low cost of Rs. 10 000 to a high assumption

of Rs. 50 000. In US the total lifetime medical costs of an AIDS case has been estimated in the range of US\$55 000 to 77 000 in 1986 [6].

The cost of hospital care is dependent on utilization of health care services by the population. We assumed utilization rates of 25, 50 and 75% for low, medium and high estimates.

2.2.5. Cost of screening blood donors for HIV

One of the main strategies for prevention of HIV transmission is through providing 'safe' blood and blood products. It is now mandatory that all blood banks screen the blood for HIV infection by enzyme-linked immunosorbent assay (ELISA) or other rapid/simple tests. It was estimated, in 1992, that a total of 20 million units of blood are donated annually in India [7]. More recently, in a news programme, this was estimated at 30 million. Each ELISA test costs about Rs. 20. This include only the cost of the test, as no incremental cost of setting up the necessary laboratory and personnel is required. Multiplying this by the number of blood units collected gives the annual cost of screening for blood.

Other costs listed in Table 1 have not been estimated. As AIDS affects able-bodied adults, it deprives the society of their education skill and experience. Thus, a new work force may have to be trained. In labour surplus communities like India, unskilled labour is relatively easy to replace but this may not apply to skilled labour.

The strengthening of health services and practice of universal precautionary measures are an important beneficial outcome of the HIV epidemic. These measures would have been otherwise necessary, but the AIDS epidemic has only accelerated the process. Though it is the only strategy for prevention of the spread of this epidemic, the cost of communication has not been assessed, as this is very difficult.

The cost of preventing vertical transmission from infected mothers to their offspring has also not been taken into account. The currently advocated strategy for this is screening all pregnant women with a sensitive test after a pre-test counselling. If the positive results of the initial screening are confirmed by a second more specific test, a post-test counselling is done. Then, the pregnant women is started on anti-retroviral therapy at about 34 weeks of gestation until delivery. The newborn is then followed-up by repeated testing to check for seroconversion. This strategy has not been instituted in India at present and therefore its cost has not been included. However, it is possible that this strategy may be introduced in future, especially in urban areas.

2.2.5.1. Valuation of cost. To convert the person-years into monetary terms we multiplied it by the per capita national income for the year 1992–93 [8]. This has been taken as Rs. 5529. All the assumptions used in this study are summarised in Table 2.

2.2.5.2. Discounting. The total cost calculated by summing up the above costs is the cumulative cost of the HIV infections acquired during 1986–95. These costs were spread over 10 years. To get the average cost per year, one could divide it by ten.

Table 2
Assumptions regarding HIV prevalence and the unit costs used in the study

Items	Low	Medium	High
Prevalence of HIV infection:			
Urban	0.5	1.2	2.0
Rural	0.1	0.4	0.7
Combined (weighted)	0.17	0.6	1.0
Total number of cases	1.4 million	2.5 million	4.5 million
Hospital admission days for AIDS cases			
Cost of hospital stay per day (Rs.)	100	150	200
Life time cost of drugs per case (Rs.)	200	400	600
Utilisation of health care services (%)	10 000	25 000	50 000
Number of annual blood donors in the country	25	50	75
	2 million	2.5 million	3 million

However in economic analysis, the preferred approach is of discounting. We used a discount rate of 5% for 10 years (division factor of 7.7217).

3. Results

Using the life table approach, the loss in productivity in years due to HIV/AIDS during 1986–95 is shown in Table 3. This varied from about 8 million years under low assumptions to 28 million years under high assumption. The productivity loss is more in urban areas than in rural areas and the difference is more at higher assumptions.

When converted to monetary terms based on per capita national income of Rs. 5529, the estimates varied from Rs. 44 billion to 156 billion, depending upon the assumptions.

All the other costs included in the study were also calculated and added to the loss in productivity. These are shown in Table 4.

The loss in productivity due to hospital admission of AIDS patients and their care giver was assumed to be same, and was estimated at Rs. 1.1 billion to 6.8 billion during the period 1986–95. The total cost of management of AIDS (Rs. 5.2

Table 3
Cumulative cost of productivity loss due to HIV/AIDS for the period 1986–95

Loss in productivity	Years (thousands)			Rupees* (billions)		
	High	Medium	Low	High	Medium	Low
Rural	11 395	6785	3195	63.0	37.5	17.7
Urban	16 740	10 615	4750	92.6	58.7	26.3
Total	28 135	17 400	7945	155.6	96.2	44

* Based on a per capita national income of Rs. 5529 per year.

Table 4

Total cost (in billion Rupees) of HIV/AIDS in India under high, low and medium assumptions

Items	Low	Medium	High
Loss in productivity due to premature deaths 1986–95	44	96.2	155.6
Loss in productivity due to hospital admission	1.1	2.8	6.8
Loss in productivity due to care givers	1.1	2.8	6.8
Total cost of medical care	5.2	53	287
Total costs for 1986–95	51.4	154.8	456.2
Equivalent annual cost	6.7	20.1	59.1
Annual cost of screening of blood	0.03	0.06	0.09
Total annual cost of HIV/AIDS	6.73	20.16	59.19

billion) cases constituted a small portion (10%) of the total cost (Rs. 51.4 billion) in the low assumption compared to a major proportion (60%) in the high incidence assumptions. This is mainly because of assumptions regarding health care utilization.

The annual cost of HIV/AIDS during the period 1986–95 was estimated as Rs. 6.7 billion if based on low assumption and Rs. 59 billion if based on high assumptions. Loss in productivity due to premature death and the treatment costs contributed the most, accounting for almost 90% of the total costs.

4. Discussion

In this paper, we have estimated the annual cost of HIV/AIDS for the period 1986–1995. As is true for any estimate of cost of any disease, this estimate is based on certain assumptions. There can be differences of opinion on these assumptions. However, we have explicitly stated the assumptions and the reasons for these. The assumptions which are likely to have a major impact on the results are: (i) incidence rates; (ii) cost of 1 year taken as per capita national income (PCNI); (iii) the cost of treatment of AIDS patients.

Our incidence assumptions appear reasonable as the total cases estimated are within range of probability of 1.5–4.5 million estimated by the experts. Chin and Lwanga had used an estimate of 350 000 HIV-infected adults as of late 1990 in South East Asia for predicting the number of adult cases in this region using the WHO projection model [9]. The World Bank estimated that in Asia (including India, China and other Asian countries, there would be about 0.4 million cases in 1990 and 9 million cases by 2000 AD [10]. As already mentioned, the current estimates of WHO and SEARO are also in the range of 3.5–4.5 million. This corresponds to our medium to high incidence assumption.

We have used PCNI as the cost of 1 year. AIDS predominantly affects poor adults. Poor people have a much lower per capita GNP, but young adults will have on average higher GNP than people of other ages. Thus, overall the use of PCNI would not have resulted in any bias in the estimate. Using minimum wages as the

cost of 1 year would result in roughly three times higher estimate of cost. The World Bank estimates the per capita GNP of India as US\$340 (Rs. 11 900 @ US\$ 1 = Rs. 35) [11]. This estimate is probably based on purchasing power. This will, therefore, roughly increase the cost two times. It may be better to use this estimate for international comparison.

Regarding the cost of treatment of AIDS cases, our assumptions are within the estimates used in other studies internationally.

The estimate of the total cost of HIV/AIDS is to be seen in context of the: (a) GNP of the country and its rate of growth; (b) estimate from other countries; (c) estimate for other diseases in India.

The Gross National product in India was Rs. 5350 billion for the year 1992–93 [8]. Our estimate of the cost of HIV/AIDS is roughly 0.1–1.1% of the GNP. At present India's GNP is growing at the rate of about 3.5% [11].

The average foregone earning per AIDS case in US has been estimated between US\$ 541 000 and 623 000 in 1986 [6]. Using PCNI as US\$ 340, our estimates are in the range of US\$ 1800–2400 per case. This should be seen in the context that per capita GNP of US is 80 times the Indian PCNI. Also, the present study estimated the loss for 10 years only. Whereas, based on the age distribution and the mortality pattern assumed, the number of years lost per case is about 40 years [1].

Cuddington, as reported by Cohen [12], based on economic modelling in 1991, estimated the economic impact of HIV/AIDS in Tanzania. He concluded that the economy would undoubtedly grow more slowly in the presence of AIDS with a 1% reduction of real GDP per annum. Kambou, Devanayagan and Over, also as reported by Cohen [12], estimated the effect of AIDS on economy through the reduction of supply of labour in a relatively unsophisticated economy of Cameroon. They estimated that the GDP rates decline by about 2% per annum.

In Thailand, the seroprevalence of HIV in the general community was around 3% in 1991. The Thai working group estimated that the annual health care expenditure per AIDS patient would vary between a low of US\$ 615 to a high of US\$ 1015 [5]. The total annual health care cost plus the value of lost income was projected to grow from US\$ 100 million in 1991 to 2.2 billion by 2000. The cumulative loss of productivity was US\$ 8 billion in 1991, compared to US\$ 1.3–5 billion estimated by us for India.

The World Bank simulations in 1993 indicated a slowing of growth per capita by an average 0.6 percentage points a year in Sub-Saharan Africa. As in the present study, the heavy macro-economic impact of AIDS came partly from the high cost of treatment. The World Bank estimated the cost of treatment to be 150 times the per capita national income [13].

For the health planners in India, to decide on the priority in investment, we need to compare the costs of HIV/AIDS to other health problems in India notably malaria and tuberculosis. However, little literature is available on these issues. In a recently published article, Sharma arrived at a figure of Rs. 15.6 billion (low) to 30 billion (high) as the annual cost of malaria and its control in India [14]. This estimate included the governments expenditure on malaria control, productivity loss due to death and morbidity attributable to malaria and the treatment costs.

About 40% of costs was due to the control programme which included costs of treatment and control strategies. The loss in productivity was estimated as Rs. 9 billion (US\$ 307 million) as low and Rs. 19 billion (US\$ 633 million) as high estimates.

Haran collected information from various sources, including governmental, non-governmental and private sector, on the expenditure incurred by various agencies working in the field of HIV/AIDS prevention, care or research. This included international funding of various projects as well. He estimated that about Rs. 1.4 and 1.5 billion were disbursed in 1996 and 1997, respectively [15]. Thus, the national response to AIDS appears to be only a fraction of the estimated cost of the disease.

It may be reasonable to state that our estimates are based on realistic assumptions and have not included many costs of AIDS, most notably costs of communication efforts, cost of retraining the work force, cost of prevention of vertical transmission, and the cost of anti-retroviral treatment. Despite this, it is clear that HIV/AIDS is likely to have a major impact on the health sector. The loss in productivity is also significant. It should also be noted that the death of an adult in a family can persist into next generation as children are withdrawn from school to help at home either by earning or by looking after sick members. These costs have not been taken into account.

The estimates from this study do provide a fairly good indication of the likely magnitude of the economic impact of HIV/AIDS on the national economy. Thus, although the economic impact of HIV/AIDS is unlikely to be as disastrous as expected until recently, it still warrants immediate attention on a level with other major health problems facing the country.

References

- [1] Pandav CS, Anand K, Shamanna BR, Chowdhury S, Nath LM. Economic consequences of HIV/AIDS in India. *Natl Med J India* 1997;10(1):27–30.
- [2] Anthony B, Mertens TE, Lal S. Estimation of adult HIV prevalence as of the end of 1994 in India. *Indian J Public Health* 1995;34(3):79–85.
- [3] Estimating the burden of HIV infection in India; in Round table on HIV/AIDS surveillance in India, Network for child development and Association for Health Environment and Development, New Delhi 1996.
- [4] Bacheti P, Moss AR. Incubation period of AIDS in San Fransisco. *Nature* 1989;338:251–3.
- [5] Viravaidya M, Obremsky SA, Myers C. The economic impact of AIDS on Thailand. In: United Nations Development Programme. The Regional Consultation on Economic Implications of HIV/AIDS, Bangalore, India, 1992.
- [6] Bloom DE, Carliner G. The economic impact of AIDS in the United States. *Science* 1988;239:604–10.
- [7] Ferguson AF. Modernisation of Blood banks. Project Report. Ministry of Health and Family Welfare, November 1992.
- [8] Central Bureau of Health Intelligence. Health Information of India—1993. Directorate General of Health Services, Ministry of Health and Family Welfare Government of India, New Delhi, December 1994.

- [9] Chin J, Lwanga SK. Estimation and projection of adult AIDS cases: a simple epidemiological model. *Bull WHO* 1991;69(4):309–406.
- [10] World Bank. Investing in Health—World development indicators. World Development Report. New York: Oxford University Press, 1993:33.
- [11] United Nations Children’s Fund. The State of World’s Children. New York: Oxford University Press, 1998:115.
- [12] Cohen D. The economic impact of AIDS. In: United Nations Development Programme. The Regional Consultation on Economic Implications of HIV/AIDS, Bangalore, India, 1992.
- [13] World Bank. Investing in Health World development indicators World Development Report. New York: Oxford University Press, 1993:20.
- [14] Sharma VP. Malaria: cost to India and future trends. *Southeast Asian J Trop Med Public Health* 1996;27(1):4–14.
- [15] Haran EGP. Study on the Financing of the national response to HIV/AIDS. Report submitted to UNAIDS and Harvard University, March 1998.