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THE IMPACT OF HIV/AIDS ON MORTALITY *

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Since 1981, when the first cases of the acquired immunodeficiency syndrome (AIDS) were diagnosed, the world has been facing the deadliest epidemic in contemporary history. By the end of 2002, more than 65 million persons had been infected by HIV and about 42 million were still alive, 38.6 million adults and 3.2 million children. According to the Joint United Nations Programme on HIV/AIDS (UNAIDS), AIDS has become the fourth most important cause of death in the world and it is already the leading cause of death in sub-Saharan Africa (UNAIDS/WHO, 2001). The rapid spread of the disease has meant that in the most affected regions there is an escalating demand for care by those infected and a need to deal with the social and economic consequences of the high levels of morbidity and mortality associated with the disease.

The detrimental impact of the HIV/AIDS epidemic is more strongly felt in developing countries, where 93 per cent of those infected with HIV lived at the end of 2002. Sub-Saharan Africa, with more than 29 million persons living with HIV at that date, remains the region where the highest prevalence levels predominate. However, both the number of infected persons and that of highly affected countries are rising in Asia and Latin America and the Caribbean. It is estimated that by the end of 2002 Asia had more than 7 million persons infected with HIV and that an additional 1.9 million HIV-positive persons lived in Latin America and the Caribbean (UNAIDS/WHO, 2002).

Because many of the people infected with HIV remain healthy for long periods before showing overt signs of immunodeficiency, obtaining reliable data on the number of new infections as they occur is generally not possible. Therefore, most of the data available refer to the prevalence of HIV in specific sub-populations, that is, they reflect the proportion of persons already infected with HIV, but do not provide information on the time when infection occurred. In countries where prevalence levels are below 1 per cent, testing of a large population is necessary to measure prevalence accurately, an approach that is not cost effective, especially if a country's population is large and geographically dispersed. However, even when overall prevalence levels are low, HIV may be spreading rapidly among groups of persons engaging in high-risk behaviours, including injecting drug users or sex workers and their clients. HIV is already present among the high-risk groups of many societies where overall prevalence is still low, causing great uncertainty about the future course of the epidemic in these countries. Spread of the disease among the general population and the consequent rise of prevalence cannot be ruled out although the evidence available is still too weak to permit the identification of countries where a surge of the epidemic is most likely to occur next.

Given the uncertainty surrounding the future course of the epidemic in countries where it is still largely confined to high-risk groups, projections that take explicit account of the impact of HIV/AIDS are made only for countries where prevalence levels have already passed a certain threshold. For the *2002 Revision*, such a threshold is set at a prevalence of 1.9 per cent among persons aged 15-49 by the end of 2001. As in past *Revisions*, any country that was considered as AIDS-affected in previous *Revisions* is again included in the group of affected countries in the *2002 Revision* even if its HIV prevalence among persons aged 15-49 is estimated to be below 1.9 per cent in 2001. In addition, five countries are included because, although their prevalence levels are still very low (below 1 per cent), their large populations imply that they have very substantial numbers of persons already infected with HIV. These five countries are Brazil and India, which were already included in previous *Revisions*, and China, the Russian Federation, and the United States of America, which have been added to the list of AIDS-affected countries for the first time in the *2002 Revision*. In total, the populations of 53 countries were projected taking into account the impact of HIV/AIDS, up from the 45 countries considered in the *2000 Revision*. Since the early 1990s, when the Population Division began incorporating explicitly the effect of HIV/AIDS in projecting the populations of highly affected countries, the number of such countries has more than tripled, rising from the 16 considered in the *1992 Revision* to the 53 listed in table 1. Among the countries considered in the *2002 Revision*, 38 countries are in Africa, five in Asia, eight in Latin America and the Caribbean, one in Europe and one in Northern America.

A. THE PAST AND FUTURE EVOLUTION OF THE HIV EPIDEMIC

The number of persons infected with HIV/AIDS is not evenly distributed among the major areas of the world. Seventy per cent of HIV infected persons in 2001 were located in the countries of sub-Saharan Africa, while this region was home to only 11 per cent of the world's population in that year. Table 2 lists the affected countries according to the level of HIV prevalence among adults aged 15-49 in 2001. The levels of prevalence presented in this table were taken from the United Nations Population Division's application of the HIV/AIDS estimation and projection model. For some countries, the prevalence levels presented in table 2 differ slightly from the UNAIDS estimates listed in table 1 because the former result from fitting the complete path of the epidemic.

The seven most affected countries, those with more than 20 per cent of the population aged 15-49 infected by 2001, are all located in Eastern Africa (Zambia and Zimbabwe) and Southern Africa (Botswana, Lesotho, Namibia, South Africa and Swaziland). These seven countries alone, with a total population of 74 million in 2001, accounted for an estimated 8.7 million HIV-infected persons aged 15-49 in 2001 or 23 per cent of the world total. An additional five countries had prevalence levels between 10 and 20 per cent in 2001. These five countries, located in Eastern Africa (Kenya, Malawi, and Mozambique) and Middle Africa (Cameroon and Central African Republic), had a total population of 80 million and accounted for 5.2 million adult infections in 2001, 14 per cent of the total number of infected adults in the world. A larger group of countries, fourteen, had prevalence levels ranging from 5 to 10 per cent. With the exception of Haiti, all those countries are located in sub-Saharan Africa. They were home to 301 million people in 2001, 9.3 million of whom were adults infected with HIV and accounted for 25 per cent of the world total. The group of twenty-two countries with prevalence levels ranging between 1 and 5 per cent is spread across many parts of Africa, Asia, and Latin America and the Caribbean. Despite the large number of countries in this group and their large overall population (310 million in 2001), they accounted for a relatively small percentage of the world's HIV-infected adults: 4.5 million or 12 per cent. In contrast, the five countries with prevalence levels lower than 1 per cent, whose large populations justified their inclusion as AIDS-affected countries in the *2002 Revision,* accounted for nearly half of the world population (2.9 billion in 2001) and had 6.8 million infected adults in 2001 or 18 per cent of the world total. India alone was estimated to have 3.8 million infected adults in 2001, a number second only to that estimated for South Africa.

Table 2 also displays estimates of the year in which widespread transmission of HIV began in each country. It must be noted that the disease could have been present at a very low level in a population for many years before the onset of widespread transmission, often affecting mostly persons in certain high-risk groups. There is considerable uncertainty surrounding the estimated time of widespread transmission. The estimates presented in table 2 should be taken as indicative, being based on what is known about the history of the epidemic and being consistent with a path for the evolution of HIV incidence that produces prevalence levels close to those observed in the late 1990s and in 2001. Because incidence itself is not measurable (persons infected do not know themselves when they acquired the infection) and many factors need to be taken into account in order to estimate prevalence levels on the basis of incidence estimates, different ways of modelling such factors can lead to different paths for the evolution of incidence over time and still be consistent with observed prevalence levels. For that reason, the new procedures used to model the AIDS epidemic in the *2002 Revision* produce different estimates of the time of onset of widespread transmission from those presented in the *2000 Revision* (United Nations, 2002).

According to table 2, the epidemic first became widespread in the Democratic Republic of the Congo (around 1970) and in Burundi (around 1973). In all other countries, widespread transmission is estimated to have occurred after 1977. In Gabon and Rwanda it began in the late 1970s. For another 25 countries, widespread transmission is estimated to have started in 1980. These include 16 countries in

Africa (located in Eastern, Middle and Western Africa), eight countries in the Americas (including the United States of America) and one in Asia (Thailand). Between 1981 and 1985, widespread transmission started in another 12 countries of Africa and in Brazil. The late 1980s saw the beginning of widespread transmission in countries of Southern Africa, and in Cambodia, India and Myanmar. Widespread transmission of the epidemic in the Russian Federation began in 1990 and in China in 1996. That is, with the exception of the countries in Southern Africa, most of the highly affected countries of Africa began to experience widespread transmission of HIV before 1986, as did most of those in the Americas. The epidemics in Southern Africa, the Russian Federation and most of the affected countries of Asia started in the late 1980s or even in the 1990s.

According to current estimates, the average time elapsed between the year of widespread transmission and the year of peak incidence is 13.8 years, but there is wide variation among countries. For example, in Uganda and Lesotho it is estimated that incidence reached its peak just 6 years after the start of widespread transmission. However, Uganda's incidence peaked at 3.8 per cent per year while Lesotho's rocketed to a level of 8.3 per cent per year (table 3), meaning that the uninfected adult population aged 15 to 49 of Lesotho had one chance in twelve of getting infected during the year of peak incidence. At the opposite end of the spectrum, in seven countries—Sierra Leone, Equatorial Guinea, Dominican Republic, Trinidad and Tobago, Honduras, India, and the United States—the time span between the start of the epidemic and peak incidence is expected to be 20 years or longer. In the United States, for instance, peak incidence is projected to occur in 2011, 31 years after the start of widespread transmission, but it must be noted that HIV incidence declined in the United States during the early 1990s before resuming an upward trend in the late 1990s.

In estimating the path of HIV incidence over time, the dynamics of the HIV/AIDS epidemic are assumed to remain constant until 2010 in terms of the four parameters that determine the model fitted to the time series of prevalence levels estimated by UNAIDS. Constancy of those parameters can be interpreted to mean constancy of the behavioural and epidemiological factors governing the transmission of the disease. After 2010, projections of the annual incidence of HIV infection assume that the rate of recruitment of persons in the group susceptible to infection will decline steadily for the next 40 years and that the probability of transmission of HIV per contact will also decline over time. Because for most countries both incidence and prevalence reach a maximum value before 2010 (see table 3), both incidence and prevalence would have been declining by 2010 even if the model's parameters had remained constant. The use of declining parameter values starting in 2010 accelerates further the decline of both incidence and prevalence levels. Even so, by 2050 prevalence levels are still substantial in the most highly affected countries. In Botswana, for instance, over one fifth of the adult population is projected to be HIV positive in 2050 (that is, prevalence is projected to decline from about 37 per cent in 2001 to 21 per cent in 2050). Similarly, in most of the affected countries, prevalence is projected to stay close to its highest level for a longer period and to decline more slowly after 2010 than it did according to the projections presented in the *2000 Revision*. As a result, for almost all affected countries, the projected HIV prevalence in 2050 is higher in the *2002 Revision* than projected in the *2000 Revision*.

Table 3 presents a few indicators of the dynamics of the epidemic in each affected country according to the estimates and projections of the *2002 Revision*. Incidence and prevalence levels are presented for the year 2001, for the year in which each attains a maximum (the peak values of incidence and prevalence) and in 2050. With the exception of Equatorial Guinea, current estimates indicate that incidence has already peaked in all the HIV-affected countries in sub-Saharan Africa. However, even after incidence begins to decline, prevalence continues to grow, mainly because HIV-positive persons survive several years after infection. Thus, prevalence reaches a maximum between 3 and 10 years after incidence peaks and the year of peak prevalence is more recent or has yet to occur, as in many countries of sub-Saharan Africa. Among the 15 AIDS-affected countries outside of Africa, seven have yet to reach their peak incidence, and only in four—Bahamas, Brazil, Haiti and Thailand—is prevalence estimated to have already reached a maximum.

To conclude this review of estimates and projections of HIV prevalence, figure 1 presents the evolution of annual prevalence levels in the population aged 15-49 for selected HIV-affected countries. Great variation among countries is evident in both the past and future course of the epidemic, and crossovers of prevalence between countries have occurred in the past and are projected to occur in the future. Kenya, for instance, had higher HIV prevalence than Botswana and South Africa until the mid-1990s but, despite the later start of the epidemic in Southern Africa, its rapid spread has driven prevalence in those countries far above that in Kenya. Uganda, which experienced an early and rapid start to the epidemic, has seen a dramatic decline in prevalence due to a concerted national campaign to combat the spread of the disease. The early and swift decline of Uganda's prevalence can be contrasted with the slower and protracted reduction projected for other African countries. Because of the many uncertainties that surround the future course of the epidemic, the projected levels of incidence and the resulting levels of prevalence can at best be taken as indicative of plausible outcomes provided that steps taken to control the epidemic prove successful in the long run.

B. Demographic impact of HIV/AIDS

The impact of AIDS is assessed for the 53 countries listed in table 1 by considering the changes in demographic indicators brought about by the disease. The results of the medium variant of the *2002 Revision*, which explicitly take into account the effect of AIDS, are compared to the results of a set of projections carried out assuming that AIDS did not exist. This second set of projections is referred to as the No-AIDS scenario. Three sets of demographic indicators are examined. The first set gives an overview of population size and growth. The second set consists of indicators of general mortality, including the crude death rate, life expectancy, and the number of deaths, and the third set consists of indicators of infant and child mortality. The indicators are examined in two ways: first at the regional level, that is, with countries grouped by world region, and second, with countries grouped according to their level of adult HIV prevalence in 2001. After this analysis, profiles of three highly affected countries are presented.

1. Population size and growth

The rising numbers of deaths due to AIDS are expected to result in a reduction of population growth and, in some instances, even in a decrease of population size. AIDS affects population growth through two mechanisms: (*1*) an increase in the number of deaths, and (*2*) a reduction in the number of births because infected girls and women die before or during the reproductive period, reducing the number of potential mothers.

Table 4 presents the estimated and projected population size and average annual growth rate for regional groupings of AIDS-affected countries, according to the medium variant and the No-AIDS scenario. The total population of the 53 affected countries in 2000 was 3,644 million, just 23 million less than it would have been in the absence of AIDS. By 2050, the reduction of population size due to AIDS is projected to increase to 479 million or 8 per cent lower than the population projected assuming No-AIDS. The majority of this difference is attributable to Africa, whose population is projected to be 320 million (or 19 per cent) less in 2050 than it would have been in the absence of HIV/AIDS. The second largest reduction is projected to occur in the 5 affected countries of Asia, whose population is expected to be 137 million less in 2050 than in would have been in the absence of AIDS. However, in relative terms, this reduction amounts to just over 4 per cent of the 2050 population of those Asian countries.

The impact of AIDS on the rate of population growth for the 53 affected countries is also projected to be significant. During 2000-2025, AIDS is likely to reduce the average annual rate of growth of the countries involved by nearly 15 per cent, from 1.18 per cent per year to 1.01 per cent annually.

During the next twenty-five years, the relative impact of AIDS on the population growth rate is expected to increase as fertility continues to drop in all countries. Thus, instead of growing at a rate of 0.62 per cent per year, the 53 affected countries will likely grow at a rate of 0.47 per cent annually, a reduction of nearly 25 per cent. At the regional level, the largest relative reductions in the growth rate are projected to occur in the affected countries of Africa and Asia. In the affected countries of Africa as a whole, average annual growth is expected to be cut by 20 per cent and 15 per cent, respectively, during 2000-2025 and 2025-2050. In the five countries of Asia, the reduction of the growth rate is expected to be about 9 per cent in 2000-2025 when the No-AIDS population would have been growing at a rate of 0.9 per cent per year, but it will likely rise to a 34 per cent reduction in 2025-2050 when the No-AIDS population would have been growing at a low 0.26 per cent per year. That is, even though HIV prevalence is projected to decline significantly during 2010-2050, the relative impact of the disease on population growth will become more accentuated over time as continued fertility reductions lead to lower rates of natural increase in the affected countries.

The comparisons made above at the regional level become more marked when countries are grouped according the their level of HIV prevalence in 2001 (see table 5). In the seven most affected countries, whose adult HIV prevalence in 2001 was above 20 per cent, AIDS is projected to bring population growth almost to a halt. Thus, the population of those seven countries is projected to increase by just 4 million people between 2000 and 2050 or less than 1 per cent. In the absence of AIDS, their overall population would have nearly doubled. While the average annual growth rate in this group of countries remains above zero during 2000-2050, in fact their overall population declines over the 2020-2030 decade (data not shown).

Significant relative reductions in the average annual rate of growth are also noticeable among the group of countries whose HIV prevalence in 2001 ranged from 10 to 20 per cent. The overall population of those countries, which would have more than doubled between 2000 and 2050 to attain 195 million, is expected to be instead 133 million or 62 million less than without AIDS. In addition, their population growth rate is projected to be about 40 per cent lower with AIDS than without.

The population reductions projected for other groups of countries are less striking, especially in relative terms. However, it bears noting that whereas the groups of countries with an adult HIV prevalence of 10 per cent or higher account for 28 per cent of the overall population reduction associated with HIV/AIDS, those with prevalence levels of less than one per cent account for 30 per cent of the overall reduction and those with levels ranging from 5 to 10 per cent account for another 29 per cent. Furthermore, among the very populous affected countries that still have very low HIV prevalence, the impact of AIDS in reducing the population growth rate is striking after 2025: during 2025-2050 the population of that group of countries is projected to grow 30 per cent less rapidly than it would in the absence of AIDS.

To conclude, it bears emphasizing that the impact of AIDS in reducing population size is due both to excess deaths and to a deficit of births. In fact, 62 per cent of the 479 million reduction of the population in 2050 is due to “excess deaths” (which could be explained in very general terms as deaths projected to occur earlier than they would if there were no AIDS). The other 38 per cent is accounted for by “missing births,” that is, births that will not occur because HIV-infected women are projected to die before the end of their reproductive life. The share of the population deficit attributable to missing births grows steadily over the course of the projection period (figure 2).

2. Population structure

The excess and premature mortality caused by AIDS has a major impact not only on population size but also on the age structure of an affected population. The most striking impact of the disease can be ascertained by focusing on the case of the seven most affected countries. In 2000, as the age pyramid

shown in figure 3 illustrates, the differences between the estimates reflecting the impact of AIDS and the No-AIDS scenario is already noticeable, particularly among children under 10 and adults between the ages of 25 and 54. And the differences by age are expected to become more accentuated in the future. By 2025, as figure 4 shows, the impact of the disease is dramatic at all ages, with age groups 35-65 being particularly hollowed out by the premature deaths caused by AIDS. Similar effects, but less striking, are noticeable among other groups of countries with lower prevalence levels of the disease.

In the 5 populous countries where HIV prevalence is currently below 1 per cent, the impact on the age and sex structure of the population will be quite small despite the large number of AIDS deaths that these countries will experience. Figure 5 shows the projected age structure in 2025 of those five countries combined. The effect of mortality on the age structure is noticeable among adults, but the impact on the number of births and child mortality will be small.

3. General mortality

Since there is as yet no cure for AIDS and virtually everyone who is infected by HIV eventually dies of the disease, the most immediate effect of the epidemic is to increase mortality. Even in developed countries, where various means of treatment can prolong the lives of those infected by HIV, AIDS is still contributing to raise mortality rates above the levels they would have had in the absence of the disease. In most developing countries, particularly those in sub-Saharan Africa, the drug therapy that can delay the onset of the life-threatening symptoms of AIDS is still largely inaccessible. Consequently, as table 6 indicates, in 2000-2005 the 38 affected countries in sub-Saharan Africa are expected to experience 14.8 million more deaths than they would have in the absence of AIDS. Among all 53 affected countries, the total number of excess deaths during that period is expected to amount to 19.8 million, implying that the countries of sub-Saharan Africa will account for 75 per cent of the excess deaths brought about by the epidemic in all the affected countries during 2000-2005. A further 3.5 million excess deaths will occur in Asia, with India accounting for most of them. In Latin American and the Caribbean, the number of excess deaths is lower, amounting to 0.7 million, and in the two more developed countries, excess deaths are expected to total 0.8 million.

Because HIV-infected adults have a median survival time of about 10 years after contracting the infection, the maximum number of excess deaths will occur after the maximum prevalence is reached. In all regions except Asia, the excess number of deaths will continue rising until 2015-2020 (not shown). In Asia, the peak is expected to occur five years later, in 2020-2025. In the affected countries of sub-Saharan Africa, excess deaths are projected to account for over 40 per cent of all deaths occurring between 2010 and 2025. Even by 2045-2050, sub-Saharan Africa will still experience 13 per cent more deaths than it would have in the absence of AIDS. In all other regions, the proportion of excess deaths expected in 2045-2050 is very low (below 3 per cent), partly because in the No-AIDS scenario the number of deaths increases to higher levels than in the projection incorporating the effect of AIDS. That is, in the absence of AIDS, there would be more people and more of them would survive longer. Therefore, if the No-AIDS scenario were extended long enough, at some point the number of deaths it produces would surpass those in the AIDS scenario, even if prevalence levels remained significant.

Comparisons can also be made in terms of the crude death rate (CDR), a general indicator of mortality. However, because the CDR is influenced by the age structure of the population, it is not strictly comparable between countries. In conditions of improving mortality the CDR will decline, but when improving mortality is accompanied by declining fertility, the age structure of the population shifts to older ages and eventually the CDR will rise as the elderly, who have the highest death rates, make up a rising proportion of the population. Consequently, examination of the effect of AIDS on the CDR will be confounded by the differing age structures of populations in different regions. For all 53 affected countries, the CDR would be expected to decline until 2015-2020 and then gradually rise even in the absence of AIDS. Owing to the impact of AIDS, the increase in the CDR is projected to occur earlier, in

2000-2005. In the affected countries of Africa, the No-AIDS scenario projects a decline in the CDR throughout the projection horizon. With AIDS, the affected countries of Africa experienced an outright increase in the CDR from 1990-1995 to 2000-2005, but a decline is expected to resume in 2005-2010. In the other three regional groups of affected countries, an increase in the CDR is expected even in the No-AIDS scenario due to population aging, but AIDS will cause the CDR to increase earlier.

Due to the extremely high number of excess deaths in sub-Saharan Africa, life expectancy in the affected African countries as a whole is projected to fall to 45.3 years in 2000-2005. The widest difference in life expectancy between the projection with AIDS and the No-AIDS scenario is projected for 2010-2015, when life expectancy in the affected countries of Africa will be 11.3 years or 19 per cent lower than without AIDS. The impact of AIDS on life expectancy in the affected countries of Africa remains substantial during the rest of the projection period. In 2045-2050, AIDS is still projected to produce a deficit of 7.8 years of life expectancy in that group of countries.

The effect on life expectancy in other regions is projected to be milder. In Asia, the reduction of life expectancy because of AIDS is expected to grow from 1.1 years in 2000-2005 until it reaches a maximum of 3.3 years in 2025-2030. In Latin America and the Caribbean, the largest deficit in life expectancy, 1.9 years, is projected to occur in 2015-2020. In the two more developed countries, the effect on life expectancy will peak at 2.3 years in 2015-2020.

Differences in all the mortality indicators become more marked when the groups of countries considered are those most highly affected by the epidemic (table 7). In the seven countries with adult HIV prevalence of 20 per cent or more in 2001, the impact of AIDS on mortality is staggering. In 2000-2005, these countries are expected to experience 155 per cent more deaths and a crude death rate that is 175 per cent higher than those projected in the absence of AIDS. Life expectancy in this period is expected to be 22.4 years, or 35 per cent, lower than without AIDS. And the detrimental impact of the disease is projected to rise further in future periods. By 2010-2015, life expectancy in the seven most affected countries will be 29.4 years lower, and the crude death rate 274 per cent higher, than in the No-AIDS scenario. Given that the reduction of HIV prevalence is projected to be gradual, even by 2045-2050 those seven countries are projected to have still a crude death rate that will be 112 per cent higher and a life expectancy expected to be 22.4 years lower than in the No-AIDS scenario. The number of deaths in 2045-2050 is projected to be 11 per cent lower than without AIDS. As discussed above, the relative impact of AIDS on the crude death rate and life expectancy is larger than on total deaths because by 2045-2050 both the population and the number of aged persons is larger in the No-AIDS scenario than in the projections that take account of the impact of AIDS.

In the groups of countries with HIV prevalence lower than 20 per cent, AIDS still has a major impact on general mortality. For example, in the group of countries with adult HIV prevalence ranging from 10 to 20 per cent in 2001, the CDR in 2010-2015 is projected to be more than double and life expectancy is expected to be 17.2 years lower than in the No-AIDS scenario. Even countries with HIV prevalence below 1 per cent will have a life expectancy in 2020-2025 that is 3 years below that projected in the absence of AIDS, and the number of deaths in that period will be 12.9 per cent higher it would have been without AIDS.

The impact of AIDS on mortality differs by sex, as shown in table 8. For the 53 affected countries as a whole, males are projected to experience 6 million more excess deaths than females over the period 2000-2020, but the percentage increase over the No-AIDS scenario will be higher for females (16.9 per cent) than for males (16.4 per cent). However, the similarity of the impact by sex at the aggregate level masks considerable variation by region. In the affected countries of Africa, females are expected to experience 7 million more excess deaths than males, while in the affected countries of Asia, AIDS deaths to males will likely exceed those to females by 10 million. In the affected countries of Latin America and the Caribbean, males are expected to experience a higher number of excess deaths than females, but in

relative terms females are expected to experience 10.2 per cent more deaths than in the No-AIDS scenario, whereas for males the equivalent percentage is 9.9 per cent. In the two affected countries of the developed world (the Russian Federation and the United States) the number of excess deaths among males is expected to be more than twice as high as that for females. The differing impact by region is due to different assumptions about the sex ratio of transmission over the course of the epidemic which reflects current patterns in the relative susceptibility to infection by sex.

Because AIDS affects mostly persons in the reproductive ages, it has a very noticeable impact on the age distribution of deaths, raising those among adults aged 25-49 and reducing the number of deaths at advanced ages (in general, 65 and over) because less people survive that long. A comparison of the deaths expected during 2000-2020 in the projections that incorporate the effect of AIDS and those in the No-AIDS scenario by age shows clearly the pattern described (table 9). In the 53 affected countries taken together, the projections with AIDS produce 43 million excess deaths among those aged 25-34 and another 45 million among those aged 35-49. There is also some excess mortality among younger age groups (16 million deaths under age 15 and nearly 5 million among those aged 15-24) and among those aged 50-64 (7 million), but the bulk of AIDS impact is concentrated among those aged 25-49. Indeed, deaths to those aged 25-49 account for 20 per cent of all deaths in the projections with AIDS instead of the 11 per cent expected according to the No-AIDS scenario. Among those aged 65 or over, in contrast, the number of deaths in the projection that incorporates AIDS is lower than in the No-AIDS scenario because fewer people survive to age 65 or over when AIDS is present.

Figures 6 and 7 illustrate the shift caused by AIDS in the age distribution of deaths. The share of deaths to those under age 5 and those aged 50 or older—that is, the two age groups that jointly account for the largest proportion of deaths in populations not affected by AIDS—decline dramatically when AIDS becomes a major cause of death and the share of deaths to persons aged 25-49 increases. The impact of AIDS is particularly striking among the countries where HIV prevalence was higher than 20 per cent in 2001. In those countries, a full 54 per cent of the deaths expected in 2000-2020 will be to persons aged 25 to 49 years of age. The increase in the number of deaths at ages 25-49 is even more dramatic when illustrated in absolute terms, as in figures 6b and 7b, which also show that the number of deaths at ages 0-4 is projected to be much higher than without AIDS, despite the decreased percentage share of this age group. Also visible is the slight reduction in the number of deaths at ages 65 and above.

4. Infant and child mortality

HIV/AIDS affects infants and children who acquire the disease from their infected mothers during pregnancy and delivery or through breastfeeding. In the absence of treatment, about one third of children born to HIV-positive women acquire the infection from their mothers. The prevalence of HIV in infants and children affects mortality in childhood. It is currently estimated that almost two-thirds of HIV-positive children survive past their first birthday. Consequently, in the countries affected by the HIV/AIDS epidemic, its effect on mortality in childhood is greater on mortality rates between the ages of 1 and 5 than on infant mortality (i.e., below age one). Furthermore, because women who are HIV-positive have, on average, lower fertility than other women, the overall impact of the epidemic on children is dampened.

Thus, even taking into account the effect of AIDS, infant mortality for all 53 affected countries declines from 70 deaths per 1,000 births in 1990-1995 to 24 deaths per 1,000 births in 2045-2050 (table 10). The effect of AIDS on infant mortality is strongest in the affected countries of Africa, where in 2000-2005 AIDS is expected to cause infant mortality to be higher by 5 deaths per 1,000 births than in the No-AIDS scenario. In all other regions the effect of AIDS on infant mortality is small although, in relative terms, it is moderate on the already very low infant mortality of the two developed countries affected by the epidemic, implying that AIDS is likely to be responsible for a 5 to 6 per cent increase in their infant mortality after 2010.

The effect of AIDS on under-five mortality is more marked than on infant mortality but, just as in the case of infant mortality, AIDS is not projected to reverse the declining trend in under-five mortality at the regional level. For the group of all 53 affected countries, under-five mortality is projected to be 7.8 per cent higher in 2000-2005 than it would be without AIDS, compared to an excess of 2.2 per cent for infant mortality, and although the relative impact of AIDS is expected to increase to 13.3 per cent in 2045-2050, by that time under-five mortality is projected to be nearly two-thirds lower than in 2000-2005 (33 deaths per 1,000 births vs. 92 deaths per 1,000 births). As expected, the effect of AIDS on under-five mortality is particularly high in the affected countries of Africa where 19 additional child deaths per 1,000 births are expected in 2000-2005 than there would have been without AIDS. But even for the affected countries of Africa, under-five mortality is expected to decline from 161 deaths per 1,000 births to 53 deaths per 1,000 births between 2000-2005 and 2045-2050. For the affected countries in all other regions, the absolute effect of AIDS on under-five mortality is considerably smaller with the result that significant reductions of mortality in childhood are projected even in the presence of AIDS.

The increases of mortality in childhood associated with AIDS are more striking when we consider countries grouped according to prevalence level, as in table 11. For the group of countries with HIV prevalence above 20 per cent in 2001, both infant mortality and under-five are estimated or projected to increase during 1990-2005. For all other prevalence groups, AIDS has not reversed the downward trend in infant and child mortality rates but it has already slowed down that decline and is projected to continue doing so over the foreseeable future.

The AIDS epidemic is also having an impact on mortality rates between ages 5 and 15. According to the survivorship estimates for children infected by HIV used in projecting the impact of the disease, about 40 per cent of infected children survive to their fifth birthday and more than 10 per cent will survive to their tenth birthday. Because non-AIDS mortality at these ages is extremely low, the relative impact of AIDS mortality on the age-specific death rates at ages 5-9 and 10-14 is quite large.

C. COUNTRY PROFILES

This section focuses on the cases of three countries: Zimbabwe in Eastern Africa, and Botswana and South Africa in Southern Africa. In all of them HIV prevalence levels are very high. Botswana and Zimbabwe had the two highest proportions of HIV-positive persons among their adult populations in 2001. But, whereas the epidemic in Zimbabwe had started in the early 1980s, the start of the epidemic in Botswana was more recent. Also recent was the epidemic raging in South Africa, where the epidemic has expanded very rapidly. In all three countries, the demographic impact of HIV/AIDS has already been significant and is expected to become severe over the medium-term future. It is of interest, therefore, to present these cases in some detail.

In Botswana, the country with the highest HIV prevalence in 2001, over one out of every three adults is HIV-positive. According to current projections of the future incidence of HIV infection, in Botswana, out of every 100 persons aged 15 in 2000, 69 will contract HIV before their fiftieth birthday. Life expectancy in Botswana has already dropped from 65 years in 1990-1995 to 56.3 years in 1995-2000 and is projected to fall dramatically to 39.7 years in 2000-2005 (table 12), a figure about 28 years lower than the life expectancy projected in the absence of AIDS. The decline in life expectancy is projected to bottom out in 2010-2015 at a level of 31.6 years and, even with a projected decline in HIV prevalence, life expectancy is still projected to be a low 43.6 years in 2045-2050. Before the AIDS epidemic hit, Botswana had one of the lowest child mortality rates in sub-Saharan Africa. Today, its under-five mortality is estimated at 104 deaths per 1,000 births, up from 63 deaths per 1,000 in 1990-1995. Although mortality under age five is projected to decline gradually after 2005, it will take 30 years to reach again

the level it had in 1990-1995. In fact, the projected level of under-five mortality in 2035-2040 is almost four times as high as that projected for the same period in the absence of AIDS.

Because of increased mortality, population growth in Botswana has already been significantly reduced and population decline is projected to begin in 2005-2010. The average annual growth rate of Botswana's population dropped from 3.3 per cent per year in 1980-1985 to 2.1 per cent in 1995-2000 and is expected to decline further to –0.4 per cent per year in 2005-2010 (figure 8). By 2050, Botswana's population is expected to be 1.4 million, 20 per cent smaller than its population in 2000 and 63 per cent lower than the population projected for 2050 in the absence of AIDS.

In Zimbabwe one out of every three adults is HIV-positive and out of 100 persons aged 15 in 2000, 69 are expected to contract the virus before age 50. Because the epidemic started earlier in Zimbabwe than in Botswana, its detrimental effects were also more pronounced earlier. In 1995-2000, Zimbabwe's life expectancy had already dropped to 41 years, 25 years below the level projected in the absence of AIDS. And even further reductions in average survivorship are expected in the future. Today, Zimbabwe's life expectancy is about 33 years and, despite a decline in the prevalence of HIV after 2010, the dramatic effect of AIDS on life expectancy is projected to diminish only minimally in the future. By 2045-2050, when Zimbabwe's life expectancy is projected to be 45.7 years it will still be 30 years lower than if AIDS had never existed (figure 9).

As in the case of Botswana, the impact of HIV/AIDS on population growth in Zimbabwe has been staggering. Estimated at 3.9 per cent per year in 1980-1985, the annual growth rate fell to 1.5 per cent in 1995-2000 and will likely fall further to just 0.5 per cent in 2000-2005. By 2050, Zimbabwe's projected population will be 61 per cent lower than the population projected without AIDS.

In South Africa, the epidemic started later than in Eastern and Middle Africa. Yet, by 2001, one out of every five adults in the country was infected by the disease. While HIV prevalence is lower than in neighbouring Botswana and Zimbabwe, because of its larger population South Africa has more than double the number of persons infected of the two other countries combined. According to projected levels of future HIV incidence, 48 out of every 100 persons aged 15 in South Africa in 2000 will likely become infected by age 50. Although the full impact of the epidemic is yet to be felt, projections over the next decade or two reveal a dire situation. Life expectancy, which was barely affected in 1990-1995, is projected to drop to 41.5 years by 2010-2015, 26.8 years below the level it would have had in the absence of AIDS.

When the higher mortality induced by HIV infection is coupled with the low fertility levels prevalent in South Africa, the country is expected to begin experiencing population decline in 2005-2010 (figure 10) and continued population reductions are projected to persist until 2050. By then, South Africa's population is expected to be 9 per cent lower than the country's population in 2000 and 44 per cent lower than the 2050 population projected in the absence of AIDS.

D. Conclusion

As this chapter has shown, for the 53 countries where adult HIV prevalence is significant, the epidemic has already affected demographic trends in serious ways. Furthermore, in most countries, the epidemic is still far from running its course. Increases in mortality, particularly at ages 25 to 49, have been common, resulting in outright reductions in life expectancy. But, although prevalence is estimated to have already peaked in many countries, the major impact of AIDS in terms of increased mortality is expected to become more serious over the medium-term future. Furthermore, in the affected countries, the cumulative effects of AIDS on population growth are dramatic. By 2050, world population is expected to be 479 million lower than it would have been in the absence of AIDS. Africa alone is expected to have 320 million fewer inhabitants in 2050 than it would have had without AIDS. At the world level, the

population deficit associated with AIDS results from 297 million premature deaths and 182 million fewer births because of the early demise of infected women.

In considering this assessment of the demographic impact of HIV/AIDS, the reader should bear in mind that there is much uncertainty surrounding both the estimated prevalence of the disease in different populations and the path that the epidemic will follow in the future. Furthermore, more needs to be known about the dynamics of the epidemic itself. For example, it is not certain that the progression from HIV infection to AIDS and from AIDS to death will occur according to the same model schedule in all populations or even in most populations in a geographical region. The introduction of therapies that increase the survivorship of infected persons would require the use of different models. Similarly, estimates of the chances of transmission of the disease from mother to child also need to be validated in a variety of settings, and will need modification if concerted action is taken to prevent mother-to-child transmission by the use of appropriate drug therapy. Changes in the assumptions made regarding any of these modelling inputs could result in sizeable changes in the projection results. Consequently, the data presented here should at best be considered as indicative of the possible toll that the epidemic might take under the specific assumptions made.

Another element of uncertainty is related to the impact that a reduction of fertility among HIV-positive women may have on the estimation of HIV prevalence. If fertility is considerably lower among HIV-positive women, available estimates of HIV prevalence may be downwardly biased (Gregson and Zaba, 1998). To improve overall estimates of prevalence, it is necessary to obtain information about HIV prevalence among men and to improve the quality of seroprevalence surveillance carried out among pregnant women visiting antenatal clinics, the cornerstone of most national estimates of HIV prevalence today.

Despite the uncertainties surrounding any measure of the impact of HIV/AIDS, it is important to underscore that all available evidence points to the same conclusion: the disease is already widespread in many countries and shows few signs of being controlled in others. The list of significantly affected countries has been increasing steadily since 1990. The estimates and projections discussed in this chapter, which already show a devastating impact of the disease, are based on an assumption that starting in 2010 behaviours that reduce the proportion of adults at risk of infection and the chance that sex with an infected person will lead to infection will be gradually adopted. If these assumptions are not borne out, the impact of the epidemic could turn out to be worse than anticipated. Governments, the international community and civil society urgently need to raise people's awareness of the seriousness of the AIDS epidemic and take the actions necessary to produce the behavioural changes upon which the assumptions are based.

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TABLE 1. COUNTRIES FOR WHICH THE DEMOGRAPHIC IMPACT OF HIV/AIDS IS EXPLICITLY INCLUDED IN THE *2002 REVISION* OF THE OFFICIAL UNITED NATIONS ESTIMATES AND PROJECTIONS

	Country	*Estimated number of HIV positive persons aged 15-49 in 2001*	*HIV prevalence among persons aged 15-49 (percentage)*
Africa			
1	Angola	320 000	5.5
2	Benin	110 000	3.6
3	Botswana	300 000	38.8
4	Burkina Faso	380 000	6.5
5	Burundi	330 000	8.3
6	Cameroon	860 000	11.8
7	Central African Republic	220 000	12.9
8	Chad	130 000	3.6
9	Congo	99 000	7.2
10	Côte d'Ivoire	690 000	9.7
11	Democratic Republic of the Congo	1 100 000	4.9
12	Djibouti [1]	30 000	7.1
13	Equatorial Guinea	5 500	3.4
14	Eritrea	49 000	2.8
15	Ethiopia	1 900 000	6.4
16	Gabon [1]	27 000	3.6
17	Gambia	7 900	1.6
18	Ghana	330 000	3.0
19	Guinea [1]	78 000	1.8
20	Guinea-Bissau	16 000	2.8
21	Kenya	2 300 000	15.0
22	Lesotho	330 000	31.0
23	Liberia [1]	114 000	6.5
24	Malawi	780 000	15.0
25	Mali	100 000	1.7
26	Mozambique	1 000 000	13.0
27	Namibia	200 000	22.5
28	Nigeria	3 200 000	5.8
29	Rwanda	430 000	8.9
30	Sierra Leone	150 000	7.0
31	South Africa	4 700 000	20.1
32	Sudan	410 000	2.6
33	Swaziland	150 000	33.4
34	Togo	130 000	6.0
35	Uganda	510 000	5.0
36	United Republic of Tanzania	1 300 000	7.8
37	Zambia	1 000 000	21.5
38	Zimbabwe	2 000 000	33.7

	Country	Estimated number of HIV positive persons aged 15-49 in 2001	HIV prevalence among persons aged 15-49 (percentage)
Asia			
1	Cambodia	160 000	2.7
2	China	850 000	0.1
3	India	3 800 000	0.8
4	Thailand	650 000	1.8
5	Myanmar [1]	594 000	2.0
Latin America and the Caribbean			
1	Bahamas	6 100	3.5
2	Belize	2 200	2.0
3	Brazil	600 000	0.7
4	Dominican Republic	120 000	2.5
5	Guyana	17 000	2.7
6	Haiti	240 000	6.1
7	Honduras	54 000	1.6
8	Trinidad and Tobago	17 000	2.5
More developed countries			
1	Russian Federation	700 000	0.9
2	United States of America	890 000	0.6

Source: Report on the Global HIV/AIDS Epidemic 2002, Joint United Nations Programme on HIV/AIDS and World Health Organization (Geneva), July 2002.

[1] Data for Djibouti, Gabon, Guinea, Liberia, and Myanmar were not reported in the source publication. The figures given here are estimates by the United Nations Population Division.

TABLE 2. ADULT HIV PREVALENCE, YEAR OF WIDESPREAD TRANSMISSION AND YEAR OF PEAK INCIDENCE FOR THE 53 AFFECTED COUNTRIES

	Country	*Adult HIV prevalence (2001)*	*Year when widespread transmission began*	*Year when HIV incidence peaks*	*Years elapsed between start of widespread transmission and peak incidence*
Countries with adult HIV prevalence above 20 per cent					
1	Botswana	36.5	1988	1997	9
2	Zimbabwe	33.9	1980	1993	13
3	Swaziland	33.7	1987	1995	8
4	Lesotho	30.1	1989	1995	6
5	Namibia	22.2	1986	1996	10
6	Zambia	21.6	1980	1991	11
7	South Africa	21.3	1987	1997	10
Countries with adult HIV prevalence between 10 per cent and 20 per cent					
1	Malawi	16.1	1980	1993	13
2	Kenya	15.0	1982	1994	12
3	Central African Republic	12.9	1980	1992	12
4	Mozambique	12.8	1985	1995	10
5	Cameroon	11.8	1985	1997	12
Countries with adult HIV prevalence between 5 per cent and 10 per cent					
1	Côte d'Ivoire	9.6	1980	1991	11
2	Rwanda	9.1	1978	1991	13
3	Burundi	8.3	1973	1987	14
4	United Republic of Tanzania	7.8	1980	1992	12
5	Congo	7.1	1983	1990	7
6	Djibouti	7.1	1980	1998	18
7	Sierra Leone	6.7	1981	2001	20
8	Ethiopia	6.5	1980	1994	14
9	Liberia	6.5	1981	1999	18
10	Burkina Faso	6.4	1980	1991	11
11	Haiti	6.1	1980	1988	8
12	Togo	6.0	1984	1993	9
13	Nigeria	5.8	1982	1997	15
14	Angola	5.5	1981	1999	18
Countries with adult HIV prevalence between 1 per cent and 5 per cent					
1	Democratic Republic of the Congo	4.9	1970	1988	18
2	Uganda	4.4	1980	1986	6
3	Benin	3.6	1985	1997	12
4	Chad	3.6	1980	1993	13
5	Gabon	3.6	1979	1992	13
6	Bahamas	3.5	1980	1990	10

TABLE 2 (*continued*)

	Country	*Adult HIV prevalence (2001)*	*Year when widespread transmission began*	*Year when HIV incidence peaks*	*Years elapsed between start of widespread transmission and peak incidence*
7	Equatorial Guinea	3.4	1981	2003	22
8	Ghana	2.8	1980	1992	12
9	Guinea-Bissau	2.8	1980	1999	19
10	Eritrea	2.8	1983	1999	16
11	Cambodia	2.7	1988	1998	10
12	Guyana	2.7	1980	1996	16
13	Sudan	2.6	1990	1999	9
14	Dominican Republic	2.5	1980	2000	20
15	Trinidad and Tobago	2.5	1980	2003	23
16	Belize	2.1	1980	1997	17
17	Myanmar	2.0	1988	2005	17
18	Guinea	1.8	1980	1994	14
19	Thailand	1.8	1980	1989	9
20	Gambia	1.6	1980	1992	12
21	Mali	1.6	1980	1992	12
22	Honduras	1.6	1980	2007	27
Countries with adult HIV prevalence below 1 per cent					
1	India	0.8	1988	2014	26
2	Russian Federation	0.8	1990	2003	13
3	Brazil	0.6	1982	1993	11
4	United States of America	0.4	1980	2011	31
5	China	0.1	1996	2008	12

TABLE 3. HIV INCIDENCE AND PREVALENCE AMONG THE POPULATION AGED 15-49 IN 2001 AND 2050, PEAK INCIDENCE AND PREVALENCE, AND YEARS WHEN PEAK INCIDENCE AND PREVALENCE OCCUR FOR THE AFFECTED COUNTRIES

	Country	*Incidence in 2001 (percentage)*	*Prevalence in 2001 (percentage)*	*Year in which incidence peaks*	*Peak incidence (percentage)*	*Year in which prevalence peaks*	*Peak prevalence (percentage)*	*Incidence in 2050 (percentage)*	*Prevalence in 2050 (percentage)*
Africa									
1	Angola	0.88	5.5	1999	0.90	2006	6.1	0.19	1.8
2	Benin	0.45	3.6	1997	0.63	2002	3.6	0.17	1.6
3	Botswana	3.88	36.5	1997	7.24	2002	36.8	2.04	20.9
4	Burkina Faso	0.71	6.4	1991	1.31	1996	7.3	0.29	2.5
5	Burundi	1.15	8.3	1987	1.58	1993	10.1	0.38	3.4
6	Cameroon	1.61	11.8	1997	1.99	2003	12.2	0.61	5.8
7	Central African Republic	1.43	12.9	1992	2.15	1998	13.2	0.65	6.1
8	Chad	0.40	3.6	1993	0.64	1998	3.8	0.16	1.4
9	Congo	0.98	7.1	1990	2.08	1993	8.3	0.45	4.0
10	Côte d'Ivoire	1.06	9.6	1991	1.96	1996	11.0	0.31	3.1
11	Democratic Republic of the Congo	0.69	4.9	1988	0.73	1996	5.0	0.22	2.0
12	Djibouti	1.07	7.1	1998	1.11	2005	7.5	0.23	2.2
13	Equatorial Guinea	0.61	3.4	2003	0.63	2009	4.4	0.08	0.8
14	Eritrea	0.47	2.8	1999	0.48	2007	3.2	0.12	1.2
15	Ethiopia	0.76	6.5	1994	1.02	2000	6.5	0.30	2.8
16	Gabon	0.39	3.6	1992	0.62	1997	3.8	0.10	1.0
17	Gambia	0.18	1.6	1992	0.29	1997	1.8	0.06	0.6
18	Ghana	0.33	2.8	1992	0.54	1997	3.1	0.10	1.0
19	Guinea	0.20	1.8	1994	0.30	1999	1.9	0.06	0.6
20	Guinea-Bissau	0.43	2.8	1999	0.44	2005	3.0	0.11	1.0
21	Kenya	1.81	15.0	1994	2.54	2000	15.1	1.07	10.1
22	Lesotho	2.65	30.1	1995	8.30	1999	30.7	1.92	17.9
23	Liberia	1.01	6.5	1999	1.06	2006	7.2	0.26	2.4
24	Malawi	1.87	16.1	1993	2.74	1998	16.7	0.80	7.2
25	Mali	0.19	1.6	1992	0.32	1996	1.8	0.08	0.6
26	Mozambique	1.30	12.8	1995	2.41	2000	12.9	0.71	6.6
27	Namibia	2.42	22.2	1996	3.95	2001	22.2	1.03	10.1
28	Nigeria	0.83	5.8	1997	0.91	2005	6.1	0.43	3.8
29	Rwanda	0.95	9.1	1991	1.69	1996	9.8	0.31	3.0

	Country	Incidence in 2001 (percentage)	Prevalence in 2001 (percentage)	Year in which incidence peaks	Peak incidence (percentage)	Year in which prevalence peaks	Peak prevalence (percentage)	Incidence in 2050 (percentage)	Prevalence in 2050 (percentage)
30	Sierra Leone	1.17	6.7	2001	1.17	2008	8.1	0.21	2.0
31	South Africa	2.51	21.4	1997	3.88	2002	21.7	0.81	8.6
32	Sudan	0.49	2.6	1999	0.57	2004	2.9	0.15	1.4
33	Swaziland	3.27	33.7	1995	6.99	2000	33.8	1.96	19.5
34	Togo	0.69	6.0	1993	1.16	1999	6.0	0.44	3.9
35	Uganda	0.39	4.4	1986	3.81	1989	13.3	0.06	0.7
36	United Republic of Tanzania	0.77	7.8	1992	1.51	1997	8.8	0.20	1.9
37	Zambia	2.38	21.6	1991	4.09	1996	23.2	1.05	10.0
38	Zimbabwe	3.77	33.9	1993	5.28	2000	34.0	1.17	12.5
Asia									
1	Cambodia	0.41	2.7	1998	0.53	2004	2.9	0.20	1.8
2	China	0.05	0.1	2008	0.15	2016	1.1	0.06	0.6
3	India	0.15	0.8	2014	0.24	2019	1.9	0.05	0.6
4	Myanmar	0.37	2.0	2005	0.38	2011	2.9	0.13	1.3
5	Thailand	0.13	1.8	1989	0.40	1994	2.4	0.04	0.4
Latin America and the Caribbean									
1	Bahamas	0.44	3.5	1990	0.67	1995	3.7	0.23	2.3
2	Belize	0.29	2.1	1997	0.31	2005	2.2	0.09	1.0
3	Brazil	0.06	0.6	1993	0.12	1998	0.7	0.01	0.2
4	Dominican Republic	0.40	2.5	2000	0.40	2010	3.0	0.15	1.4
5	Guyana	0.34	2.7	1996	0.39	2004	2.7	0.20	2.0
6	Haiti	0.86	6.1	1988	1.65	1992	7.7	0.25	2.3
7	Honduras	0.30	1.6	2007	0.33	2013	2.5	0.09	0.9
8	Trinidad and Tobago	0.43	2.5	2003	0.43	2009	3.4	0.08	0.9
More developed countries									
1	Russian Federation	0.20	0.8	2003	0.23	2009	1.6	0.05	0.5
2	United States of America	0.05	0.4	2011	0.07	2018	0.6	0.02	0.2

TABLE 4. ESTIMATED AND PROJECTED POPULATION SIZE AND ANNUAL GROWTH RATE ACCORDING TO THE MEDIUM VARIANT ("WITH AIDS") AND TO THE NO-AIDS SCENARIO ("WITHOUT AIDS") BY REGIONAL GROUP OF AFFECTED COUNTRIES, 2000-2050

	Population size (millions)			*Annual growth rate (percentage)*	
Groups of affected countries	*2000*	*2025*	*2050*	*2000-2025*	*2025-2050*
All 53 affected countries					
With AIDS	3 644	4 687	5 264	1.01	0.47
Without AIDS	3 667	4 921	5 744	1.18	0.62
Difference	-23	-235	-479	-0.17	-0.15
Percentage difference	-0.6	-4.8	-8.3	-14.5	-24.7
38 countries in Africa					
With AIDS	603	983	1 384	1.96	1.37
Without AIDS	619	1 139	1 704	2.44	1.61
Difference	-16	-156	-320	-0.48	-0.24
Percentage difference	-2.6	-13.7	-18.8	-19.8	-15.1
5 countries in Asia					
With AIDS	2 414	2 970	3 098	0.83	0.17
Without AIDS	2 419	3 034	3 235	0.91	0.26
Difference	-5	-65	-137	-0.08	-0.09
Percentage difference	-0.2	-2.1	-4.2	-8.6	-34.2
8 countries in Latin America and the Caribbean					
With AIDS	197	251	273	0.96	0.33
Without AIDS	198	257	282	1.03	0.37
Difference	-1	-6	-9	-0.07	-0.04
Percentage difference	-0.5	-2.2	-3.2	-6.9	-11.2
2 more developed countries					
With AIDS	431	482	510	0.45	0.22
Without AIDS	432	491	524	0.51	0.26
Difference	-1	-9	-13	-0.06	-0.03
Percentage difference	-0.3	-1.7	-2.6	-11.6	-13.0

TABLE 5. ESTIMATED AND PROJECTED POPULATION SIZE AND ANNUAL GROWTH RATE ACCORDING TO THE MEDIUM VARIANT ("WITH AIDS") AND TO THE NO-AIDS SCENARIO ("WITHOUT AIDS") BY PREVALENCE GROUP OF AFFECTED COUNTRIES, 2000-2020

	Population size (millions)			*Annual growth rate (percentage)*	
Groups of affected countries	*2000*	*2025*	*2050*	*2000-2025*	*2025-2050*
Countries with adult HIV prevalence above 20 per cent					
With AIDS	74	77	78	0.18	0.05
Without AIDS	77	118	151	1.73	0.96
Difference	-3	-42	-73	-1.56	-0.91
Percentage difference	-4.2	-35.1	-48.4	-89.8	-94.9
Countries with adult HIV prevalence between 10 and 20 per cent					
With AIDS	79	110	133	1.33	0.77
Without AIDS	81	139	195	2.17	1.34
Difference	-2	-30	-62	-0.84	-0.58
Percentage difference	-3.1	-21.5	-32.0	-38.8	-42.8
Countries with adult HIV prevalence between 5 and 10 per cent					
With AIDS	293	498	703	2.12	1.38
Without AIDS	300	560	839	2.50	1.62
Difference	-7	-62	-137	-0.38	-0.24
Percentage difference	-2.2	-11.1	-16.3	-15.4	-14.7
Countries with adult HIV prevalence between 1 and 5 per cent					
With AIDS	304	489	681	1.90	1.32
Without AIDS	310	521	745	2.08	1.43
Difference	-5	-31	-64	-0.18	-0.11
Percentage difference	-1.7	-6.0	-8.6	-8.6	-7.6
Countries with adult HIV prevalence below 1 per cent					
With AIDS	2 895	3 513	3 670	0.77	0.17
Without AIDS	2 900	3 583	3 814	0.85	0.25
Difference	-5	-69	-144	-0.07	-0.08
Percentage difference	-0.2	-1.9	-3.8	-8.4	-30.2

TABLE 6. NUMBER OF DEATHS, CRUDE DEATH RATE AND LIFE EXPECTANCY AT BIRTH FOR THE MEDIUM VARIANT ("WITH AIDS") AND THE NO-AIDS SCENARIO ("WITHOUT AIDS"), BY AFFECTED COUNTRIES GROUPED BY REGION, SELECTED PERIODS 1990-2050

	1990-1995	*2000-2005*	*2010-2015*	*2020-2025*	*2045-2050*
All 53 affected countries					
Number of deaths (thousands)					
With AIDS	161 792	181 929	206 544	231 333	291 534
Without AIDS	156 633	162 175	174 274	193 384	279 116
Absolute difference	5 158	19 754	32 270	37 950	12 418
Percentage difference	3.3	12.2	18.5	19.6	4.4
Crude death rate					
With AIDS	9.9	9.7	9.8	10.1	11.2
Without AIDS	9.6	8.5	8.1	8.0	9.8
Absolute difference	0.3	1.1	1.7	2.0	1.3
Percentage difference	3.5	13.2	21.5	25.0	13.6
Life expectancy at birth					
With AIDS	61.8	62.9	64.2	65.9	71.8
Without AIDS	62.6	65.5	68.4	70.8	75.6
Absolute difference	-0.8	-2.6	-4.1	-4.9	-3.8
Percentage difference	-1.2	-4.0	-6.1	-6.9	-5.0
38 countries in sub-Saharan Africa					
Number of deaths (thousands)					
With AIDS	40 030	55 696	62 822	64 336	63 953
Without AIDS	36 814	40 889	43 889	45 751	56 442
Absolute difference	3 216	14 807	18 933	18 585	7 510
Percentage difference	8.7	36.2	43.1	40.6	13.3
Crude death rate					
With AIDS	16.0	17.5	16.0	13.7	9.5
Without AIDS	14.6	12.3	10.2	8.5	6.8
Absolute difference	1.4	5.1	5.8	5.2	2.7
Percentage difference	9.5	41.8	57.2	61.4	39.0
Life expectancy at birth					
With AIDS	48.7	45.3	47.1	51.3	62.3
Without AIDS	51.2	54.8	58.3	62.1	70.1
Absolute difference	-2.5	-9.5	-11.3	-10.8	-7.8
Percentage difference	-4.9	-17.3	-19.3	-17.4	-11.1
5 countries in Asia					
Number of deaths (thousands)					
With AIDS	93 403	96 065	111 258	131 972	182 768
Without AIDS	92 088	92 604	100 386	114 893	177 947
Absolute difference	1 314	3 461	10 872	17 078	4 821
Percentage difference	1.4	3.7	10.8	14.9	2.7

TABLE 6 (*continued*)

	1990-1995	*2000-2005*	*2010-2015*	*2020-2025*	*2045-2050*
Crude death rate					
With AIDS	8.5	7.7	8.1	9.0	11.8
Without AIDS	8.4	7.4	7.3	7.7	11.0
Absolute difference	0.1	0.3	0.9	1.3	0.8
Percentage difference	1.5	4.0	11.7	17.0	7.1
Life expectancy at birth					
With AIDS	63.9	67.2	68.9	70.2	75.1
Without AIDS	64.2	67.9	71.0	73.4	77.4
Absolute difference	-0.3	-0.7	-2.1	-3.2	-2.3
Percentage difference	-0.5	-1.1	-2.9	-4.4	-3.0
8 countries in Latin America and the Caribbean					
Number of deaths (thousands)					
With AIDS	6 635	7 539	8 499	9 731	14 063
Without AIDS	6 434	6 842	7 725	9 001	14 026
Absolute difference	201	697	774	730	37
Percentage difference	3.1	10.2	10.0	8.1	0.3
Crude death rate					
With AIDS	7.5	7.4	7.5	7.9	10.3
Without AIDS	7.3	6.7	6.7	7.1	10.0
Absolute difference	0.2	0.7	0.8	0.7	0.4
Percentage difference	3.3	10.9	11.5	10.4	3.6
Life expectancy at birth					
With AIDS	65.1	67.1	69.7	72.0	77.0
Without AIDS	65.6	68.9	71.6	73.9	78.3
Absolute difference	-0.6	-1.7	-1.9	-1.9	-1.3
Percentage difference	-0.9	-2.5	-2.6	-2.6	-1.6
2 more developed countries					
Number of deaths (thousands)					
With AIDS	21 724	22 629	23 964	25 295	30 750
Without AIDS	21 297	21 839	22 272	23 738	30 701
Absolute difference	427	789	1 692	1 557	49
Percentage difference	2.0	3.6	7.6	6.6	0.2
Crude death rate					
With AIDS	10.6	10.4	10.5	10.6	12.1
Without AIDS	10.4	10.0	9.6	9.8	11.8
Absolute difference	0.2	0.4	0.8	0.8	0.3
Percentage difference	2.1	4.0	8.6	8.3	2.8

TABLE 6 (*continued*)

Life expectancy at birth					
With AIDS	71.9	73.2	74.4	76.1	79.7
Without AIDS	72.5	74.1	76.6	78.4	81.1
Absolute difference	-0.6	-1.0	-2.2	-2.2	-1.4
Percentage difference	-0.8	-1.3	-2.9	-2.9	-1.7

TABLE 7. NUMBER OF DEATHS, CRUDE DEATH RATE AND LIFE EXPECTANCY AT BIRTH FOR THE MEDIUM VARIANT ("WITH AIDS") AND THE NO-AIDS SCENARIO ("WITHOUT AIDS"), BY PREVALENCE GROUP OF AFFECTED COUNTRIES, SELECTED PERIODS 1990-2050

	1990-1995	*2000-2005*	*2010-2015*	*2020-2025*	*2045-2050*
Countries with adult HIV prevalence above 20 per cent					
Number of deaths (thousands)					
With AIDS	3 364	7 737	9 519	8 943	6 546
Without AIDS	2 816	3 038	3 250	3 701	5 894
Absolute difference	548	4 699	6 269	5 242	651
Percentage difference	19.5	154.7	192.9	141.7	11.0
Crude death rate					
With AIDS	10.5	20.7	24.9	23.3	16.9
Without AIDS	8.7	7.5	6.7	6.5	8.0
Absolute difference	1.8	13.2	18.2	16.8	8.9
Percentage difference	20.4	175.4	273.6	259.6	112.0
Life expectancy at birth					
With AIDS	57.0	41.3	37.6	41.0	52.3
Without AIDS	60.8	63.7	67.0	69.6	74.6
Absolute difference	-3.8	-22.4	-29.4	-28.6	-22.4
Percentage difference	-6.2	-35.1	-43.9	-41.1	-30.0
Countries with adult HIV prevalence between 10 per cent and 20 per cent					
Number of deaths (thousands)					
With AIDS	4 878	8 037	9 065	9 249	8 768
Without AIDS	4 422	5 079	5 179	5 267	6 856
Absolute difference	456	2 958	3 886	3 982	1 912
Percentage difference	10.3	58.2	75.0	75.6	27.9
Crude death rate					
With AIDS	14.9	19.6	19.1	17.3	13.4
Without AIDS	13.4	11.8	9.5	7.9	7.2
Absolute difference	1.5	7.8	9.6	9.4	6.2
Percentage difference	11.0	66.7	101.4	119.4	86.0
Life expectancy at birth					
With AIDS	50.8	41.8	42.3	45.9	55.6
Without AIDS	53.6	55.6	59.5	63.4	71.0
Absolute difference	-2.8	-13.8	-17.2	-17.6	-15.4
Percentage difference	-5.3	-24.8	-28.9	-27.7	-21.7
Countries with adult HIV prevalence between 5 per cent and 10 per cent					
Number of deaths (thousands)					
With AIDS	20 559	26 178	29 281	30 325	31 453
Without AIDS	19 404	20 754	22 197	22 777	27 288
Absolute difference	1 155	5 424	7 085	7 548	4 165
Percentage difference	6.0	26.1	31.9	33.1	15.3

	1990-1995	*2000-2005*	*2010-2015*	*2020-2025*	*2045-2050*
Crude death rate					
With AIDS	17.2	16.8	14.9	12.7	9.2
Without AIDS	16.1	12.9	10.5	8.6	6.7
Absolute difference	1.1	3.9	4.4	4.2	2.5
Percentage difference	6.6	30.3	42.0	48.6	37.1
Life expectancy at birth					
With AIDS	47.2	46.5	48.7	52.7	63.0
Without AIDS	49.0	53.8	57.5	61.5	69.9
Absolute difference	-1.8	-7.3	-8.8	-8.8	-6.9
Percentage difference	-3.6	-13.7	-15.2	-14.3	-9.8
Countries with adult HIV prevalence between 1 per cent and 5 per cent					
Number of deaths (thousands)					
With AIDS	17 307	20 611	22 586	24 163	28 344
Without AIDS	15 805	17 835	19 556	21 061	27 319
Absolute difference	1 502	2 776	3 030	3 102	1 025
Percentage difference	9.5	15.6	15.5	14.7	3.8
Crude death rate					
With AIDS	13.3	12.8	11.5	10.3	8.5
Without AIDS	12.0	10.9	9.6	8.5	7.5
Absolute difference	1.2	2.0	2.0	1.8	1.0
Percentage difference	10.3	18.2	20.4	21.6	13.2
Life expectancy at birth					
With AIDS	53.1	54.0	56.8	60.0	68.3
Without AIDS	55.5	58.0	61.0	64.3	71.3
Absolute difference	-2.4	-4.0	-4.2	-4.3	-3.0
Percentage difference	-4.4	-6.9	-6.9	-6.7	-4.3
Countries with adult HIV prevalence below 1 per cent					
Number of deaths (thousands)					
With AIDS	115 685	119 365	136 093	158 653	216 423
Without AIDS	114 188	115 469	124 092	140 578	211 759
Absolute difference	1 497	3 897	12 001	18 076	4 665
Percentage difference	1.3	3.4	9.7	12.9	2.2
Crude death rate					
With AIDS	8.8	8.0	8.4	9.1	11.8
Without AIDS	8.6	7.8	7.6	8.0	11.1
Absolute difference	0.1	0.3	0.8	1.2	0.7
Percentage difference	1.4	3.6	10.5	14.8	6.1

Life expectancy at birth					
With AIDS	65.4	68.3	70.0	71.3	76.0
Without AIDS	65.7	69.0	72.0	74.3	78.1
Absolute difference	-0.3	-0.7	-2.0	-3.0	-2.0
Percentage difference	-0.5	-1.0	-2.8	-4.0	-2.6

TABLE 8. NUMBER OF EXCESS DEATHS, BY SEX, IN THE MEDIUM VARIANT IN COMPARISON WITH THOSE IN THE NO-AIDS SCENARIO, BY REGIONAL GROUPS OF AFFECTED COUNTRIES, 2000-2020

	Males		*Females*		*Both sexes*	
Period	*Number of excess deaths (thousands)*	*Percentage increase*	*Number of excess deaths (thousands)*	*Percentage increase*	*Number of excess deaths (thousands)*	*Percentage increase*
All 53 affected countries						
2000-2005	10 338	12.0	9 416	12.4	19 754	12.2
2005-2010	13 745	15.4	12 915	16.4	26 660	15.9
2010-2015	17 054	18.4	15 217	18.7	32 270	18.5
2015-2020	19 453	19.8	17 054	20.1	36 508	19.9
Total	60 591	16.4	54 602	16.9	115 192	16.6
38 countries in Africa						
2000-2005	7 038	33.0	7 768	39.8	14 807	36.2
2005-2010	8 232	36.8	10 071	49.2	18 303	42.7
2010-2015	8 389	36.6	10 544	50.3	18 933	43.1
2015-2020	8 339	35.6	10 639	49.8	18 978	42.4
Total	31 998	35.5	39 023	47.3	71 021	41.1
5 countries in Asia						
2000-2005	2 227	4.5	1 235	2.9	3 461	3.7
2005-2010	4 136	8.0	2 213	5.0	6 349	6.7
2010-2015	7 078	13.0	3 793	8.3	10 872	10.8
2015-2020	9 606	16.4	5 434	11.2	15 040	14.0
Total	23 047	10.5	12 675	6.8	35 722	8.8
8 countries in Latin America and the Caribbean						
2000-2005	433	11.0	263	9.1	697	10.2
2005-2010	437	10.5	324	10.4	761	10.5
2010-2015	415	9.4	360	10.8	774	10.0
2015-2020	401	8.5	375	10.4	776	9.3
Total	1 686	9.9	1 322	10.2	3 007	10.0
2 more developed countries						
2000-2005	640	5.8	149	1.4	789	3.6
2005-2010	940	8.5	307	2.8	1 247	5.7
2010-2015	1 172	10.5	520	4.7	1 692	7.6
2015-2020	1 107	9.6	606	5.3	1 713	7.5
Total	3 860	8.6	1 582	3.5	5 441	6.1

TABLE 9. AGE DISTRIBUTION OF PROJECTED DEATHS FOR 2000-2020 ACCORDING TO THE MEDIUM VARIANT ("WITH AIDS") AND THE NO-AIDS SCENARIO ("WITHOUT AIDS") AND DIFFERENCE BETWEEN THE TWO BY AGE GROUP, BY REGIONAL GROUP OF AFFECTED COUNTRIES

Groups of affected countries	*Age group*							*Total deaths (thousands)*
	0-4	*5-14*	*15-24*	*25-34*	*35-49*	*50-64*	*65+*	
All 53 affected countries								
With AIDS (percentage of total deaths)	16.8	3.6	3.1	8.2	11.9	15.0	41.4	802 268
Without AIDS (percentage of total deaths)	18.4	3.0	2.9	3.4	7.4	16.5	48.4	687 076
Difference in number of deaths (thousands)	8 286	8 032	4 649	42 980	45 137	6 947	-839	115 192
38 countries in Africa								
With AIDS (percentage of total deaths)	31.7	8.0	5.7	15.9	16.7	8.6	13.4	243 422
Without AIDS (percentage of total deaths)	41.4	7.5	6.5	6.3	8.5	10.4	19.3	172 401
Difference in number of deaths (thousands)	5 675	6 548	2 732	27 813	25 856	2 990	-592	71 021
5 countries in Asia								
With AIDS (percentage of total deaths)	12.3	2.0	2.0	5.0	9.8	17.7	51.2	431 239
Without AIDS (percentage of total deaths)	12.8	1.9	1.8	2.3	6.8	18.6	55.9	395 517
Difference in number of deaths (thousands)	2 292	1 262	1 617	12 349	15 340	3 029	-167	35 722
8 countries in Latin America and the Caribbean								
With AIDS (percentage of total deaths)	10.4	1.6	3.3	7.8	14.7	19.1	43.0	33 124
Without AIDS (percentage of total deaths)	10.8	1.3	3.3	5.1	11.8	20.4	47.4	30 117
Difference in number of deaths (thousands)	192	143	100	1 064	1 343	198	-33	3 007
2 more developed countries								
With AIDS (percentage of total deaths)	1.3	0.3	1.2	3.5	8.5	17.3	67.9	94 482
Without AIDS (percentage of total deaths)	1.2	0.2	1.0	1.8	6.1	17.6	72.1	89 041
Difference in number of deaths (thousands)	128	80	200	1 753	2 598	730	-47	5 441
Countries with adult HIV prevalence above 20 per cent								
With AIDS (percentage of total deaths)	12.5	6.4	4.6	27.8	26.5	9.9	12.3	35 968
Without AIDS (percentage of total deaths)	22.4	3.8	4.6	5.2	10.4	18.3	35.3	12 861
Difference in number of deaths (thousands)	1 602	1 810	1 052	9 339	8 183	1 220	-99	23 107

TABLE 10. INFANT MORTALITY AND UNDER-FIVE MORTALITY ACCORDING TO THE MEDIUM VARIANT ("WITH AIDS") AND TO THE NO-AIDS SCENARIO ("WITHOUT AIDS"), BY REGIONAL GROUP OF AFFECTED COUNTRIES, SELECTED PERIODS 1990-2050

Groups of affected countries	*1990-1995*	*2000-2005*	*2010-2015*	*2020-2025*	*2045-2050*
		Infant mortality (per thousand)			
All 53 affected countries					
With AIDS	70	62	51	42	24
Without AIDS	69	61	50	41	24
Absolute difference	1	1	1	1	1
Percentage difference	0.9	2.2	2.9	3.2	3.4
38 countries in sub-Saharan Africa					
With AIDS	104	94	80	65	35
Without AIDS	101	90	75	61	32
Absolute difference	2	5	5	4	3
Percentage difference	2.4	5.3	6.3	6.9	8.6
5 countries in Asia					
With AIDS	64	53	41	33	20
Without AIDS	64	52	40	32	20
Absolute difference	0	0	1	1	0
Percentage difference	0.1	0.5	1.6	2.3	1.9
8 countries in Latin America and the Caribbean					
With AIDS	49	39	31	23	9
Without AIDS	48	39	30	23	9
Absolute difference	0	0	1	0	0
Percentage difference	0.7	1.3	1.8	1.9	2.5
2 more developed countries					
With AIDS	11	9	8	7	5
Without AIDS	11	9	7	6	5
Absolute difference	0	0	0	0	0
Percentage difference	0.4	2.2	5.0	6.4	6.1
		Under-five mortality (per thousand)			
All 53 affected countries					
With AIDS	103	92	76	62	33
Without AIDS	99	85	69	56	29
Absolute difference	4	7	7	6	4
Percentage difference	4.4	7.8	10.0	11.1	13.3
38 countries in sub-Saharan Africa					
With AIDS	175	161	134	108	53
Without AIDS	163	142	117	92	43
Absolute difference	12	19	18	16	10
Percentage difference	7.4	13.5	15.3	17.3	23.1

TABLE 10 (*continued*)

Groups of affected countries	*1990-1995*	*2000-2005*	*2010-2015*	*2020-2025*	*2045-2050*
5 countries in Asia					
With AIDS	87	67	51	41	24
Without AIDS	85	65	48	38	23
Absolute difference	2	2	3	3	1
Percentage difference	2.1	3.1	6.7	7.5	6.5
8 countries in Latin America and the Caribbean					
With AIDS	62	50	40	31	13
Without AIDS	59	47	37	28	12
Absolute difference	3	3	3	2	1
Percentage difference	5.2	6.1	7.8	8.8	9.4
2 more developed countries					
With AIDS	15	11	10	9	7
Without AIDS	14	11	9	8	6
Absolute difference	1	0	1	1	1
Percentage difference	5.9	4.5	13.3	16.2	16.1

TABLE 11. INFANT MORTALITY AND UNDER-FIVE MORTALITY ACCORDING TO THE MEDIUM VARIANT ("WITH AIDS") AND TO THE NO-AIDS SCENARIO ("WITHOUT AIDS"), BY PREVALENCE GROUP OF AFFECTED COUNTRIES, SELECTED PERIODS 1990-2020

Group of affected countries	*1990-1995*	*2000-2005*	*2010-2015*	*2020-2025*	*2045-2050*
			Infant mortality (per thousand)		
Countries with adult HIV prevalence above 20 per cent					
With AIDS	63	65	55	45	27
Without AIDS	59	51	41	33	19
Absolute difference	5	14	14	12	8
Percentage difference	8.0	27.2	34.2	37.9	43.1
Countries with adult HIV prevalence between 10 per cent and 20 per cent					
With AIDS	100	96	80	65	36
Without AIDS	97	88	72	57	31
Absolute difference	3	8	8	7	6
Percentage difference	3.1	8.9	11.0	13.0	18.5
Countries with adult HIV prevalence between 5 per cent and 10 per cent					
With AIDS	109	95	80	65	35
Without AIDS	107	92	76	61	32
Absolute difference	2	4	4	3	2
Percentage difference	1.9	4.3	5.1	5.7	7.7
Countries with adult HIV prevalence between 1 per cent and 5 per cent					
With AIDS	94	86	74	61	33
Without AIDS	93	84	72	59	33
Absolute difference	1	1	1	1	1
Percentage difference	1.4	1.6	1.9	2.0	2.1
Countries with adult HIV prevalence below 1 per cent					
With AIDS	58	47	36	29	17
Without AIDS	58	47	36	28	17
Absolute difference	0	0	1	1	0
Percentage difference	0.1	0.5	1.6	2.3	1.9
			Under-five mortality (per thousand)		
Countries with adult HIV prevalence above 20 per cent					
With AIDS	98	114	100	84	49
Without AIDS	85	73	57	45	23
Absolute difference	13	41	43	40	26
Percentage difference	15.2	56.4	76.2	88.4	113.6
Countries with adult HIV prevalence between 10 per cent and 20 per cent					
With AIDS	167	163	136	109	58
Without AIDS	155	138	110	84	40
Absolute difference	12	24	26	25	19
Percentage difference	8.1	17.5	23.7	29.8	47.2

Group of affected countries	*1990-1995*	*2000-2005*	*2010-2015*	*2020-2025*	*2045-2050*
Countries with adult HIV prevalence between 5 per cent and 10 per cent					
With AIDS	185	162	134	107	52
Without AIDS	174	146	119	93	43
Absolute difference	11	16	16	14	9
Percentage difference	6.1	10.9	13.1	15.1	22.0
Countries with adult HIV prevalence between 1 per cent and 5 per cent					
With AIDS	156	144	120	97	48
Without AIDS	146	132	112	89	44
Absolute difference	10	12	9	8	4
Percentage difference	6.9	8.8	7.8	8.6	9.6
Countries with adult HIV prevalence below 1 per cent					
With AIDS	77	59	45	36	21
Without AIDS	75	58	42	34	19
Absolute difference	2	2	3	3	1
Percentage difference	2.2	3.1	6.8	7.6	6.6

TABLE 12. EXPECTATION OF LIFE AT BIRTH AND UNDER-FIVE MORTALITY IN THE MEDIUM VARIANT ("WITH AIDS") AND THE NO-AIDS SCENARIO ("WITHOUT AIDS") FOR SELECTED AFFECTED COUNTRIES, 2000-2005, 2010-2015, AND 2045-2050

Country	*2000-2005*				*2010-2015*				*2045-2050*			
	Life expectancy (years)		*Under-five mortality (per 1000 births)*		*Life expectancy (years)*		*Under-five mortality (per 1000 births)*		*Life expectancy (years)*		*Under-five mortality (per 1000 births)*	
	With AIDS	*Without AIDS*	*With AIDS*	*Without AIDS*	*With AIDS*	*Without AIDS*	*With AIDS*	*Without AIDS*	*With AIDS*	*Without AIDS*	*With AIDS*	*Without AIDS*
Botswana	39.7	68.1	104.1	45.2	31.6	70.7	92.8	32.0	43.6	76.2	55.1	13.6
South Africa	47.7	66.6	80.1	44.5	41.5	69.9	70.2	32.4	55.7	76.0	39.1	15.4
Zimbabwe	33.1	67.6	113.7	53.8	31.8	70.5	98.3	38.0	45.7	76.2	52.9	18.0

Figure 1. Estimated and projected HIV prevalence among persons aged 15-49, selected countries, 1980-2050

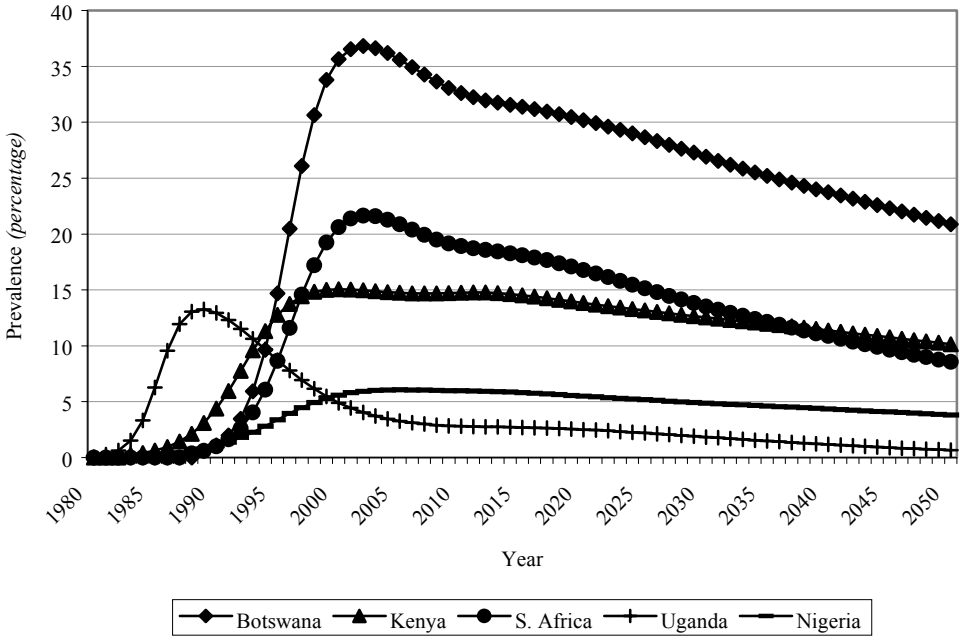


Figure 2. Percentage of cumulative population difference between the medium variant and the No-AIDS scenario that is attributable to excess deaths and missing births, 2000-2050

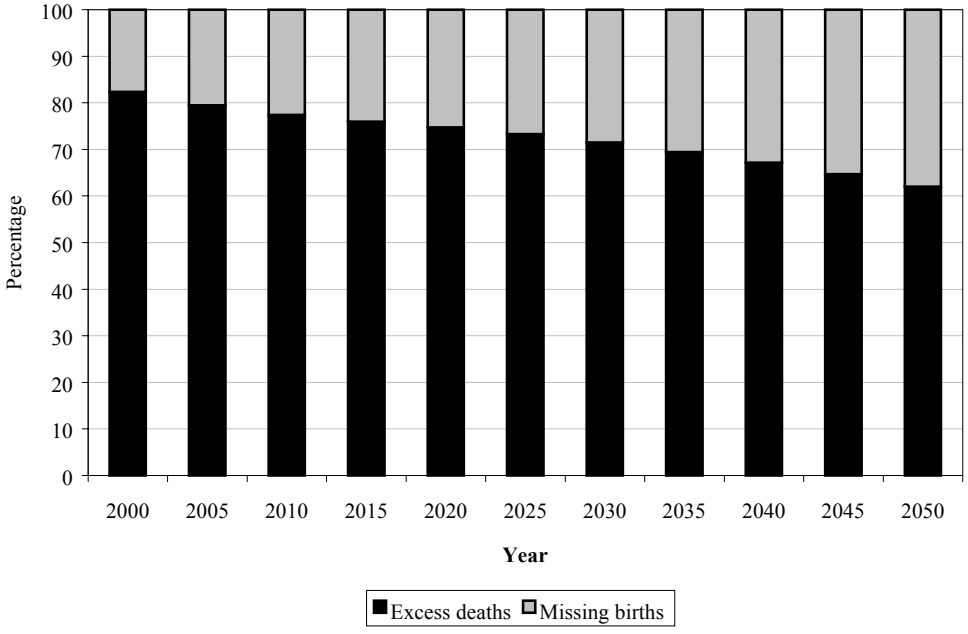


Figure 3. Population in the medium variant ("with AIDS") and in the No-AIDS scenario ("without AIDS"), by sex and age group, 7 most affected countries, 2000

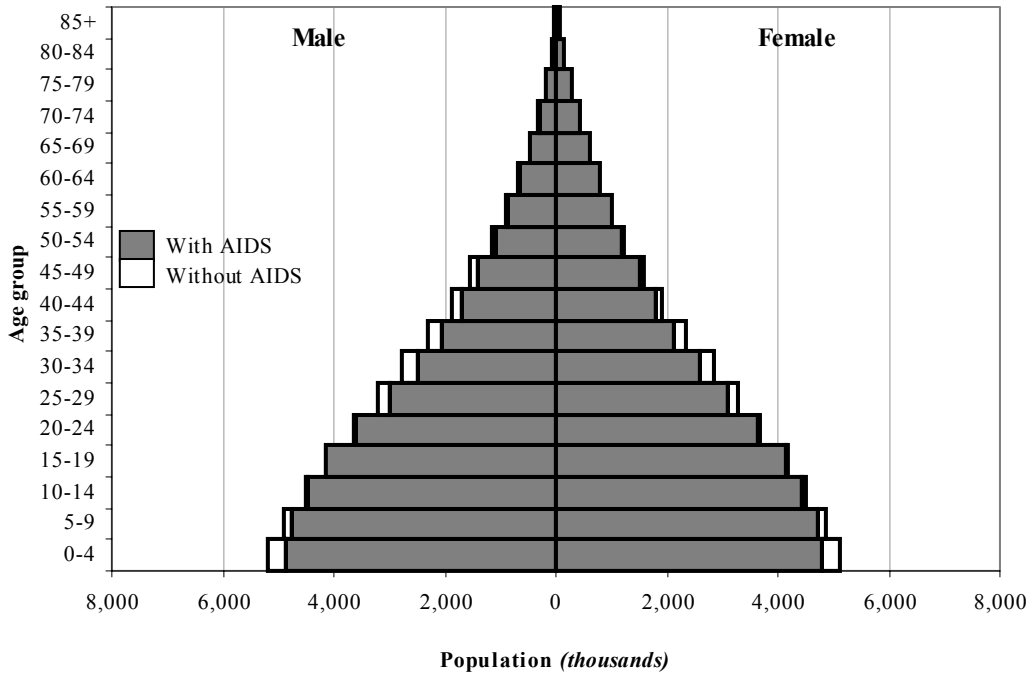


Figure 4. Population in the medium variant ("with AIDS") and in the No-AIDS scenario ("without AIDS"), by sex and age group, 7 most affected countries, 2025

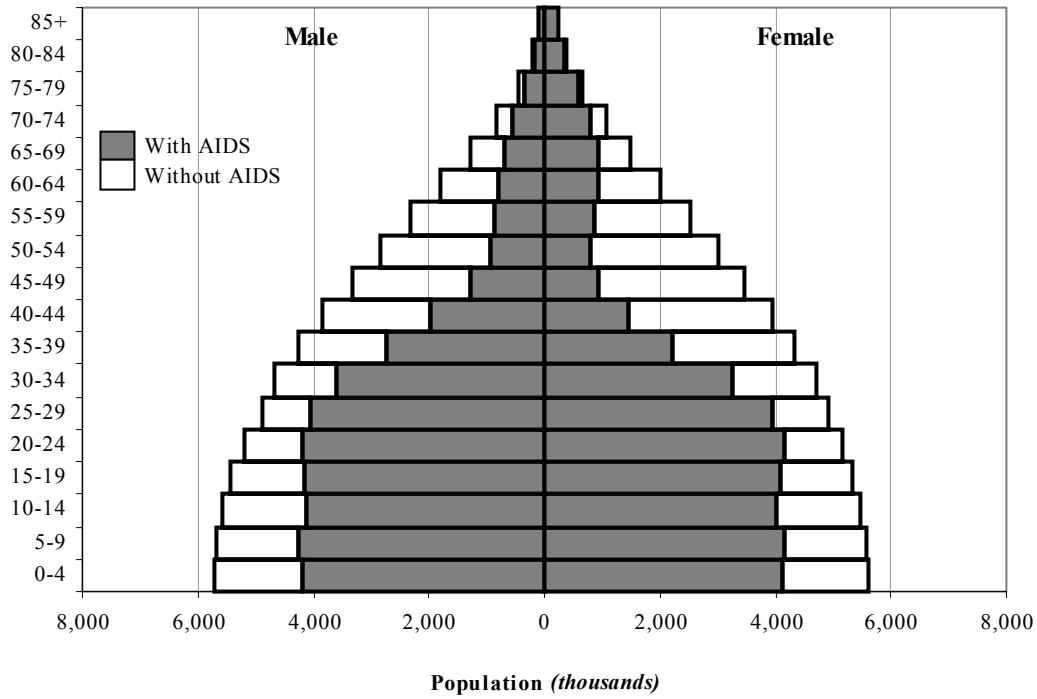


Figure 5. Population in the medium variant ("with AIDS") and in the No-AIDS scenario ("without AIDS"), by sex and age group, countries with 2001 prevalence lower than 1 per cent, 2025

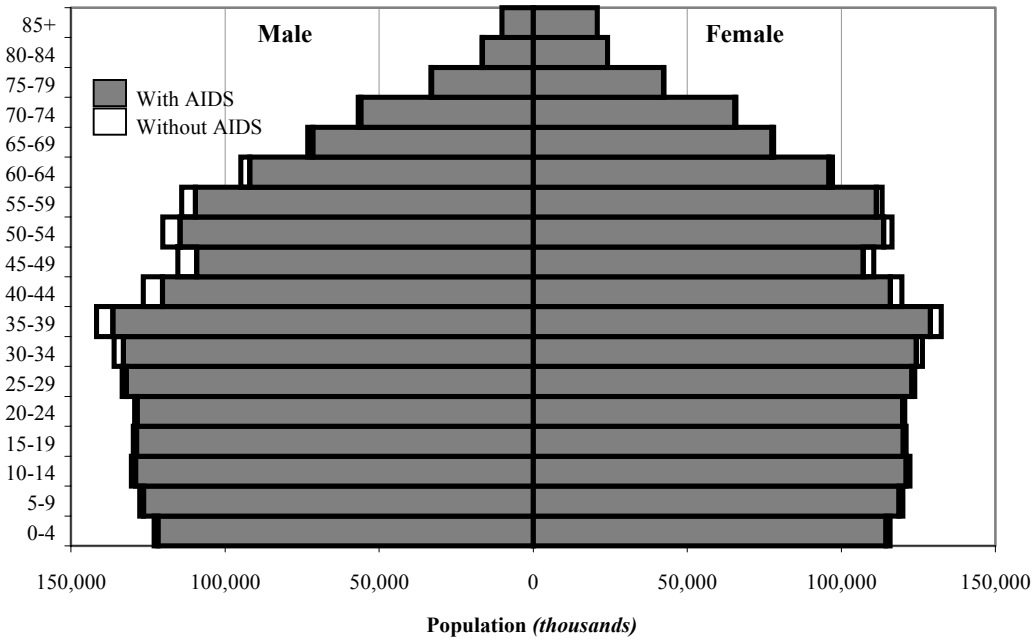


Figure 6. Percentage distribution of projected deaths by age in the medium variant ("with AIDS") and in the No-AIDS scenario ("without AIDS") for the 53 affected countries, 2000-2020

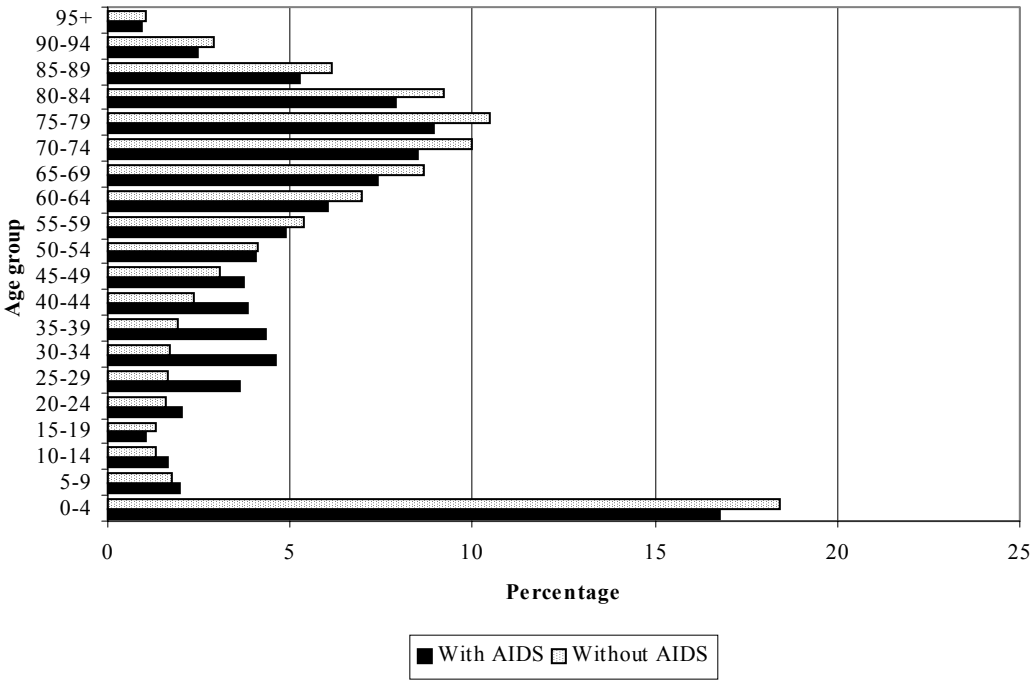


Figure 7. Percentage distribution of projected deaths by age in the medium variant ("with AIDS") and in the No-AIDS scenario ("without AIDS") for the 7 most affected countries, 2000-2020

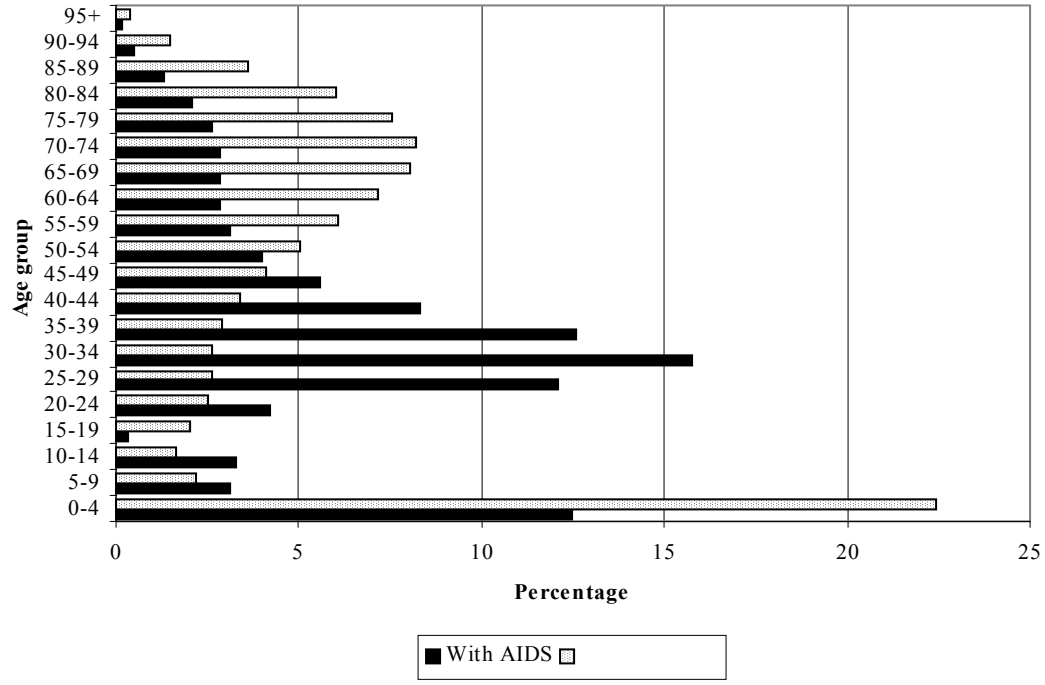


Figure 6b. Number of deaths by age in the medium variant ("with AIDS") and in the No-AIDS scenario ("without AIDS") for the 53 affected countries, 2000-2020

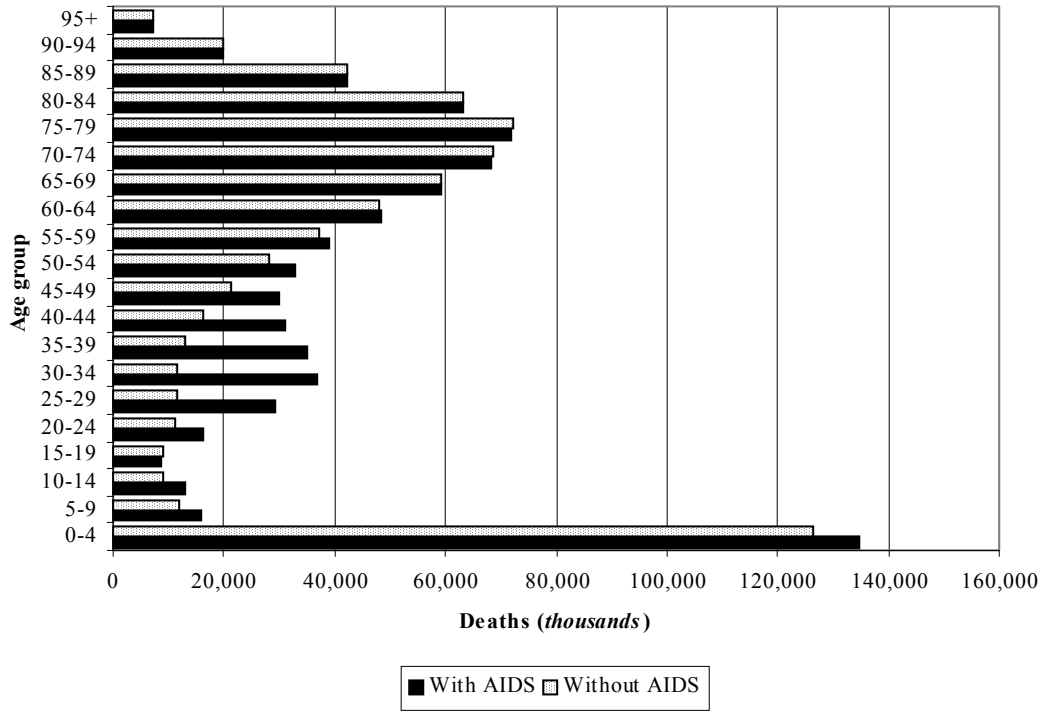


Figure 7b. Number of deaths by age in the medium variant ("with AIDS") and in the No-AIDS scenario ("without AIDS") for the 7 most affected countries, 2000-2020

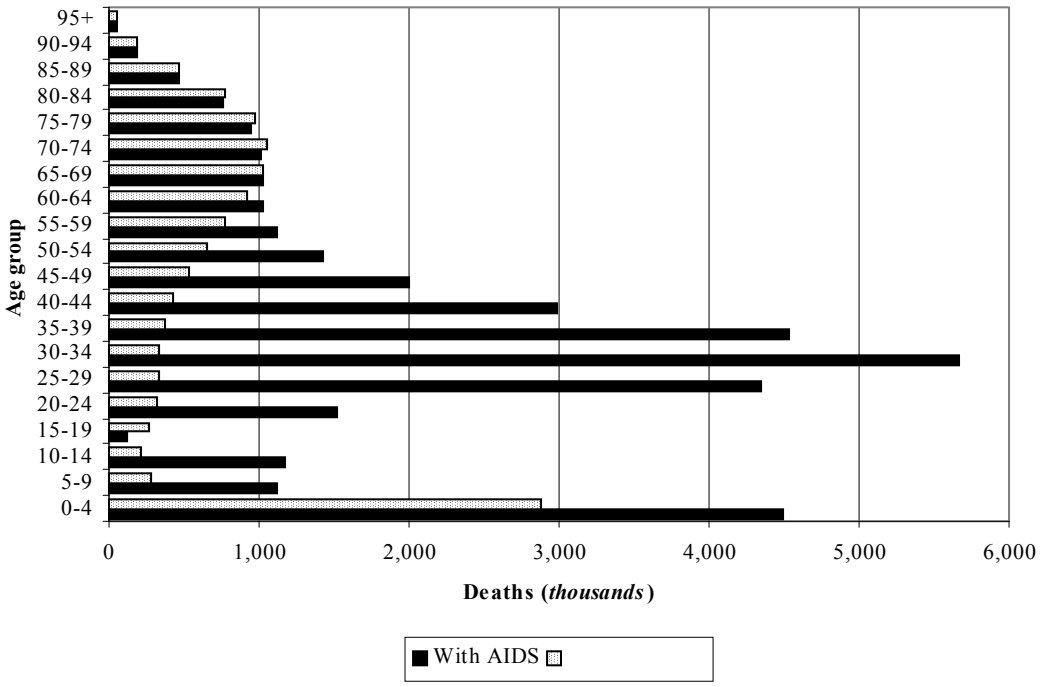


Figure 8. Annual population growth rate projected in the medium variant ("with AIDS") and in the No-AIDS scenario ("without AIDS"), Bostwana, 1980-1985 to 2010-2015

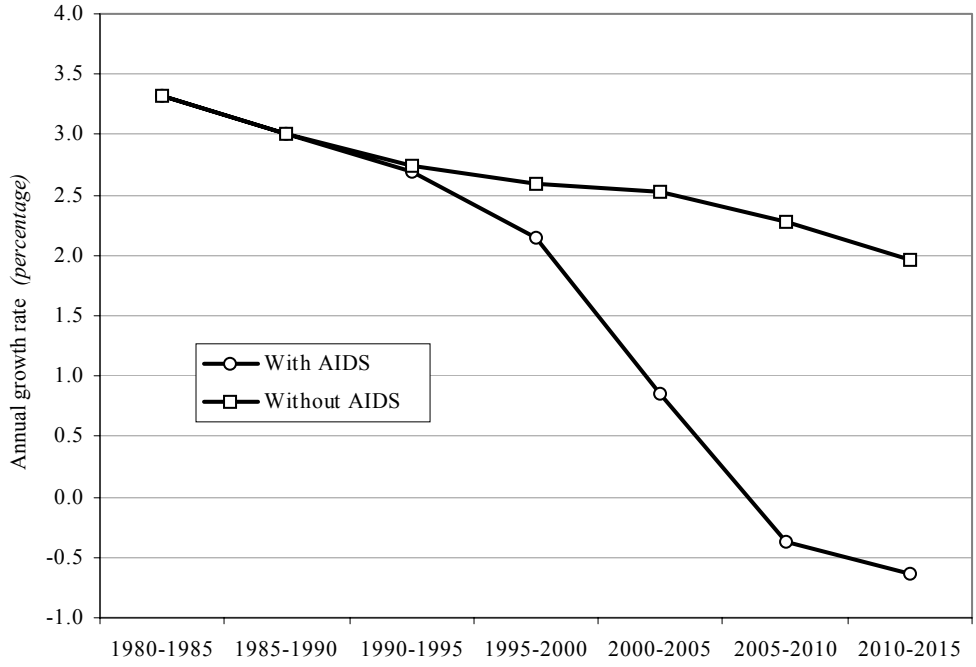


Figure 9. Life expectancy projected in the medium variant ("with AIDS") and in the No-AIDS scenario ("without AIDS"), Zimbabwe, 1980-1985 to 2045-2050

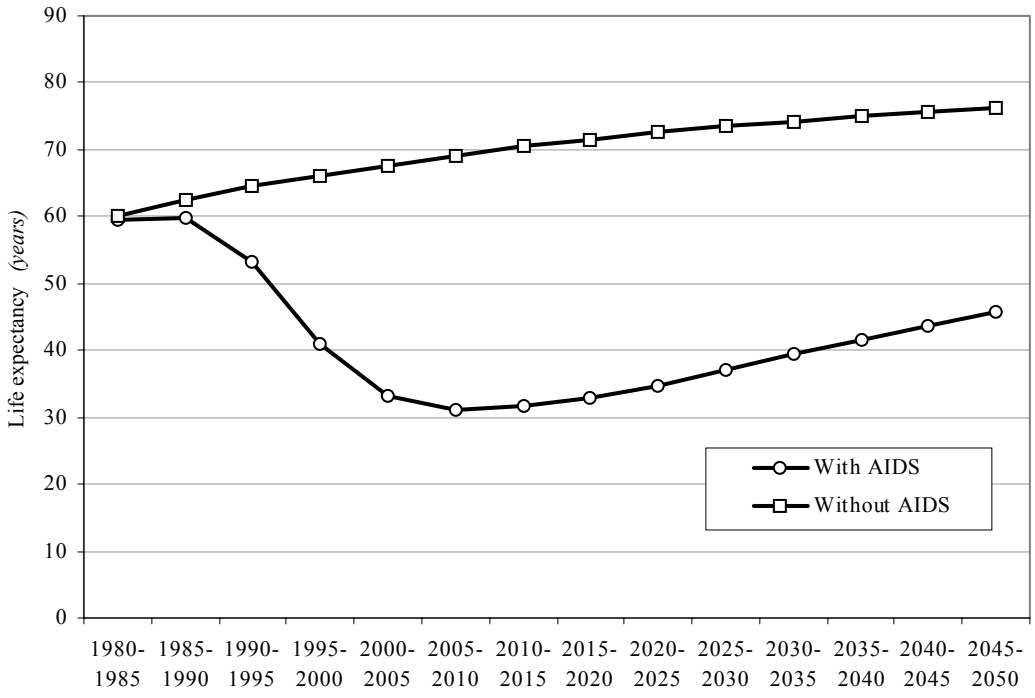
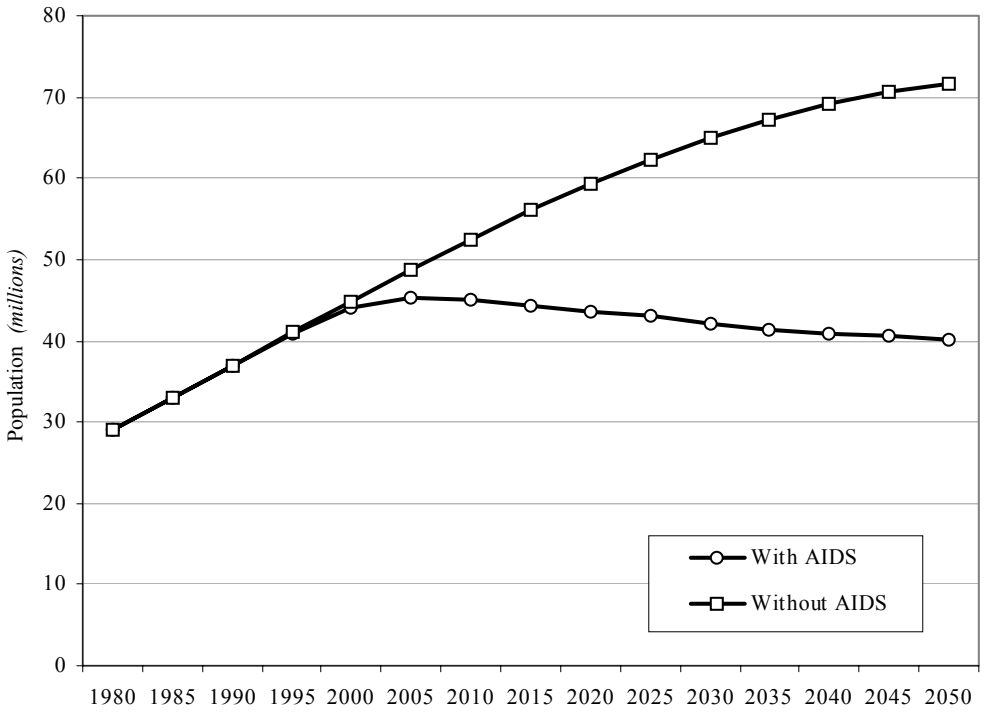


Figure 10. Population projected in the medium variant ("with AIDS") and in the No-AIDS scenario ("without AIDS"), South Africa, 1980-2050



ANNEX

A. MODELLING THE DYNAMICS OF THE HIV/AIDS EPIDEMIC

The approach used to model the dynamics of the HIV/AIDS epidemic is that suggested by the UNAIDS Reference Group on Estimates, Modelling and Projections (2002). The first stage in modelling is to derive estimates of the yearly probability of being infected by HIV (annual incidence) from available estimates of HIV prevalence. In countries of sub-Saharan Africa these prevalence estimates are derived mainly from data on the proportion sero-positive among pregnant women attending the antenatal clinics that belong to the system of sentinel surveillance sites in each country. Consequently, strictly speaking, available estimates of prevalence refer to the HIV prevalence among pregnant women only. It has been shown, however, that prevalence levels among pregnant women aged 15-49 provide reasonable estimates of prevalence levels among all women in the same age group (Gregson and Zaba, 1998; Glynn et al, 2001; Gregson, Zaba and Hunger, 2002). There is scant information on how well prevalence levels among pregnant women represent those among men. Only recently have nationally representative surveys of HIV sero-prevalence begun to be taken in countries of sub-Saharan Africa and in depth analyses of their results in comparison with the data obtained from antenatal clinics are starting. In the absence of information, the models presented here assume that available estimates of prevalence among pregnant women aged 15-49 are adequate proxies of HIV prevalence among both all women and all men.

The model used to derive annual estimates of incidence from observed prevalence levels is based on three differential equations representing the dynamics of the epidemic over time (UNAIDS Reference Group on Estimates, Modelling and Projections, 2002). The model assumes that the total population of persons over 15, denoted by N, can be divided into three groups:

1. persons already infected by HIV at time t, denoted by $Y(t)$;

2. persons at risk of being infected by HIV at time t, that is, the susceptible population, denoted by $Z(t)$, and

3. persons who, at time t, are not at risk of being infected by HIV, denoted by $X(t)$.

The first differential equation indicates how the number of persons infected changes over time:

$$\frac{dY(t)}{dt} = \left[\frac{rY(t)}{N(t)} + \theta(t)\right] \bullet Z(t) - \int_0^t \left[\frac{rY(s)}{N(s)} + \theta(s)\right] \bullet Z(s) \bullet M(t-s)ds \qquad (1)$$

that is, the increase in the number infected depends on the interaction between the proportion already infected [$Y(t)/N(t)$] and the susceptible population $Z(t)$. The parameter $\theta(t)$ is included to jump-start the epidemic. It is set to a positive value when the epidemic starts, and becomes zero thereafter. The parameter r represents the force of infection, that is, the probability that an interaction between an infected individual and a susceptible one results in the infection of the latter.

The integral in equation (1) represents the cumulative number of deaths among individuals infected by HIV since time 0, that is, the start of the epidemic. The function $M(t)$ is the instantaneous probability of dying at time t whether because of AIDS or because of other causes and is given by:

$$M(t) = \left(\mu + \alpha \bullet t^{\alpha-1} \Big/ \beta^{\alpha} \right) \bullet \exp\left[-\mu \bullet t - \left(t \Big/ \beta \right)^{\alpha} \right] \tag{2}$$

That is, the probability of dying is modelled as a Weibull density function with shape parameter α and position parameter β. In equation (2), μ represents the force of mortality due to causes other than AIDS.

The second differential equation indicates how the susceptible population changes over time:

$$\frac{dZ(t)}{dt} = F\left(\frac{X(t)}{N(t)}\right) \bullet E(t) - \left[\mu + \frac{rY(t)}{N(t)} + \theta(t) \right] \bullet Z(t) \tag{3}$$

where $E(t)$ represents the number of individuals entering the population aged 15 or over at time t. $E(t)$ is therefore the number of persons reaching exact age 15 at time t. $E(t)$ can be estimated as:

$$E(t) = l(15, t-15) \bullet b(t-15) \bullet \left[X(t-15) + Z(t-15) + (1-\nu) \bullet \xi \bullet Y(t-15) \right] \tag{4}$$

where $l(15, t\text{-}15)$ is the probability of surviving from birth to age 15 among persons born at time t-15, $b(t$-15) is the birth rate at time t-15, ν is the probability of HIV transmission from mother to child, and ξ is a factor reflecting the reduction of fertility among HIV positive women.

However, not all persons reaching age 15 are immediately susceptible to being infected with HIV. The fraction that becomes part of the susceptible population is a function of the proportion of the population that is not susceptible and is defined as:

$$F\left(\frac{X(t)}{N(t)}\right) = \frac{\Omega\left(\frac{X(t)}{N(t)}\right)}{\left(\Omega\left(\frac{X(t)}{N(t)}\right) - 1 + \frac{1}{F\left(\frac{X(0)}{N(0)}\right)} \right)} \tag{5}$$

where Ω is a function defined by:

$$\Omega\left(\frac{X(t)}{N(t)}\right) = \exp\left[\varphi \bullet \left[\frac{X(t)}{N(t)} - 1 + F\left(\frac{X(0)}{N(0)}\right) \right] \right] \tag{6}$$

and $F[X(0)/N(0)]$ is the fraction of individuals who entered the susceptible group when they turned 15 just as the HIV epidemic started and φ is a parameter modulating the recruitment of persons into the susceptible group. In addition, in equation *(3)*, μ represents the mortality rate among the population not infected with HIV and the rest of the expression in parenthesis represents the decrement of $Z(t)$ caused by the transfer of persons from the susceptible group to the group of those infected with HIV.

The third equation shows how the non-susceptible population changes over time:

$$\frac{dX(t)}{dt} = \left(1 - F\left(\frac{X(t)}{N(t)}\right)\right) \bullet E(t) - \mu \bullet X(t) \tag{7}$$

Together equations (1), (3) and (7) constitute a system of differential equations that can be solved numerically by using the Runge-Kutta method, provided values of all relevant parameters are known. Population-based estimates of population size at the start of the epidemic, births and mortality risks over time are available. In addition, assumptions are made about the probabilities of dying of AIDS among those infected, about the probability of mother-to-child transmission and about the extent to which the fertility of HIV-positive women is reduced. Then, assuming an initial value of $\theta(t)$ as well as a year when the epidemic began, it is possible to estimate via numerical approximation methods the values of r, $F[X(0)/N(0)]$ and φ that minimize the distance between the HIV prevalence generated by the model and the HIV prevalence estimated on the basis of data from antenatal clinics at various points in time. More specifically, a non-linear iterative optimization procedure is used to obtain the least-squares estimate of the parameters r, $F[X(0)/N(0)]$ and φ, given an initial value of $\theta(0)$ and the year of start of the epidemic.

Once the values of all parameters are obtained, equations (1) to (7) can be used to estimate the number of persons living with HIV, the number in the susceptible group and the number who are not susceptible, as well as the number of newly infected individuals for each year t ranging from the start of the epidemic to 2001 (the most recent year with data on prevalence available). In carrying out these calculations, the Population Division's procedure makes allowance for changes in the demographic dynamics of the population. That is, the effects of changing mortality and fertility rates are properly reflected in the application of the epidemiological model described above.

However, in order to estimate the effect of the HIV/AIDS epidemic on mortality and population dynamics, it is necessary to derive estimates of the infected population by age and sex. The procedures followed in such derivation are described in the next section.

B. Modelling the demographic impact of HIV/AIDS

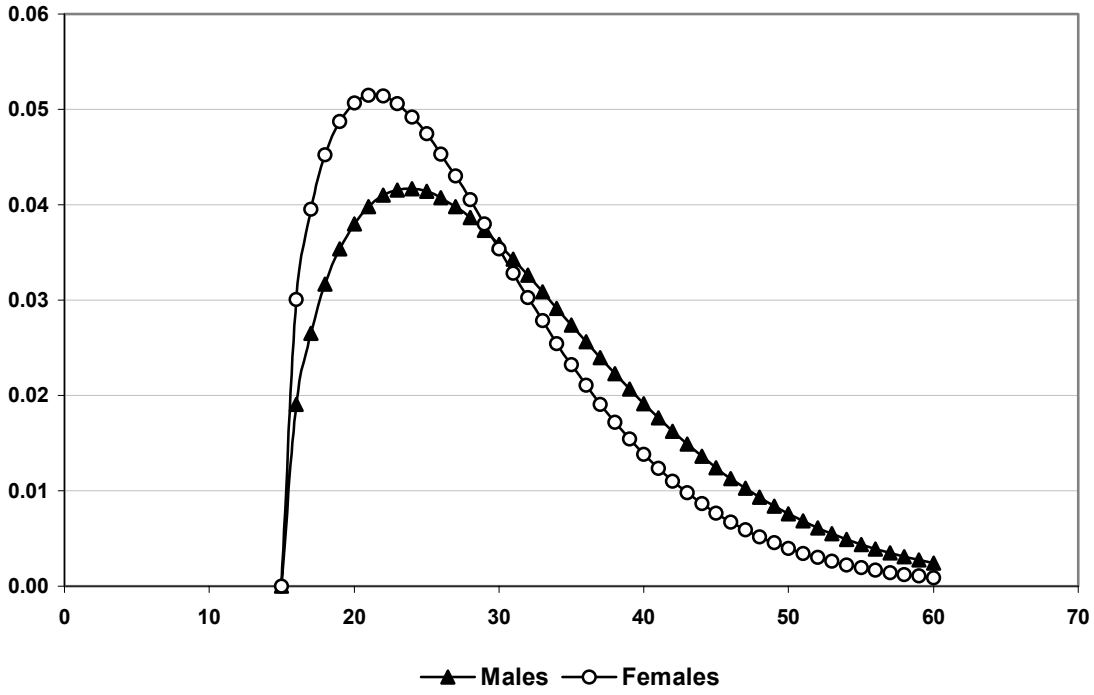
The estimation of the demographic impact of HIV/AIDS is carried out in several steps. Essentially, the estimates of annual HIV incidence derived from the epidemiological model with all sexes and ages combined are converted into age and sex-specific estimates of newly infected individuals and the population that was initially free from the epidemic is projected over single-year intervals using a multi-state procedure that tracks the transitions of individuals from susceptibility to infection to AIDS and to death, as well as the deaths of the uninfected population. Populations are projected by single years of age and the infected population is further classified by duration of infection in single years. The exact steps followed and the assumptions made in recreating the dynamics of a population affected by the HIV/AIDS epidemic are described in detail below.

Step 1: *Derivation of the number of new infections by sex*. The model used to derive the parameters r, $F[X(0)/N(0)]$ and φ does not take into account the age or sex of the population infected. To derive estimates of the impact of HIV/AIDS by age and sex, it is first necessary to distribute by sex the yearly number of newly infected individuals, as yielded by the general epidemiological model described in Section A. Although data on the distribution by sex of newly infected individuals are rare, there is some evidence suggesting that when HIV/AIDS is spread mainly by heterosexual transmission, the proportion of males among the newly infected is high at first (at about 80 per cent) but declines to about 45 per cent

during the 7 to 9 years following the start of the epidemic. On the basis of this observation and following the practice of UNAIDS, the proportion of males among the newly infected is assumed to decline from 80 per cent or so at the start of the epidemic to 45 per cent after a few years and to remain constant at that level until 2000. Under that assumption, the annual number of newly infected individuals per year is distributed by sex.

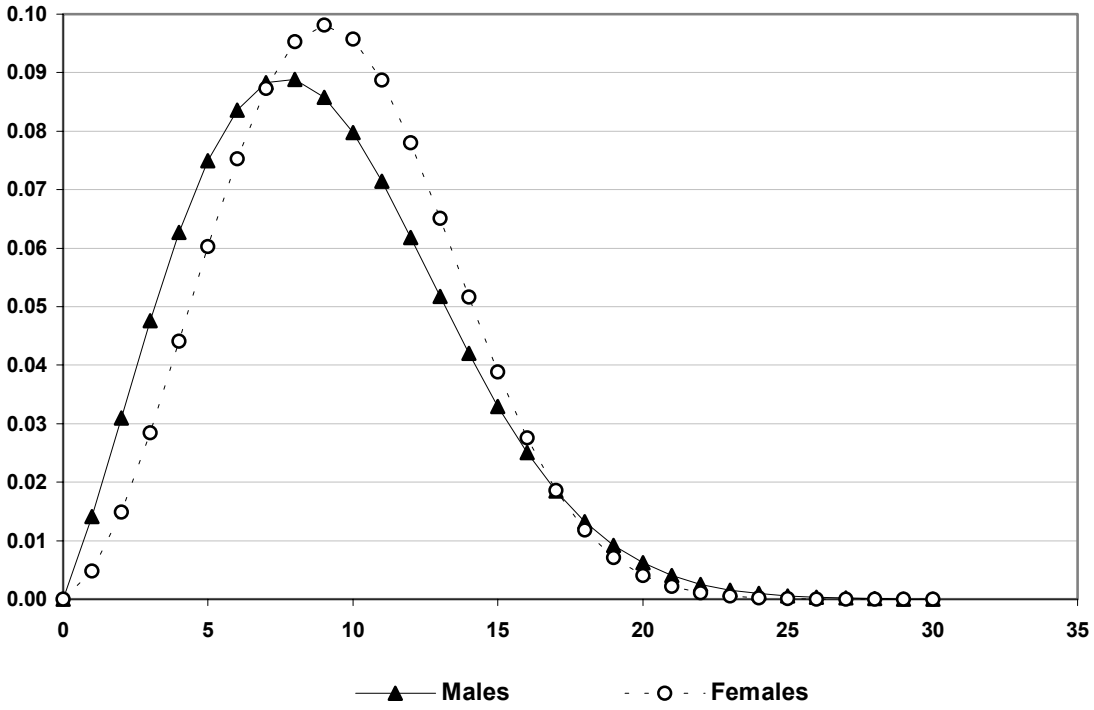
Step 2: *Derivation of the number of newly infected men and women by age*. Once estimates of the newly infected by sex are available, they are distributed by single-year of age according to model age distributions derived from empirical data fitted using a Weibull distribution. Five different age distributions of the newly infected were derived for each sex but the set used for the purposes of this paper, named "standard", has a mean age at infection of 31.2 years for males and 28 years for females. Figure A1 shows the density functions by age for males and females.

Figure A1. Age distribution of new infections for males and females



Step 3: *Estimation of the number of deaths caused by AIDS among HIV positive persons*. To estimate the number of deaths due to AIDS by age and sex, the infected population is projected over time using a multi-state approach that takes account of the competing risks of moving from being HIV-positive to developing full blown AIDS versus the probability of dying of a cause other than AIDS. The probability schedules used to reflect the chances of developing full blown AIDS after x years of infection (the incubation period) are assumed to follow a Weibull distribution. Different schedules were used for each sex, with a median incubation period of about 9.3 years for both sexes combined, a slightly longer median incubation period for females (9.6 years) and a shorter one for males (9 years). The schedules are shown in figure A2. The probability of progressing from HIV infection to AIDS was modelled as a function of the duration of infection and no allowance was made for systematic differences in the incubation period related to age at infection.

Figure A2. Annual probability of transition from HIV infection to AIDS



Competing mortality risks for causes other than AIDS were estimated on the basis of mortality estimates for the whole population. It was assumed that among HIV positive persons, the risk of dying of a cause other than AIDS was independent from the risk of dying of AIDS.

Once individuals develop full blown AIDS, they are assumed to die within two years. The probability of dying was modelled using a Weibull distribution according to which 49 per cent of those developing full blown AIDS die within one year and the rest do so during the second year.

Step 4: *Calculation of the number of children infected by HIV/AIDS.* A by-product of the calculations described above is the population living with HIV or AIDS classified by sex, age and duration of infection. To estimate the number of children that can potentially become infected by their mothers, the numbers of HIV-positive women in each age group are multiplied by the age-specific fertility rates estimated for the whole population but reduced by a factor $\xi = 0.8$ to take into account the lower probability of conception among HIV-positive women. Because most HIV-positive children acquire the disease from their infected mothers at or near the time of birth, the number of HIV-positive children is obtained by assuming a fixed rate of transmission of HIV from mother to child ($\nu = 0.35$) and multiplying it by the number of children born to HIV-positive women. Such an approach produces the number of children who become HIV positive at birth or soon thereafter during each year.

Step 5: *Calculation of the number of AIDS deaths among children*. In children the length of infection is the same as their age. Projection of the number of surviving HIV-positive children is made by modelling the probability that infected children have of surviving HIV infection up to age *x, s(x),* as a double Weibull function:

$$s(x) = 1 - \left[p \bullet (1 - \exp(-(\alpha \bullet x)^{\eta})) + (1 - p) \bullet (1 - \exp(-(\beta \bullet x)^{\iota}))\right] \quad (8)$$

where $p = 0.6$, $\alpha = 0.9$, $\eta = 0.9$, $\beta = 0.1$ and $\iota = 10$. Allowance is also made for the probability of surviving from other causes of death by multiplying $s(x)$ by the normal $l(x)$ function of the life table for uninfected children.

Step 6: *Projecting the population that is not infected by HIV*. Steps (1) to (6) describe how the HIV-positive population is projected from the start of the epidemic onward. In fact, the full multi-state projection procedure used projects also the non-infected population allowing for two possible and independent ways of leaving that group: (*a*) by dying from non-AIDS causes, or (*b*) by becoming infected with HIV (i.e., the yearly incidence). In addition, the age-specific fertility rates applied to non-infected women are increased in such a way that the overall fertility rates of the population as a whole (both infected and not infected women) match those estimated from available data.

Step 7: *Calculation of revised life-tables that reflect the impact of HIV/AIDS*. The results of the multi-state projections permit the calculation of life tables that reflect both the effect of general mortality and the added impact of HIV/AIDS in a manner consistent with what is known about HIV prevalence in each country. The life tables representing average mortality for five-year periods are then used to carry out the "normal" population projections over five-year periods prepared by the Population Division for countries affected by the epidemic. That is, the projection procedure ultimately used for both countries that are not yet affected in a significant way by HIV/AIDS and those affected by the epidemic is the same. This approach allows us to "splice" easily forward projections for periods before the start of the epidemic with those after its start and also to create "NO-AIDS" versions of the forward projections that represent estimated population dynamics in the absence of HIV/AIDS.