Impact of HIV/AIDS on Gross Domestic Product (GGP) in the WHO Africa Region

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SUMMARY

HIV/AIDS is hypothesized to have substantive negative impact on health status and economic development of individuals, households, communities and nations. The objective of this study was to estimate the burden of HIV/AIDS on GDP in the WHO African Region using a production function approach. The economic burden analysis was done using a double-log econometric model and a cross-sectional data on 45 to 46 countries in the WHO African Region. The data were obtained from WHO, UNAIDS, ECA, UNDP and the World Bank publications. The coefficient for Capital (K), Education (EN), Export (X) and Imports (M) were found to be statistically significant determinants of per capita Gross Domestic Product (GDP) at 5% level of significance (using a one-sided t-distribution test). Unfortunately, HIV/AIDS morbidity (V) and HIV/AIDS deaths (VD), at the same level of significance, were found to have statistically insignificant impact on GDP. However, the coefficients of these variables had negative signs as expected. In all African countries, there is need for more detailed research on the total economic cost of HIV/AIDS (probably estimated using micro-level costing and willingness-to-pay methods) and for economic evaluations of treatment, prevention and promotion programmes.

[Afr. J. Health Sci. 2002; 9: 27-39]

Introduction

The HIV/AIDS epidemic that started between late 1970s and early 1980s has had a negative impact on health status and economic development of individuals, households, communities and nations [1]. The epidemic is considered as an enemy of development in its totality [2]. Development refers to the process of improving the quality (with sustenance, self-esteem and freedom at its core) of all human lives [3].

In a broad sense, Economic Growth (EG) means a steady/sustained process through which the productive capacity of the economy is increased over time to bring about rising levels of national output or gross domestic product (GDP) [4]. EG is not a sufficient condition for development, however, it is a necessary prerequisite for any society's sustenance, i.e. the ability to meet its basic needs. The next section explains the different avenues through which HIV/AIDS could adversely affect EG.

One of the most cherished human freedoms is the freedom from disease [5].

Unfortunately, HIV/AIDS causes debility, morbidity and premature death among its victims. By the end of 1999, 70.1% (i.e. 25.5 million) of the adults and children living with HIV/AIDS and, 71.7% (i.e. 3.8 million) of newly infected adults and children resided in Sub-Saharan Africa [6]. The main mode of transmission for adults living with HIV/AIDS is heterosexual intercourse. Another important mode of HIV transmission is through blood transfusion. About 25% of the units of blood transfused in Africa today are not tested for HIV, contributing to 5 to 10% of cases of HIV infection in Africa [7].

HIV/AIDS erodes physical, mental and social well-being of its victims and those around them. Its morbidity forces people to deviate from well-being (= health), thus causing physical and psychological pain/discomfort, anxiety/depression, reduction in mobility, self care inhibitions (especially during the late stages of AIDS), social participation inhibition (especially due to stigma) and compromised performance of activities of daily living; all these being the different dimensions of quality of life [8, 9]. Thus, HIV/AIDS attenuates the ability of its victims to optimally perform their roles or functions as expected by society. Furthermore, AIDS kills its victims prematurely, in many cases before they reach their prime, and more importantly, in their most productive years.

The objective of this study was to estimate the economic burden (EB) of HIV/AIDS in the WHO African Region using a production function approach. Such a study could be put into multiple uses:

i. The EB results could arguably inform choices in resource allocation by estimating resource consequences of a specific disease in comparison with those of other health problems.
ii. EB estimates could potentially be used by Ministry of Health policy makers and programme managers in multi-sectoral sensitization campaigns to garner socioeconomic and political support for the HIV/AIDS control programme. The estimates would especially be useful when lobbying with the Ministry of Finance to commit more budgetary allocations to the prevention and management of HIV/AIDS.
iii. EB estimates would be a potent advocacy tool for international non-governmental organizations that support HIV/AIDS control initiatives in Africa. Such evidence would enable them develop a strong case for continued financial and technical support from their home countries.
iv. Whereas there have been HIV/AIDS EB studies conducted in some countries in the Region, they have not been undertaken in all the countries in the African Region. Thus, there is need for such a study that aims at generating estimates for all the countries in the Region.
v. The econometric model estimated in this study would be useful to the policy makers in the productive sectors (e.g. agriculture, industry and commerce) for forecasting the impact of HIV/AIDS on gross domestic product, and for planning and implementing measures for mitigating the negative effects on total production.
vi. The econometric model estimated in this study could be used to simulate the benefits of policy interventions/measures geared at attenuating the negative effects of HIV/AIDS on GDP.
vii. Researchers undertaking EB of HIV/AIDS in future could adapt the methodology used in the current study which may lead to research cost savings.

Materials and Methods

Methods

Economic burden of illness (EBI) or total cost-of-illness studies dates back to 1920 [10]. Their aim is to inform choices in resource allocation by estimating resource consequences of a specific disease in comparison with those of other health problems. There are three approaches to measurement of EBI studies, namely: total cost (TC), contingent valuation (CV) and production function (PF) approaches [11].

Total Cost-of-Illness Approach (TCA)

The essence of TC approach is to recognize, identify, list/itemize, measure, value and sum the costs of a specific health problem, e.g. HIV/AIDS. This approach takes into account costs borne by health care system, community and family in directly addressing the health problem (i.e. direct costs); monetary values of productivity losses caused by the health problem, borne by the individual, family, society, or by the employer (i.e. indirect costs); and the costs of pain, grief and suffering (intangible or psychic costs) [10].

Contingent Valuation Approach (CVA)

CV involves respondents' valuation, in monetary terms, of goods or services that may not be directly measurable [12]. CV has two alternative strands: willingness-to-pay (WTP), which asks individuals to state the maximum amount that they would be willing to pay to acquire a good or service, and willingness-to-accept the loss or reduction of a good or service. Within health sector, CV has been used to value prevention, treatments or services, and outcomes or health states. For example, Kirigia, Sambo and Kainyu [13] elicited WTP values for seven health states or outcomes, and used them in a cost-benefit analysis of preventive schistosomiasis interventions [14]. In the context of HIV/AIDS, those individuals at risk of HIV infection could be asked directly how much they would be willing to pay for a specific health care intervention that would enable them to avoid the risk of infection, and hence, the related negative effects on quality life, quantity of life, learning, productivity and capacity to enjoy leisure activities. Alternatively, an individual at risk could be asked for the minimum amount of income he/she would be willing to accept in order to forego the benefits of participating in an intervention geared at protecting people from the risk of HIV infection.

Production Function Approach (PFA)

A production function (PF) depicts the relation between the quantities of various scarce productive resources used per period of time and the maximum quantity of the good (or service) that can be produced per period of time [15] to satisfy human wants. A productive resource is a raw material (a natural substance) or a man-made good that is used in the production of other goods or services. Those are also called factors of production; they include land (encompassing all natural resources), labour, capital (man-made tools of production and the technology embodied in them), human capital (the skills and knowledge embodied in a person) and entrepreneurial ability (the ability to organize and plan production and develop new products) [16].

The quality and quantity of factors of production determines the absolute quantity of GDP, i.e. the total value of goods and services produced in the economy. GDP is the sum of total value of consumption expenditure, investment expenditure, government purchases of goods and services, and net exports (i.e. exports minus imports) of goods and services. Alternatively, it can be viewed as the total value of consumption expenditure, gross private saving (business saving + personal saving + depreciation), net tax revenues (tax revenue minus domestic transfer payments,

net interest paid, and net subsidies), and total private transfer payments to foreigners [4]. HIV/AIDS impacts on magnitudes and growth of GPD in a number of ways.

First, we know that marginal productivity of labour (i.e. change in GDP as a result of change labour) is a function of health status, effort, time spent working, cognitive capabilities, ability, physical capital stock, and intermediate inputs [17]. HIV has a debilitating effect on those who test positive but continue working. Although these people would be able to work probably throughout each day, their productivity might be sub-optimal, due to impaired strength, stamina, agility and concentration. The impairment could even be due to psychological effect of the knowledge that one is HIV positive.

Second, those with AIDS and suffering bouts of various opportunistic infections, depending on the severity and length of each episode of illness, might have to take time-off from work to seek health care or/and to recover at home. Thus HIV/AIDS morbidity will reduce quantity and quality of nation's labour force, and hence its productivity, other factors held constant (e.g., availability of complementary factors).

Third, there is growing epidemiological evidence that ill-health erodes the ,victims cognitive capabilities (especially among those with full-blown AIDS), and hence, ability to acquire knowledge and skills through training [18]. In other words, it has direct effects on the returns on other investments in human resources, such as schooling and training (formal and informal).

Fourth, in terminal stage with full-blown AIDS (which may last for 1 year before death), victims are often completely immobilized, and hence, incapable to attend to themselves, let alone being productive [10]. During this stage other people have to take time off from work to provide care for their sick ones.

Fifth, children of HIV/AIDS victims may be forced to drop out of school, either due to reallocation of school fees budget to meet medical expenses, to care for the patient, as a result of being orphaned or to compensate for the reduction in adult labour availability, and hence, negative inter-generational effects on the human capital creation process. In the long term, this trend of disinvestments in children's education and care will in turn influence overall productivity of the labour force and ultimately economic growth.

Sixth, the potential contribution of labour as an input to production depends on both the absolute size of the labour force and its productivity. By causing premature mortality to significant number of workers between ages 15-60, AIDS will reduce both the size and growth of the labour force.

Seventh, HIV/AIDS erodes the capacity of man to produce physical capital (man-made tools of production and the technology embodied in them) needed to produce goods for satisfying human wants. Furthermore, in order to meet catastrophic health care expenses, households are forced to sell land and physical capital, e.g. farm equipment, machinery and other productive household assets.

Eighth, attrition of labour force through AIDS-related premature death may lead to a reduction in total household consumption expenditure, government tax revenues, private business and personal savings, and hence, the resources available for investment purposes.

Lastly, HIV/AIDS by eroding quality and quantity of labour, human capital and entrepreneurial abilities diminishes a nation's capacity to exploit all natural resources, and hence, serves to either choke or stagnate growth in GDP.

Symbolically, the effect of HIV/AIDS on the gross domestic product can be expressed as follows:

$$GDP = f(D, L, K, HK, EA, OE, P) \quad \ldots\ldots\ldots (i)$$

where GDP = real capita gross domestic product, i.e. real value of annual volume of goods and services divided by population; D=land; L=Labor input (≥15 yrs); K=capital stock; HK=human capital (health stock and

the skills and knowledge embodied in a person), whose proxies in this study are life expectancy (LE) and educational enrolment (EN); EA = entrepreneurial ability (the ability to organize and plan production and develop new products), for which we could not find data; OE = a vector of other factors affecting production such as openness of the economy, whose proxies are exports (X) and imports (M); and P = magnitude of HIV/AIDS problem, measured in terms of number of HIV/AIDS cases (V) and deaths (VD). According to the macro-economic theory, D, K, LE, EN, EA and X variables are expected to be directly related to GDP, thus their coefficients would be expected to assume positive signs. On the contrary, the parameter for M would be expected to take-on a negative sign because the variable constitutes a leakage from the national economy. The sign for the coefficient for L is indeterminate due to high levels of unemployment and underemployment in the African Region.

Equation (I) shows the effect of 'V' and 'VD' on GDP, holding the effects of D, L, K, HK, EA and OE constant. If HIV/AIDS is a burden on the economies of African countries, as argued above, then the coefficients for variables 'V' and 'VD' would be expected to assume a negative sign. Given that the effects of the explanatory variables (in Equation I) on the dependent variable (GDP) are unlikely to be linear, we shall estimate Cobb-Douglas production functions of the following forms:

$$GDP = aD^{\beta 1}L^{\beta 2}K^{\beta 3}LE^{\beta 4}EN^{\beta 5}X^{\beta 6}M^{\beta 7}V^{\beta 8}E.....(II)$$

$$GDP = aD^{\beta}L^{\beta 2}K^{\beta 3}LE^{\beta 4}EN^{\beta 5}X^{\beta 6}M^{\beta 7}VD^{\beta 8}E....(III)$$

Taking logarithms of both sides of equations (II) and (III), we obtain the double-log models (IV) and (V):

$$Log\ GDP = log\ a + \beta_1 log\ D + \beta_2 log\ L + \beta_3 log\ K + \beta_4 log\ LE + \beta_5 log\ EN + \beta_6 log\ X + \beta_7 log\ M + \beta_8 log\ V + E\ ...(IV)$$

$$Log\ GDP = log\ a + \beta_1 log\ D + \beta_2 log\ L + \beta_3 log\ K + \beta_4 log\ LE + \beta_5 log\ EN + \beta_6 log\ X + \beta_7 log\ M + \beta_8 log\ VD + E\ .....(V)$$

where: log is the natural logarithm (i.e., log to the base *e*, where *e* is equals 2.718); *a* is the intercept term; β's are the coefficients of elasticity, which can take any value between 0 (perfectly inelastic) to ∞ (infinity); and E is a random (stochastic) error term capturing all factors that affect GDP but are not taken into account explicitly [20]. Equations IV and V were estimated using STATA 7.0 [21].

Data Sources and Analysis

The data used to estimate equations (IV) and (V) were obtained from two sources. Gross Domestic Product per capita (GDP), capital (K), educational enrolment (EN), life expectancy (LE) exports (X), imports (M), and HIV/AIDS cases (V) from UNDP [22]; arable land per capita (D) and labour force (L) from the World Bank [23]; and AIDS deaths (VD) from UNAIDS/ECA (1).

The data analysis was accomplished in a number of steps:

(a) The data were entered into the EXCEL computer program spreadsheet. The first column was occupied by the names of countries; the second column by per capita GDP; and the other columns by each of the explanatory variables.

(b) With exception of country names, data in the other columns were copied using the computer mouse.

(c) Without exiting EXCEL, we opened STATA programme.

(d) We then pasted the EXCEL file, copied in step 'b', on the STATA [21] editor/spreadsheet.

(e) Since the variables in equation 'iii' are in logarithmic form, there was need to transform the dependent and independent variables into their logarithms. This was accomplished by typing the following command (as many times as the number of variables in the equation) into the commands window for STATA: *generate logGDP = ln(GDP).* That is the command used to create the logarithm of GDP. Those for the dependent variables were generated in a similar manner.

(f) The double-log model 'iii' was estimated by typing the following command into STATA window: regress [logGDP, logD, logL, LogK, logLE, logEN, logX, logM, logDS]. The dependent and explanatory variables are defined in Table 1.

TABLE 1: Variable Descriptions

Variable	Variable Description
GDP	Per capita gross domestic product (GDP), i.e. real value of annual volume of goods and services divided by population (in purchasing power parity US$)
D	Hectares of arable land per capita, i.e. total arable land divided by population
L	The number of people who are currently employed and people who are unemployed but seeking work, as well as first-time job-seekers. In general, labour force excludes students, homemakers, other unpaid care-givers and economically inactive groups (e.g. the retired).
K	Gross domestic investment as a percentage of GDP. It consists of additions to fixed assets of the economy plus net changes in inventory.
LE	Life expectancy in years.
EN	Combined primary, secondary and tertiary gross enrolment ratio.
X	Exports of goods and services expressed as a percentage of GDP.
M	Imports of goods and services expressed as a percentage of GDP.
V	Annual number of adults and children living with HIV/AIDS.
VD	Annual number of AIDS-related deaths

Results

Table 2 presents the means and standard deviations of the untransformed variables.

TABLE 2: Means and Standard Deviations

Variable	Mean	Standard Deviation
GDP	2149.463	2388.444
Land (D)	0.243	0.154
Labour (L)	5,933,333	8,776,000
Capital (K)	22.053	13.431
Education (EN)	46.732	19.55
Life expectancy (LE)	51.117	8.414
Exports (X)	32.713	21.792
Imports (M)	45.993	30.334
HIV/AIDS (V)	460802.22	725394.17
AIDS deaths (VD)	48,755	73,261.2

Table 3 summarizes the GDP elasticities and slope coefficients from the estimation of equation (IV). The readers should recall that equation (IV) excludes the number of AIDS-related deaths. The adjusted R-squared is 0.66, meaning that the fitted model explains about 66% of the total variation in GDP. The coefficients for capital (K), education (EN), exports (X) and imports (M) have the expected signs and are statistically significant at 5% level of significance using the t-distribution test. The coefficient for HIV/AIDS (V) morbidity has as expected a negative sign, but it is not statistically significant determinant of GDP. The coefficient β measures the *elasticity* of GDP with respect to a particular explanatory variable, that is, the percentage change in GDP for a given small percentage change in explanatory variable in question. For example, in column 2 of Table 3, the capital (K) elasticity coefficient is 0.521, implying that for a one percent increase in domestic investment (proxy for physical stock), the GDP (as measured in US$ per capita) on the average increases by about 0.52 percent. Since the capital elasticity value of 0.521 is less than 1 in absolute terms, we can say that the GDP per capita is capital-inelastic.

Since elasticity is given by $[(\partial DGP/\partial R_i) \times (R_i/GDP)]$, we obtained the slope coefficients in column 3 of Table 3 by applying the following formula: $[(GDP/R_i) \times (\beta)]$, where GDP and Ri (explanatory variable i) are both averaged across the various countries. For instance, the slope for HIV/AIDS cases (V) were obtained as follows: [2,149.463,802.22) x –0.0165] = 0.000077. That slope coefficient means that an increase in the number of people living with HIV/AIDS by one person leads to US$0.000077 decrease in GDP. In other words, the slope for V is the economic burden of HIV/AIDS morbidity.

The regression model (V) was also estimated with the number of AIDS-related deaths (VD) instead of the number of people living with HIV/AIDS to determine the impact of deaths on GDP per capita. The results are portrayed in Table 4. The slope coefficient for VD is –0.000741, implying that death of an extra person due to AIDS decreases GDP per capita by US$0.000741.Thus, the latter is the loss in GDP attributable to an AIDS death.

TABLE 3: Per Capita Gross Domestic product Elasticities and Slope Coefficients (including log of number of people living with HIV/AIDS)

Explanatory Variables (R_i)	Coefficient (β)	Slope [(GDP/R)β][a]	't'-Statistic	P>|t|
Log (D)	0.0355	314.02	0.94	0.352
Log (L)	-0.0136	0.0000049	-1.63	0.112
Log (K)	0.521	50.78	2.13	0.040*
Log (EN)	0.775	35.65	3.61	0.001*
Log (LE)	0.7482	31.46	0.96	0.345*
Log (X)	0.7599	49.93	3.51	0.001*
Log (M)	-0.9993	46.70	-3.32	0.002*
Log (V)	-0.0165	0.000077	-1.12	0.272
Constant	1.38		0.45	0.654
Number of observations = 45 F(9,35) = 11.82 Prob>F = 0.0000 Adjusted R-squared = 0.6629 Root MSE = 0.48602				

Note: * Indicates that the coefficients of those variables are statistically significant at 5% level of significance using a one-sided t-distribution test.

[a] Average (across the 45 countries) GDP per capita and those for individual variables are used in estimating the slope coefficients.

TABLE 4: Per Capita Gross Domestic Product Elasticities and Slope Coefficients (estimated in including log of number of AIDS deaths)

Explanatory Variables (R_i)	Coefficient (β)	Slope [(GDP/R)β][a]	't'-Statistic	P>|t|
Log (D)	0.0354	313.13	0.94	0.355
Log (L)	-0.0137	0.000005	-1.63	0.112
Log (K)	0.5205	50.73	2.13*	0.040
Log (EN)	0.7761	35.70	3.60*	0.001
Log (LE)	0.7964	33.49	1.02	0.315
Log (X)	0.7488	49.20	3.47*	0.001
Log (M)	-0.9920	46.36	-3.29*	0.002
Log (VD)	-0.0168	0.000741	-1.02	0.313
Constant	1.1721		0.38	0.704
Number of observations = 45 F(9,35) = 11.73 Prob > F = 0.0000 Adjusted R-squared = 0.6611 Root MSE = 0.48731				

Note: * Indicates that the coefficients of those variables are statistically significant at 5% level of significance using a one-sided t-distribution test.

[a] Average (across the 45 countries) GDP per capita and those for individual variables are used in estimating the slope coefficients.

Discussion

Although the African Region remains the worst affected region with regard to HIV/AIDS since the late 1990s, this study found that an increase in the number of people living with HIV/AIDS by one person decreases GDP per capita by only US$0.000077. In other words, an increase in the total number of people living with HIV/AIDS by 1,000,000 reduces GDP per capita by only US$77, i.e. –0.000077 times 1 million people. In total all the countries lost US$1,597 due to HIV/AIDS morbidity (see the Appendix).

On the other hand, on average, death of one person living with HIV/AIDS leads to a statistically insignificant loss in GDP of US$0.000741. In 1999, the countries included in the analysis lost a total of 2,193,975 human lives due to AIDS; which led to an undiscounted lifetime GDP loss (LGL) of US$37,392. The LGL were estimated as follows:

$$\sum_{i=1}^{45} (AGE_R - AGE_D) \times (VD_A \times GDP_l) = [(55 - 32) \times (2,193,975) \times (0.000741)]$$

where: AGE_R is the average retirement age in the Region, which was assumed to be 55 years; AGE_D is the average age at AIDS-related death, which was assumed to be 32 years; VD_A is the total number of AIDS-related deaths across the various countries in a year, estimated at *2,193,975* by UNAIDS/ECA [1]; and GDP_L is the loss in per capita GDP due to death of one person living with HIV/AIDS, estimated at US$*0.000741* in the current study.

The above findings mean that the impact of HIV/AIDS morbidity and mortality on GDP is insignificant; which could be attributed to a number of reasons:

1. *High rate of unemployment and underemployment:* Unemployment is the share of the labour force that is without work but available for and seeking employment [24]. Approximately 23% of the total labour force in Algeria, Botswana and Mauritius was unemployed in 1997. Since these countries have better economic indicators than majority of the other African countries, total unemployment rate for Africa in general is likely to be much higher. Underemployment is a situation in which persons are working less than they would like to work, either daily, weekly, monthly or seasonally [3]. On average about 69% of the total labour force in Africa is engaged in the Agricultural sector [24]. According to the Economic Commission for Africa [25] urban informal sector in Africa accounts for about 60 per cent of urban employment. In these two sectors, underemployment and under-utilization of skills are believed to be high but are difficult to quantify. Given the high unemployment and under-employment rates, it is relatively easy to replace any labour force attrition, especially occurring in the agricultural and informal sectors. This line of argument is supported by the evidence that the effect of the size of labour force (L) on GDP was found to be small, insignificant and to have a negative sign. The latter implies that, *ceteris paribus,* the marginal productivity of labour would increase as the size of labour decreases.
2. *Social capital:* African communities have a large caring externality manifested in various social networks and coping mechanisms. When a household head or co-head is afflicted by a

serious illness, extended family members and friends would normally contribute their labour to the affected household to compensate for the loss.

3. *Depletion of inter-generational human capital*: in exceptional cases children might be withdrawn from school to both care for the sick and compensate for the reduction in household labour force caused by a prolonged illness. Of course such a trend will in the short term mitigate or ameliorate the negative effects on labour force, but in the long-term, it might have negative effects on inter-generational human capital creation process. The effect of the latter can only be captured through longitudinal studies.
4. *Epidemiological considerations*: "Because of the long symptom-free period between the time of HIV infection and the development of AIDS – an average of about 10 years – the number of people actually sick with AIDS at any time is only a small percentage of those infected" [26]. This implies that the majority of the 25.3 million African adults and children living with HIV/AIDS [6] can go about their daily living almost as before the infection.

Conclusion

If the objective function that the society wishes to maximize is the per capita gross domestic product (GDP), which is unlikely to be the main one or the only one, it appears that the reduction of HIV/AIDS morbidity is not the best way of pursuing it. Instead, it would be best achieved through investments into education to increase combined primary, secondary and tertiary gross enrolment ratios; domestic capital investments; and exports promotion. However, we must recall that development in all societies strives not just to raise levels of living but also to increase the availability and widen the distribution of basic life-sustaining goods such as shelter, protection, food and health [3]. Thus, it would be dangerous to base the advocacy for investments into prevention and control of any specific disease (including HIV/AIDS) on its burden on per capita gross domestic product alone. Instead, such advocacy efforts should espouse all the three objectives of development, i.e. increasing availability and widening distribution of basic life-sustaining commodities, raising levels of living, and expanding the range of economic and social choices of all the people. Although the production function approach might not be capable of quantifying effects of disease control on these developmental objectives, they might be amenable to costing and contingent willingness-to-pay methods. Therefore, it is recommended that countries should complement HIV/AIDS economic burden estimates obtained through the production function approach with detailed cost estimates derived using the other two methods mentioned above.

In addition to economic burden studies, there is need for three types of studies to guide decision-making:

i. Analysis of demand analysis for various HIV/AIDS interventions [27];
ii. Economic evaluations of alternative ways of preventing and managing HIV/AIDS, to identify those that are most cost-effective; and
iii. Economic viability analysis with a view to identifying the most sustainable financing mechanisms for ensuring access to cost-effective interventions.

Acknowledgements

We are indebted to Jehovah Adonai for his multi-faceted support during the analysis and write-up of this paper. The views and opinions expressed here are authors and should **NOT** be attributed to either the WHO or any of the acknowledged.

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Manuscript received on: January 9 2002, Accepted on: May 20 2002.

APPENDIX: Annual and Lifetime loss in GDP attributable to HIV-AIDS

Countries	HIV/AIDS Death (1999)	Yearly loss in GDP due to AIDS deaths (US$)	Undiscounted Lifetime loss in GDP (US$)	HIV-AIDS Cases	Annual loss in GDP due to HIV/AIDS morbidity (US$)
Angola	15000	11.1	255.6	110000	8.5
Benin	2614	1.9	44.5	54000	4.2
Botswana	24000	17.8	409.0	190000	14.6
Burkina Faso	43000	31.9	732.8	370000	28.5
Burundi	39000	28.9	664.7	260000	20.0
Cameroon	52000	38.5	886.2	320000	24.6
CAR	23000	17.0	392.0	180000	13.9
Chad	10000	7.4	170.4	87000	6.7
Congo	8600	6.4	146.6	100000	7.7
DR Congo	95000	70.4	1619.1	950000	73.2
Cote d'Ivoire	72000	53.4	1227.1	700000	53.9
Equatorial Guinea	120	0.1	2.0	2400	0.2
Ethiopia	280000	207.5	4772	2600000	200.2
Gabon	2000	1.5	34.1	23000	1.8
Gambia	1400	1.0	23.9	13000	1.0
Ghana	33000	24.5	562.4	210000	16.2
Guinea	5600	4.1	95.4	74000	5.7
Guinea-Bissau	1300	1.0	22.2	12000	0.9
Kenya	180000	133.4	3067.7	1600000	123.2
Lesotho	16000	11.9	272.7	85000	6.5
Madagascar	870	0.6	14.8	8600	0.7
Malawi	70000	51.9	1193	710000	54.7
Mali	9900	7.3	168.7	89000	6.9
Mauritania	610	0.5	10.4	6100	0.5
Mozambique	98000	72.6	1670.2	1200000	92.4
Namibia	18000	13.3	306.8	150000	11.6
Niger	6500	4.8	110.8	65000	5.0
Nigeria	250000	185.3	4260.8	2300000	177.1
Rwanda	40000	29.6	681.7	370000	28.5
Senegal	7800	5.8	132.9	75000	5.8
Sierra Leone	8200	6.1	139.8	68000	5.2
South Africa	250000	185.3	4260.8	2900000	223.3
Swaziland	7100	5.3	121.0	84000	6.5
Tanzania	140362	104.0	2392.2	1400000	107.8
Togo	14000	19.4	238.6	170000	13.1
Uganda	110000	81.5	1874.7	930000	71.6
Zambia	99000	73.4	1687.3	770000	59.3
Zimbabwe	160000	118.6	2726.9	1500000	115.5
TOTAL	**2193975**	**1625.7**	**37391.9**	**20736100**	**1596.7**