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BLOOD DONORS AND AIDS IN AFRICA:

THE GIFT RELATIONSHIP REVISITED

by

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-- select donors based on a risk profile that would give priority to males or married couples in rural areas, who are in age groups least likely to be infected.

The donor selection strategy will require increased investment in "cold chains" to preserve bloods donated in rural areas. These increased costs need to be balanced against benefits of cleaner blood to urban populations and increased availability of medicine for rural populations.

SUMMARY

Transmission of HIV by transfusion may account for an estimated 10 percent of total cases of AIDS in Africa and 25 percent among children. Industrial countries now routinely test their donated blood for HIV. But for most African countries, the cost of the HIV testing represents the entire per capita health budget for a year [Oldfield, 1987]. Therefore, the strategy for insuring a safe blood supply must rely more on donor selection than blood testing. The seroprevalence of HIV in the blood donors, relative to the low-risk population, therefore becomes critical when donor selection, instead of blood testing, is the primary means to insure the quality of the blood supply.

Most recipients (66 to 100 percent) of HIV-positive blood become infected. All blood products can transmit HIV The presence of other infections, such as malaria, does not appear to be a determining factor in seroconversion. But recipients of infected blood progress to AIDS more rapidly than people infected by other means.

Twenty-four African countries have well-documented data on blood donors and equivalent low-risk populations from the same geographical area in the same year. In nine countries, blood donors in capital cities had considerably higher HIV seroprevalence than other low-risk groups; in seven countries the difference was statistically significant.

Outside the capitals of Africa, data were available for eleven regions in six African countries. In only two regions was the seroprevalence of HIV in blood donors higher than in the low-risk control group.

In five of the six countries that had data by sex of the blood donor, the HIV seroprevalence of female donors was higher than male donors. The HIV seroprevalence of female blood donors appears to be not only unrepresentative of women as a whole, but it is also not representative of blood donors in general. Female blood donors appear to be a higher-risk group than either the general population or the male donors.

Of nine countries that have data on blood donors over time, five have seroprevalence that is either declining or not changing. Four countries have increases in the seroprevalence of blood donors.

Given the data currently available and the fiscal inability to test all blood donations, several strategies proposed by African doctors and this paper are:

-- decrease the need for transfusions, especially by controlling malaria; and

PREFACE

The Center for International Research conducts economic and demographic studies, some of which are issued as Staff Papers. A complete list of these papers is included at the end of this report. The use of data not generated by the U.S. Bureau of the Census precludes performing the same statistical reviews the Bureau does on its own data.

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The HIV seroprevalence of blood donors is critical because most recipients of HIV-positive blood become infected. In one U.S. study, 59 percent of living HIV-positive blood recipients were HIV-positive or had AIDS [Ward, et al., 1989]. Recipients were most likely to become seropositive if they received blood just before the donor was clinically diagnosed with AIDS [Ward, et al., 1987]. In a Swedish study, all recipients of infected blood became seropositive [Ward, et al., 1988].

In Africa, many of the blood recipients are likely to be infected already with other diseases, such as malaria, sexually transmitted diseases, or tuberculosis. Immunocompromised recipients appear, however, to have the same HIV serologic profile as immunocompetent recipients [Anderson, 1986]. There may be some correlation between clinical states and presence of serum neutralizing antibodies as suggested by one study in the United States [Anderson, 1986]. But the presence or absence of other infections does not seem to be a determining factor of whether the recipient becomes seropositive.

All blood products can transmit HIV [Giesecke, et al., 1988]. There appears to be a dose response phenomena; both donors and recipients became symptomatic together or remained asymptomatic together [Zuck, 1988]. And recipients of infected blood who become infected progress to AIDS more rapidly than people infected by other means. The mean number of months required for progression from infection to AIDS in the general U.S. population is 96 to 108 months [Osmond, 1989]. If the infection is by transfusion, however, the mean is 80 months for adults and 44 months for children in the United States [Lagakos and DeGruttola, 1989].

THE DATA QUALITY AND QUALIFICATIONS

The data used in the comparisons in this paper are imprecise, and, therefore, imperfect. Random and truly representative HIV serological surveys are extremely rare in Africa; therefore, most comparisons embody some selection bias.

Sample sizes often are small by social science and epidemiological standards, but not necessarily by biomedical standards. HIV seroprevalence in similar populations tends to be inversely related to sample sizes [Torrey, Way, and Rowe, 1988]. Good sample surveys are expensive and time consuming and most African countries have neither money nor time. Therefore, the existing, imperfect data must be used to help sort out the patterns of infection among donors and recipients until more precise data become available.

In order to minimize the problems with the data, the seroprevalence data used are from the largest samples available. Both time and place were controlled in the comparisons. All data used had at least two confirmatory

INTRODUCTION

Blood donors have been characterized as gift givers [Titmuss, 1971]. But the gift may unwittingly be death when the blood is infected with Human Immunodeficiency Virus (HIV). Blood transfusions have caused an estimated 3 percent of all cases of AIDS in the United States and an estimated 10 percent in Africa [Piot, 1987]. Five percent of adult AIDS patients in Kinshasa, Zaire and 25 percent of the AIDS in Kinshasan children may have been caused by infected blood [Zuck, 1988 and Mann, 1987a]. The nature of the gift relationship in Africa, therefore, becomes crucial to the containment of the AIDS epidemic, especially among children.

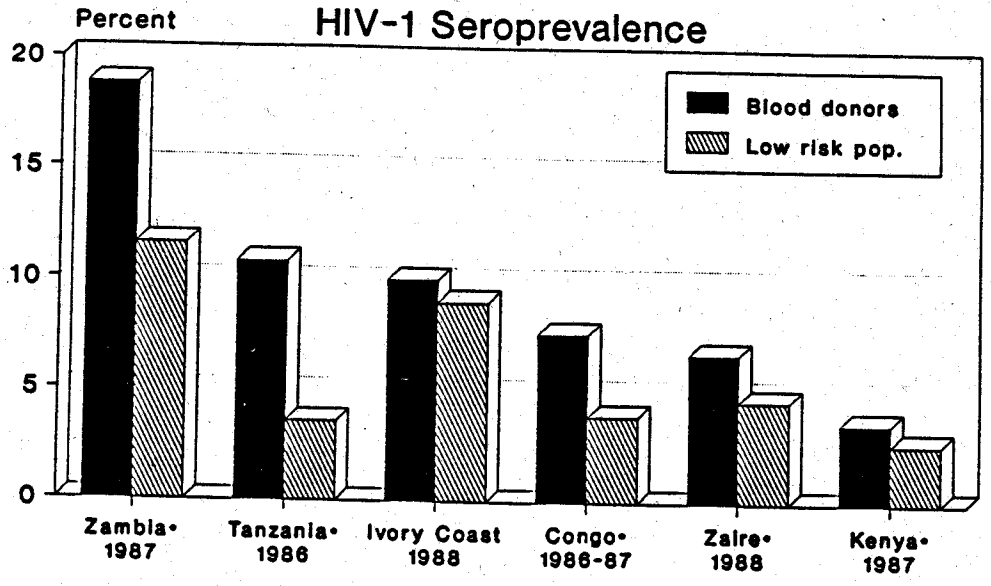
Most industrial countries have a systematic collection program that relies heavily on the public donation of blood. Titmuss' [1971] classic comparative study of blood collection in industrial countries showed that the financial arrangements for collecting blood varied widely and that the best quality blood came from people who had donated rather than sold their blood. The majority of donors in Africa are family members of a patient. Family members are, in general, good sources of clean blood. But in countries where the HIV seroprevalence is high among low-risk people, blood donations even from family members becomes more risky.

Industrial countries now routinely test their donated blood for HIV. But for most African countries, the cost of a single HIV test is equal to the per capita health budget for a year [Oldfield, 1987]. Therefore, the strategy for insuring a safe blood supply must rely more on donor selection than blood testing. The seroprevalence of HIV in the blood donors, relative to the low-risk population, therefore becomes critical when donor selection, instead of blood testing, is the primary means to insure the quality of the blood supply.

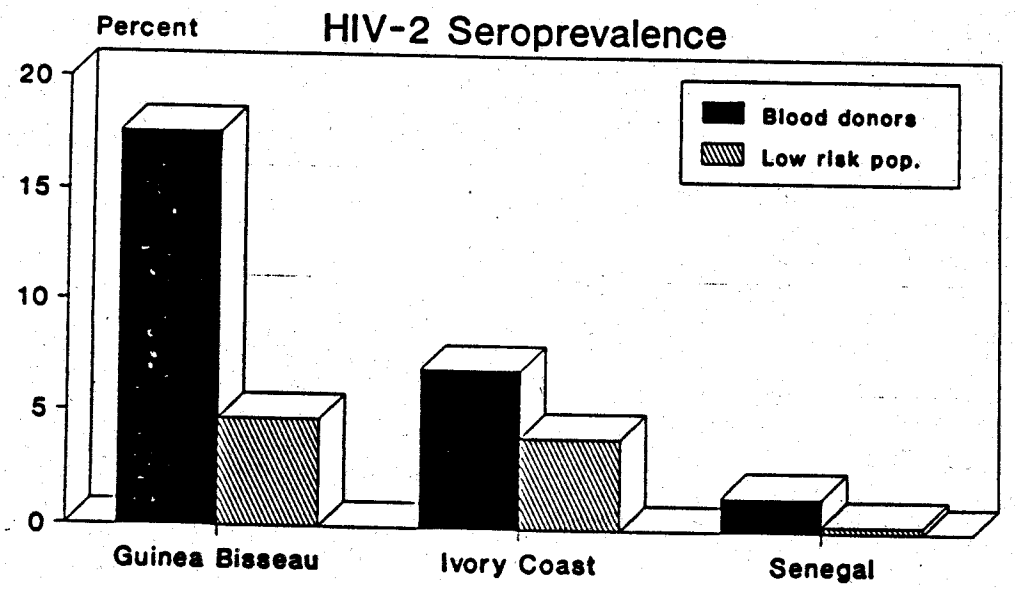
This paper compares the seroprevalence of blood donors and other low-risk groups in 24 African countries to determine whether blood donors are a random selection of the low-risk population. The comparisons are first made between capital-city blood donors and low-risk population groups; then between non-capital-city donors and low-risk groups. Comparisons of seroprevalence are also made between male and female donors and then trends in the seroprevalence of blood donors over time are discussed. Finally, several strategies for improving the safety of the blood supply, when testing is unaffordable, are outlined.

Figure 1.

HIV-1 and HIV-2 Seroprevalence of Blood Donors vs. Low Risk Populations in Capital Cities



• Statistically significant difference



serological tests. Statistical tests (Chi square with the Yates corrections) also were run on the results to indicate which differences may be important. In some cases, large-sized samples are not included because there was no comparable low-risk group, or there was not enough information about year, place, tests, or sample population. Over time, as the medical reporting improves, comparisons of different samples will become easier.

The data were drawn from the HIV/AIDS Surveillance Data Base--a compilation of HIV seroprevalence information contained in journals, articles, and public presentations and maintained by the Center for International Research, U.S. Bureau of the Census, for the Agency for International Development. Reliability of the data have been assessed. But given the quality of the original data, the patterns described below still should be considered tentative indications, rather than precise estimates, of the problem. As better data become available, these comparisons need to be updated.

THE HIV SEROPREVALENCE OF URBAN BLOOD DONORS IN CAPITAL REGIONS COMPARED WITH THE LOW-RISK POPULATION

Twenty-four African countries have well-documented data on the HIV-1 and/or HIV-2 seroprevalence of blood donors and equivalent low-risk populations in capital cities for the same year. Low-risk generally is defined as a group that has no known risk factor for AIDS, such as pregnant women or groups defined as "healthy adults". In four of the countries, the blood donors had a seroprevalence rate that was at least 0.5 points less than the low-risk population for either HIV-1 or HIV-2. But only in Cameroon was this difference statistically significant. In five countries, the blood donors had a HIV-1 seroprevalence rate that was significantly higher. In four countries, the donors' HIV-2 seroprevalence was higher than in the low-risk population, and two of these differences are highly significant. (Figure 1 summarizes the data from these surveys. Appendix table A-1 provides the details of the surveys compared.)

The five countries in which the HIV-1 seroprevalence of capital city blood donors was significantly higher than the low-risk population in the capital area are discussed below.

-- In Brazzaville, Congo, two surveys of blood donors gave different results. In one survey, HIV seroprevalence for blood donors is 3.7 percentage points higher than for the low-risk population. The sample sizes are large and the difference is highly significant. However, another survey of blood donors with a 50-percent larger sample size showed almost equal seroprevalence among donors and low-risk population. This suggests that there can be striking differences among blood donor samples themselves. It also would be good news if the second sample represents the future trends better than the first sample, but there is no assurance that it does.

countries blood donors had a seroprevalence level of HIV-2 that was higher than in the low-risk population, two of which were statistically significant.

-- In Dakar, Senegal, the level of HIV infection was much lower than in Zaire. But a large sample (92,000) of blood donors in 1987 showed that the level of HIV infection (both HIV-1 and HIV-2) was five times the level in a large sample of pregnant women (1.5 versus 0.3, percent respectively). The survey did not disaggregate HIV-1 and HIV-2. But given the seroprevalence patterns in Senegal in general, the seroprevalence is much more likely to be for HIV-2 than HIV-1. Since HIV-2 has been shown to cause AIDS, differences in its seroprevalence should be as much of a concern as for HIV-1.

-- In Bissau, Guinea-Bissau, the seroprevalence of blood donors for HIV-2 was 17.6 percent in the first 2 months of a study and a remarkable 5.3 percent in the last 4 months. This suggests a remarkable and encouraging change in the blood donors. A large household survey of 1,330 people in an adjacent part of Bissau estimated the seroprevalence to be 5.3 percent. If the blood donors of the latter 4 months of the survey are an indication of the long-term level, then the rate of the blood donors is no higher than the general population.

A survey of blood donors in Cape Verde, Praia-Santiago Island, also showed a much higher HIV-2 seroprevalence than in a control population. But the sample of blood donors was so small, 13, that it needs to be reconfirmed.

THE SEROPREVALENCE OF BLOOD DONORS AND THE LOW-RISK POPULATION OUTSIDE THE CAPITAL REGION

In general, HIV seroprevalence is much lower outside of the capital region than in the capital region [Torrey, et al., 1988]. A recent study in Zambia suggests the HIV seroprevalence in blood donors varies inversely with the distance from big cities (seroprevalence of HIV-1 in various rural areas ranged from 0 to 3 percent, in urban areas from 0 to 10 percent, and in big cities from 0 to 11 percent [Luo, et al., 1989]). The question this section addresses is whether the seroprevalence of blood donors outside the capital region is higher or lower than other low-risk groups in the same region who are the most likely to receive their donated blood.

Eleven regions in six African countries have data on the seroprevalence of their blood donors to compare with low-risk groups from the same region (Figure 2; Appendix table A-2 summarizes the data). The pattern is clearly different than in the capital cities. In six of the eleven regions, the seroprevalence of the donors was lower than the low-risk population by more than 1 percentage point. In two cases, the seroprevalence of HIV-1 and HIV-2 for blood donors were discordant compared with the low-risk population (one higher, one lower). Among these samples, only in Dabou City, Ivory Coast, do the blood donors have a higher seroprevalence than the general population. In that city, researchers found a seroprevalence among blood donors of 6.5 percent for HIV-1 and 4.5

-- In Dar es Salaam, Tanzania, a survey of 622 blood donors found a seroprevalence rate of 10.8 percent. Two other smaller surveys about the same time found 7.3 percent and 4.4 percent for male blood donors only. The highest estimate of seroprevalence not only comes from the largest sample but also is the result of seven-enzyme immunoassays for HIV-1 and, therefore, should be the most reliable estimate and also the most worrisome. All of these seroprevalence rates are higher than the seroprevalence rate of pregnant women (3.6 percent).

-- In Kinshasa, Zaire, the difference in the seroprevalence of blood donors and the low-risk population was both large and significant. In 1988, blood donors had an HIV seroprevalence of 2.1 points higher than the low-risk population. This was not a new pattern, however. In 1987, the difference was 2.2 points higher, and in 1986 and 1985, the seroprevalence also was higher based on much smaller sample sizes. Another sample of blood donors in Kinshasa in 1988 had a seroprevalence rate of 4.8 percent, which is not much different than the controls. But the sample size was smaller than the sample we are comparing (1,025 versus 3,448) and the reference to the sample suggested that only the Elisa tests was done to verify the seroprevalence. The persistent, significantly higher HIV seroprevalence of blood donors means that their contribution to the epidemic, especially among children, may be substantial.

-- In Lusaka, Zambia, the large difference between blood donors and low-risk population in 1987 (18.8 percent versus 11.6 percent) was highly significant.

-- In Nairobi, Kenya, the seroprevalence of blood donors in 1987 steadily rose from 1.5 percent in July to 3.6 percent in December. While the average seroprevalence over the entire year was approximately equal to the seroprevalence of a large sample of women in labor (2.7 percent), the seroprevalence of the 5,014 blood donors in December was significantly higher. Since the most recent data is both the most important and most worrisome, it is the comparison used in Figure 1.

In Kigali, Rwanda, the seroprevalence rate of the blood donors in several studies varied between 14.3 and 18.0 percent in 1985. One study reported seroprevalence for single and married blood donors (20.2 and 6.5 percent, respectively). The seroprevalence of donors in general is similar to the seroprevalence of wage earners (17.3 percent) and actually lower than in a study of women at a well-baby clinic (27.1 percent) 2 years later in 1987. But the seroprevalence of blood donors in Kigali city was much higher than the seroprevalence of the general population of Kigali District (3.0 in 1986). To the extent that people in the area surrounding the capital city have access to the blood supplies from the city itself, this is a relevant and troubling difference.

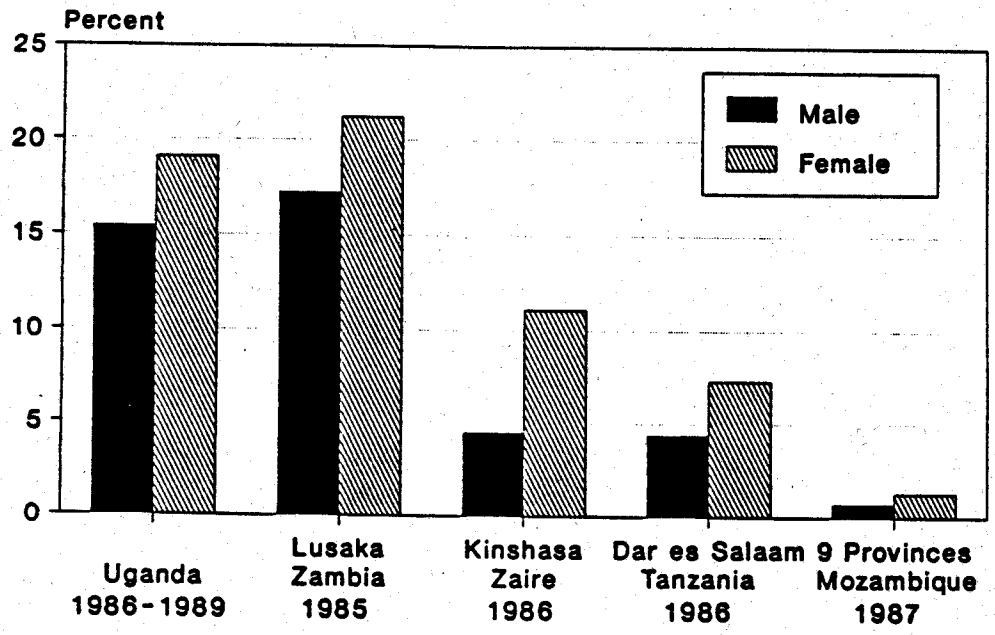
Although the natural history of HIV-2 is not yet well understood, it is known to compromise the immune system and cause AIDS. There is some evidence that the average incubation period may be longer than for HIV-1 and the risk of infection per contact somewhat lower [Poulsen, et al., 1989]. In three

THE HIV SEROPREVALENCE OF MALE AND FEMALE BLOOD DONORS

Seven regions in six African countries have seroprevalence data on their blood donors by gender. In all of these countries, blood donors were disproportionately male. In fact, there were often so few females that large observed differences in seroprevalence were not statistically significant because of the small sample size of women. But the pattern of seroprevalence is striking and consistent throughout Africa and, therefore, bears discussion. Figure 3 summarizes the data.

Figure 3.

Male Blood Donors vs. Female Blood Donors
HIV-1 Seroprevalence



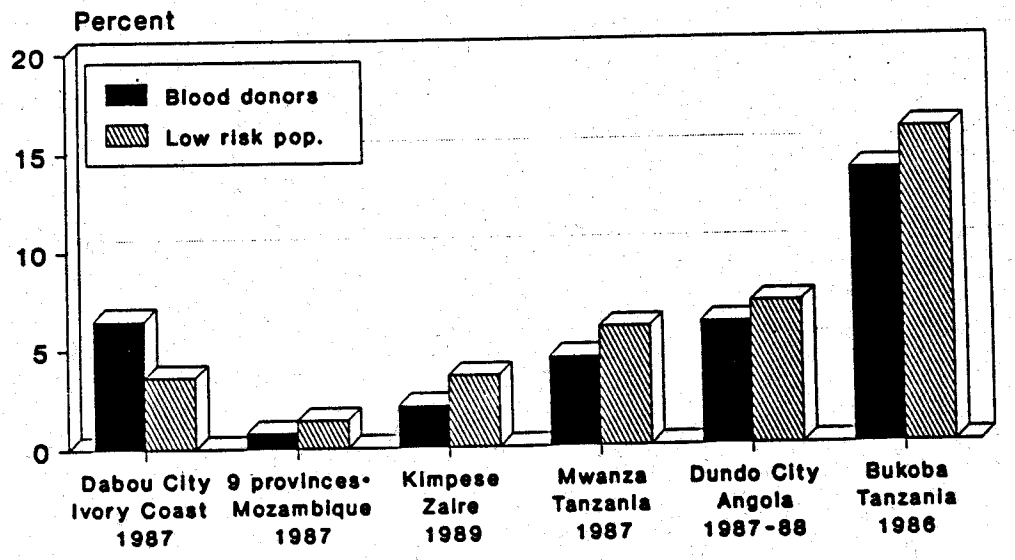
In five of the six countries, female donors have a seroprevalence higher than male donors.

-- In Kinshasa, Zaire, a 1986 survey of blood donors consisted of 18 women compared with 307 men. The women's seroprevalence was 11.1 percent versus 4.5 percent for men.

percent for HIV-2, which was higher than in a survey of a healthy adult population in which the estimated seroprevalence for each virus was 3.6 percent.

Figure 2.

HIV-1 Seroprevalence of Blood Donors vs. Low Risk Population Outside the Capital City



• Statistically significant difference

A comparison of Appendix tables A-1 and A-2, however, shows that in two of six countries the blood donors for at least one region outside the capital city had the same or higher HIV seroprevalence than the blood donors in the capital city:

-- Dundo City, Angola, and

-- Bukoba, Tanzania.

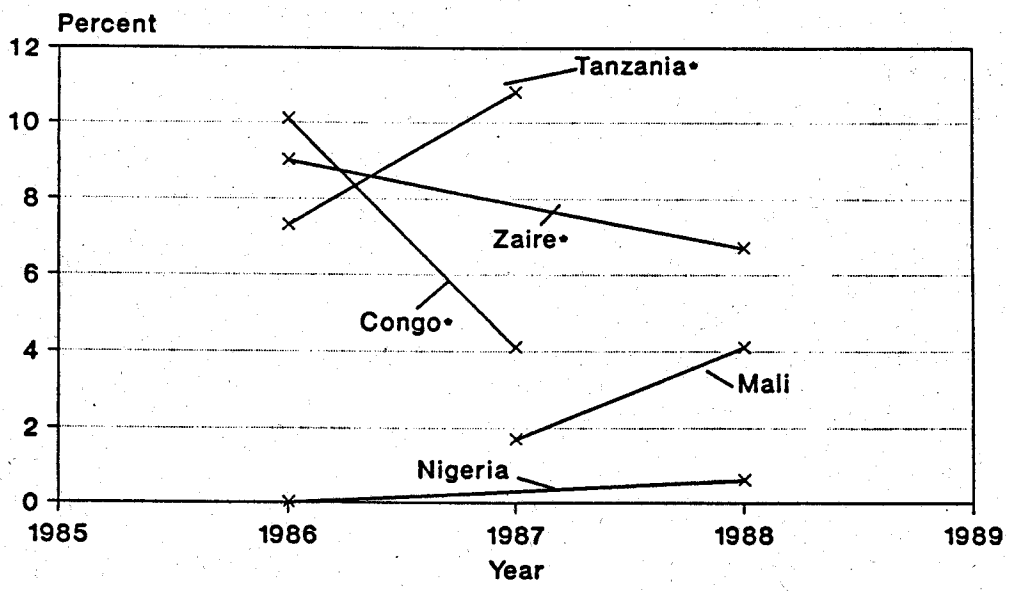
And in both cases, the region borders on a neighboring country with higher seroprevalence levels. This demonstrates clearly that while HIV seroprevalence is, in general, lower in rural areas, there are important exceptions to this general pattern, particularly in the case of some regional cities.

-- In Congo, seroprevalence went from 10.1 percent in 1986 to 4.0 percent in the 1986-87 period. We have found that in several instances, the larger the sample size, the smaller the estimate of seroprevalence tends to be. But the sample size of 4,387 in 1986 was already considerable, so more than sample size is likely to be needed to explain this substantial and statistically significant decrease.

-- In Kinshasa, Zaire, the decline is less dramatic, but still statistically significant. The estimates are based on large sample sizes and, therefore, also may be signaling an important trend. In 1986, the seroprevalence of donors was 9.0 percent; by 1988, it had dropped to 6.7 percent.

Figure 4.

Trends Over Time in HIV-1 Seroprevalence of Blood Donors



• Statistically significant difference (p <.05).

Four countries have surveys of blood donors that suggest that the seroprevalence of blood donors may be continuing to increase:

-- In Tanzania, the seroprevalence rose from an estimated 7.3 percent in 1986 to 10.8 percent in 1986-87.

-- In Kenya, the level of seroprevalence was lower, but the rise from 1.6 percent to 3.6 percent over a 6-month period in 1987 was striking.

-- In Zambia, the number of male blood donors was twice the number of female donors, and their seroprevalence was 20 percent less (17.2 percent versus 21.2 percent).

-- In Launda, Angola, there were 3 women donors versus 69 males. One woman (33.3 percent) was positive for HIV-2; no male donor was positive for either HIV-1 or HIV-2.

-- In Dar es Salaam, Tanzania, a sample of 535 male and female blood donors had a HIV seroprevalence rate of 7.3 percent compared with 4.4 percent among 225 all male blood donors.

-- In Uganda, samples of 10,899 male donors and 1,624 female donors showed a statistically significant differential of 3.7 percent higher HIV-1 seroprevalence rate among the female donors.

The HIV seroprevalence of female blood donors appears to not only be unrepresentative of women as a whole, but it is also not representative of blood donors in general. Female blood donors appear to be a higher-risk group than either the general population or male donors.

TRENDS IN BLOOD DONOR SEROPREVALENCE OVER TIME

Nine African countries have data on the HIV seroprevalence of their blood donors over several years. The details are summarized in Figure 4. For five of the nine countries the trend has been either decreasing or not changing. The decreasing trend may, in fact, be due to one or more factors:

-- the testing has improved and gives fewer false positives than it did previously;

-- the blood donors are self-selecting themselves more carefully; and

-- the sample sizes are increasing and becoming more representative of the general donor population.

But the trend also may be real and if so, it would be encouraging. However, the long incubation period for HIV (time between infection and AIDS) suggests that the true population HIV seroprevalence will decline only slowly over time, even if no new infections were taking place.

The two countries where there had been essentially no change are Ethiopia and Guinea. They had little or no seroprevalence in their blood donors in the earlier date, and in 1987-88 they still had little or none.

Angola showed a minor decline in the seroprevalence of its male donors. Two other countries showed more important declines:

IMPLICATIONS OF THE SEROPREVALENCE OF AFRICAN BLOOD DONORS FOR THE PUBLIC HEALTH SYSTEM

Infected blood donors pose a special challenge to African health care systems. Their blood is essential to the life of patients who need the transfusion, but the blood is also deadly if the donor is HIV positive. Three strategies to insure a clean blood supply are:

-- test all blood;

-- reduce the number of transfusions; and

-- screen out high-risk donors.

Dr. L. Muyembe-Tamfum, Dean of the University of Kinshasa School of Medicine [1987] concluded that testing all blood would be too expensive for many African countries since the cost of a single test is the same as the annual per capita health costs in many countries. N. Carvalho [1989] proposes reducing the number of transfusions and screening out high-risk donors. Transfusions in African countries are given disproportionately to pediatric and OB/GYN patients. In six provincial hospitals in Cameroon, 39 percent of patients transfused were in the OB/GYN service; 38 percent were in pediatrics [Workshop, 1989]. Jaeger, et al. [1989b] found that 79 percent of the transfusions in Mama Yemo Hospital were in the age groups 5 years and under and 15 to 39 years. Seventy-seven percent of the 5 years and under group transfusions were malaria related and 43 percent of the 15 to 39 years olds were for pregnancy-related complications. Therefore, the study concluded that in order to reduce the transmission of HIV, African governments need to control malaria better and hospitals need to develop strict transfusion guidelines, especially in obstetrics.

Dr. L. Muyembe-Tamfum [1987] also suggested that in order to reduce the potential for transfusing of HIV-contaminated blood, donors should be selected on their epidemiological or clinical characteristics. In the United States, donors are discouraged by self-assessment. But in Kinshasa, only 15 percent of the blood donors who turned out to be positive thought that they were at risk, even after a detailed interview [Mann, 1987b]. This suggests that relying on self-selection is likely to have a minimum impact on the safety of the blood supply and that Dr. Muyembe-Tamfum's strategy of independently "identifying a broad group with higher than average risk of being....infected" is likely to be more effective than donor self-selection.

If the available data on seroprevalence are reasonably representative, then a strategy to lower the HIV seroprevalence in African blood donations would be to:

-- Avoid urban women blood donors. Urban women blood donors appear to have higher seroprevalence than urban male donors, as well as other low-risk groups, in a number of countries.

-- In Bamako, Mali, two large surveys of blood donors were conducted in 1987 and 1988. In the year between the surveys, the HIV-1 seroprevalence increased from 1.7 to 4.1 percent.

-- In Ibadan, Nigeria, HIV-1 seroprevalence increased from 0.0 percent in 1986 to 0.6 percent in 1988.

Most African countries do not have reliable data over time and, therefore, the trends in seroprevalence are unknown. But to the extent that other countries may have undocumented trends similar to Tanzania, Mali, and Nigeria, strong steps should be taken to protect the blood supply. Even in a country such as Zaire, where the seroprevalence of HIV in blood donors may be beginning to decline, the donors' seroprevalence is still above the level for the general population and, therefore, is a major public health hazard.

HIV SEROPREVALENCE BY CHARACTERISTIC OF THE BLOOD DONOR

In Africa, most blood donors are related to patients needing blood. In Cameroon, Dr. Marcel Monny-Lobe [1989] estimates that 80 percent of blood donors are family members. To the extent that hospital patients may be disproportionately HIV-positive, then their sexually active family members also may be disproportionately HIV-positive. In fact, a study by Jaeger, et al. [1989a] of 2,237 blood donors in Kinshasa found the following distribution of characteristics and HIV seroprevalence:

	Kinshasan blood donors		
Characteristic	Voluntary	Family member	Paid
Percent of total donors	12.0	62.0	26.0
Percent HIV-1-positive	2.9	5.1	4.9

The higher HIV seroprevalence of paid and family donors relative to voluntary donors was replicated in a study of blood donors in Uganda. The voluntary Ugandan blood donors had a seroprevalence rate of 8.0 percent and the family members had a seroprevalence rate of 22.0 percent [Watson-Williams, et al., 1989]. The Ugandan study also showed that the unit cost of testing the bloods of volunteers with lower seroprevalence was less than the cost for family members. The blood donor system in Africa traditionally has relied on family members as a source of blood. But when a sexually transmitted disease becomes a major cause of illness in a country, family members may not be the best sources of uninfected blood. Developing new sources of uninfected blood will be a major challenge for the African health systems.

-- Avoid blood donors from the high-risk ages for HIV-1 and HIV-2 seroprevalence. The high-risk age groups are young adults for HIV-1 and older adults for HIV-2. This strategy will pose special dilemmas for countries in which both viruses exist.

-- Recruit blood donors from outside the major urban areas. The HIV seroprevalence is often lower even a few miles from the capital cities (Appendix tables A-5 and A-6). Not only is the rural seroprevalence rate lower than the urban rate, but the rural blood donors generally had a lower seroprevalence rate than other rural, low-risk groups. But special care must be taken to avoid pockets of high seroprevalence in some non-capital cities.

Africa does not have a long tradition of a nationwide blood collection system that is anonymous and voluntary. Some tribes are likely to find the donation of blood culturally offensive; others will object on physical grounds alone. Therefore, the development of a new blood collection strategy is easier to describe than it will be to implement. It also will be a supplement to the inexpensive testing described by Mitchell, et al., [1990] rather than a replacement.

Using blood donors from rural areas will increase the costs necessary to maintain the blood by the "cold chain" while transporting it to urban areas. There will be real costs of improving and extending the cold chain. But the cost is not a sunk cost for AIDS alone because the cold chain works both ways. It also improves the availability of drugs in rural areas from the urban centers. It is a needed improvement in the rural health systems independent of the AIDS epidemic; now it could become a reciprocal bargain. If the rural populations are willing to provide their blood to the rest of the country, they could become part of the cold chain. And they will receive in return for their blood a better supply of medical supplies for their own health. It is a bargain some will make, especially for their children. It would not be a panacea, but it will maximize the chances of safe blood with moderate costs. And it will allow the resources that some might be tempted to spend on HIV testing to be used as a longer-term health capital investment to fight AIDS in particular and improve the rural health care system in general. Then the cold chain would become the symbol of the "gift relationship" in Africa.

APPENDIX A

DETAILED TABLES

Table A-1. HIV Seroprevalence of Blood Donors Versus Low-Risk Population in Capitol Cities--Continued

Country and city	Capital City Blood Donors						Capital City Low-Risk Population						Blood Donors versus Low-Risk Population: Statistical Tests	
	Source	Year	Sex and age	HIV	Sample size	Seroprev-alence	Seroprev-alence	Sample size	HIV	Sex and age	Year	Source	Difference	Significance
Kenya	G0017	1987	B All	1	5,014	3.6	2.7	2,910	1	F All	1987	K0010	+ 0.9	P<.05
Mali, Bamako	M0054	1987	B All	1	139	0.0	0.4	573	1	F All	1987	M0054	- 0.4	
	M0054	1987	B All	2	139	0.7	1.4	573	2	F All	1987	M0054	+ 0.7	
Morocco,Casablanca	B0009	1984-87	B All	1	3,577	0.0	0.0	778	1	F All	1984-87	B0009	0.0	
Mozambique, Maputo City	D0016	1987	B All	1	418	0.7	0.9	532	1	B All	1987	D0016	- 0.2	
Rwanda, Kigali	C0001	1985	M All	1	182	14.3	17.3	301	1	M All	1985	C0001	- 3.0	
Senegal, Dakar	L0018	1987	B All	1,2	2,000	1.5	0.3	800	1,2	F All	1987	L0018	+ 1.2	P<.01
Somalia, Mogadishu	A0007	1986-87	B All	1	745	0.0	0.0	795	1	B All	1986-87	A0007	0.0	
Tanzania, Dar es Salaam	B0024	1986-87	B All	1	622	10.8	3.6	192	1	F All	1986	M0014	+ 7.2	P<.01
Tunisia	G0015	1985-87	B All	1	1,472	0.1	0.0	452	1	M All	1985-87	G0015	+ 0.1	
	G0015	1985-87	B All	2	1,472	0.0	0.0	452	2	M All	1985-87	G0015	0.0	
Uganda, Kampala	J0001	1986	B All	1	370	11.0	13.5	1,011	1	F All	1986	M0038	- 2.5	
Zaire, Kinshasa	N0027	1988	B All	1	3,448	6.7	4.6	1,370	1	F All	1988	N0027	+ 2.1	P<.01
Zambia, Lusaka	M0079	1987	B All	1	5,505	18.8	11.6	1,954	1	F All	1987	H0028	+ 7.2	P<.001

Table A-1. HIV Seroprevalence of Blood Donors Versus Low-Risk Population in Capital Cities

Country and city	Capital City Blood Donors						Capital City Low-Risk Population						Blood Donors versus Low-Risk Population: Statistical Tests	
	Source	Year	Sex and age	HIV	Sample size	Seroprev-alence	Seroprev-alence	Sample size	HIV	Sex and age	Year	Source	Difference	Significance
Angola, Launda	F0010	1987	B All	1	72	0.0	0.0	136	1	B All	1987	F0010	0.0	
	F0010	1987	B All	2	72	1.4	1.5	136	2	B All	1987	F0010	- 0.1	
Benin, Contonou	L0005	1986-87	B All	1	3,478	0.1	0.0	878	1	F All	1986-87	L0005	+ 0.1	
	Z0007	1987	B All	2	36	0.0	0.0	83	2	F All	1987	Z0007	0.0	
Cameroon, Yaounde	K0024	1987-88	B All	1	3,535	0.3	1.1	900	1	F All	1987	K0021	- 0.8	P<.01
Cape Verde, Praia-Santiago Island	B0016	1987	B All	1	13	0.0	0.0	236	1	B All	1987	B0016	0.0	
	B0016	1987	B ALL	2	13	15.4	6.4	236	2	B All	1987	B0016	+ 9.0	
CAR, Bangui	S0069	1989	B All	?	1,048	7.4	8.0	186	?	F All	1989	S0069	- 0.6	
Congo, Brazzaville	Y0004	1986-87	B All	1	13,505	4.0	3.9	1,833	1	F All	1987-88	L0028	+ 0.1	
	C0009	1986-87	B All	1	8,009	7.6	3.9	1,833	1	F All	1987-88	L0028	+ 3.7	P<.001
Djibouti, Djibouti	B0037	1987-88	B All	1	1,270	0.0	0.3	1,760	1	B All	1987-88	B0037	- 0.3	
Egypt (national)	W0007	1986-87	B All	1	5,893	0.0	0.2	10,234	1	B All	1986-87	S0026	- 0.2	P<.01
Ethiopia	Z0009	1988	B All	1	3,000	0.0	0.0	122	1	B All	1987	A0012	0.0	
Guinea, Conakry	F0018	1987-88	B All	1	3,209	0.2	0.0	142	1	F All	1987-88	F0018	+ 0.2	
	F0018	1987-88	B All	2	3 209	0.2	0.0	142	2	F All	1987-88	F0018	+ 0.2	
Guinea-Bissau, Bissau	C0023	1987	B All	2	189	5.3	0.0	1,329	2	B All	1987	P0025	+ 0.6	
	C0023	1987	B All	2	91	17.6	4.7	1,329	2	B All	1987	P0025	+ 12.9	P<.001
Ivory Coast, Abidjan	O0004	1988	B All	1	199	10.0	9.0	198	1	F All	1988	O0004	+ 1.0	
	O0004	1988	B All	2	199	7.0	4.0	198	2	F All	1988	O0004	+ 3.0	

Table A-3. Male Blood Donors Versus Female Blood Donors HIV Seroprevalence

Country and city	Male Blood Donors						Female Blood Donors						Female Blood Donors Versus Male Blood Donors: Statistical Tests	
	Source	Year	Sex and age	HIV	Sample size	Seroprev-alence	Seroprev-alence	Sample size	HIV	Sex and age	Year	Source	Difference	Significance
Guinea Bissau	G0027	1987-88	M All	2	871	8.6	5.3	76	2	F All	1987-88	G0027	- 3.3	
Mozambique, 9 provinces	B0025	1987	M All	1	2,047	0.7	1.3	318	1	F All	1987	B0025	+ 0.6	
Tanzania, Dar es Salaam	M0014	1986	M All	1	225	4.4	7.3	535	1	B All	1986	B0011	+ 2.9	
Uganda	W0029	1986-89	M All	1	10,899	15.4	19.1	1,624	1	F All	1986-89	W0029	+ 3.7	$p < 0.5$
Zaire, Kinshasa	N0012	1986	M All	1	307	4.5	11.1	18	1	F All	1986	N0012	+ 6.6	
Zambia, Lusaka	M0003	1985	M All	1	203	17.2	21.2	104	1	F All	1985	M0003	+ 4.0	

Table A-2. HIV Seroprevalence of Blood Donors Versus Low-Risk Population Outside the Capital Cities

Country and city	Outside Capital City Blood Donors						Outside Capital City Low-Risk Population						Blood Donors versus Low-Risk Population: Statistical Tests	
	Source	Year	Sex and age	HIV	Sample size	Seroprev-alence	Seroprev-alence	Sample size	HIV	Sex and age	Year	Source	Difference	Significance
Angola, Dundo City	F0010	1987	B All	1	50	6.0	7.2	111	1	B All	1988	C0041	- 1.2	
	F0010	1987	B All	2	50	16.0	15.1	111	2	B All	1988	C0041	+ 0.9	
Ivory Coast, Dabou City	G0031	1987	B All	1	200	6.5	3.6	195	1	B All	1987	G0038	+ 2.9	
	G0031	1987	B All	2	200	4.5	3.6	195	2	B All	1987	G0038	+ 1.1	
Mozambique, 9 provinces	B0025	1987	B All	1	2,370	0.8	1.4	5,788	1	B All	1987	D0020	- 0.6	P<.05
Senegal, Casamance area	R0002	1986-87	B All	1	84	0.0	0.0	260	1	F All	1986-87	R0002	0.0	
	R0002	1986-87	B All	2	84	0.0	2.7	260	2	F All	1986-87	R0002	- 2.7	
Various cities	M0045	1985-88	B All	1	4,194	0.0	0.1	7,341	1	B All	1985-88	M0045	- 0.1	
	M0045	1985-88	B All	2	4,194	0.6	0.5	7,341	2	B All	1985-88	M0045	+ 0.1	
Tanzania, Bukoba	M0014	1986	B All	1	36	14.0	16.0	100	1	F All	1986	M0014	- 2.0	
Mwanza	D0024	1987	B All	1	155	4.5	6.0	332	1	F All	1987	D0024	- 1.5	
Bukumibi	D0024	1987	B All	1	59	1.7	5.2	134	1	F All	1987	D0024	- 3.5	
Mwanza City	D0024	1987	B All	1	9	0.0	7.4	149	1	F All	1987	D0024	- 7.4	
Zaire, Kimpese	H0021	1989	B All	1	1,000	2.1	3.6	2,305	1	F All	1989	H0021	- 1.5	
Lwiro	N0027	1987	B All	1	267	1.4	3.4	58	1	B All	1987	N0027	- 2.0	

Table A-5: Estimates of HIV-1 Seroprevalence by Residence and Risk Factor, for Developing Countries: Circa 1988

REGION AND COUNTRY	CAPTIAL/MAJOR CITY		OUTSIDE MAJOR CITY		URBAN CITY SOURCES		OUTSIDE CITY SOURCES	
	LOW RISK	HIGH RISK	LOW RISK	HIGH RISK	LOW RISK	HIGH RISK	LOW RISK	HIGH RISK
AFRICA								
Algeria	-	-	-	-				
*Angola	1.3a	14.2a	-	-	C0041	S0043		
*Benin	.1	4.5	6.7	-	L0005	Z0007	C0087	
Botswana	.8c	1.2c	.1c	-	O0008	O0008	O0008	
*Burkina Faso	1.7b	16.9a	-	-	K0033	K0033/S0010		
Burundi	16.3	18.5	-	-	S0071	G0003		
*Cameroon	.8	6.9	.4	-	P0042	K0024	K0024	
*Cape Verde	.0	.0	-	-	A0046	B0016		
Central African Rep.	7.4	20.6	3.7	7.9	S0069	G0016	J0005	G0016
Chad	.0	-	.0	-	J0005		J0005	
Comoros	-	-	-	-				
Congo	3.1	34.3b	1.0	-	L0039	M0032	M0080	
*Djibouti	.3	2.7	.0b	-	B0037	C0082	F0017	
Egypt	.0	.0	-	-	W0007	S0005		
*Equatorial Guinea	.3	-	.3	-	J0009		J0009	
Ethiopia	.0	18.2	.0	-	Z0009	Z0010	Z0009	
*Gabon	1.8	-	.8	-	D0027		D0027	
*Gambia, The	.1	1.7a	-	.0b,c	W0027	P0034		M0031
Ghana	.0	25.2	-	-	N0031	M0018		
*Guinea	.6	-	.2	-	K0059		F0018	
*Guinea-Bissau	.1	.0b	.0		A0042	K0033	P0025	
*Ivory Coast	10.5a	23.8a	1.1a	-	O0004	V0002	O0015	
Kenya	2.7	59.2	1.0	-	K0010	V0022	P0011	
Lesotho	.1	-	-	-	S0075			
Liberia	.0	.0b	.0c	-	F0007	M0060	W0015	
Libya	.0	-	-	-	G0034			
*Madagascar	.0	.0b	-	-	C0061	M0030		
Malawi	16.4	55.9	-	-	C0068	G0005		
*Mali	.4	23.0a	-	-	M0054	B0022		
*Mauritania	.0b	.0	-	-	C0093	M0015		
Mauritius	.0	-	-	-	K0026			
Mayotte	-	-	-	-				
*Morocco	.0	.2	-	-	B0009	B0009		
*Mozambique	1.1	2.6	.8	-	D0020	D0016	B0025	
*Namibia	2.5	-	-	-	L0040			
Niger	-	5.8	-	-	B0068			
*Nigeria	.5	4.3a	.0	.5	N0052	A0043	W0028	W0028
Reunion	-	-	-	-				
*Rwanda	30.3	79.8b,c	1.7	-	L0055	C0003	G0029	
St. Helena	-	-	-	-				
*Sao Tome & Principe	.0	-	-	-	L0022			
*Senegal	.4a	2.0a	.0b	-	M0089	K0047	R0002	
Seychelles	-	-	-	-				
*Sierra Leone	3.6a	2.7a	-	-	K0060	A0032		
Somalia	.0	.4	-	-	A0007	O0006		
South Africa	.1	2.5	-	-	C0045	O0020		
Sudan	.0	.0	-	-	H0038	B0021		
Swaziland	.0b,c	.0b	-	-	S0001	S0050		
Tanzania	7.3	38.7	5.4	11.8	B0011	M0050	N0024	N0029
Togo	-	-	-	-				
*Tunisia	.1	1.9	-	-	G0015	G0015		
Uganda	24.3	86.0b	12.3	76.0b	N0048	N0003	K0023	N0003
Western Sahara	-	-	-	-				
Zaire	7.1	37.8	.8	17.7	Q0006	V0022	N0017	V0022
Zambia	11.6	26.2c	-	-	H0028	M0003		
Zimbabwe	3.2c	-	1.4	6.6b	Z0002		M0105	M0105

Table A-4. Trends Over Time in HIV-1 Seroprevalence of Blood Donors

Country and city	First Time Period Blood Donors						Second Time Period Blood Donors						Trends Over Time: Statistical Tests	
	Source	Year	Sex and age	HIV	Sample size	Seroprev-alence	Seroprev-alence	Sample size	HIV	Sex and age	Year	Source	Difference	Significance
Angola, Launda	B0039	1986	M All	1	452	0.4	0.0	72	1	B All	1987	F0010	- 0.4	
Congo, Brazzaville	M0026	1986	B All	1	4,387	10.1	4.0	13,505	1	B All	1987	Y0004	- 6.1	P<.001
Ethiopia, Addis Ababa	G0021	1983-87	B All	1	50	0.0	0.0	3,000	1	B All	1988	Z0009	0.0	
Guinea, Conakry	K0012	1986	B All	1	128	0.0	0.2	3,209	1	B All	1987-88	F0018	+ 0.2	
Kenya, Nairobi	G0017	7/87	B All	1	5,762	1.6	3.6	5,014	1	B All	12/87	G0017	+ 2.0	P<.001
Mali, national	M0071	1987	B All	1	1,140	1.7	4.1	1,841	1	B All	1988	M0071	+ 2.4	P<.001
Nigeria, Ibadan	E0009	1986	B All	1	2,000	0.0	0.6	1,464	1	B All	1988	E0009	+ 0.6	
Tanzania, Dar es Salaam	B0011	1986	B All	1	535	7.3	10.8	622	1	B All	1986-87	B0024	+ 3.5	P<.05
Zaire, Kinshasa	N0027	1986	B All	1	1,648	9.0	6.7	3,448	1	B All	1988	N0027	- 2.3	P<.01

Table A-6: Estimates of HIV-2 Seroprevalence by Residence and Risk Factor, for Developing Countries: Circa 1988

REGION AND COUNTRY	CAPTIAL/MAJOR CITY		OUTSIDE MAJOR CITY		URBAN CITY SOURCES		OUTSIDE CITY SOURCES	
	LOW RISK	HIGH RISK	LOW RISK	HIGH RISK	LOW RISK	HIGH RISK	LOW RISK	HIGH RISK
AFRICA								
*Angola	1.3a	13.7a	-	-	C0041	S0043		
*Benin	-	3.7	.9	-		K0007	C0087	
*Burkina Faso	.0b	22.8a	-	-	K0033	K0033/S0010		
*Burundi	-	-	-	-				
*Cameroon	-	-	.0	-			G0060	
*Cape Verde	1.4	8.2	-	-	A0046	B0016		
*Djibouti	-	.0	-	-		C0082		
*Equatorial Guinea	.0	-	.0	-	J0009		J0009	
*Gabon	.3	-	.0	-	D0027		D0027	
*Gambia, The	1.7	25.6a	-	3.2b,c	W0027	P0034		M0031
*Guinea	.2	-	.0	-	K0059		F0018	
*Guinea-Bissau	6.5	64.1b	4.7	-	A0042	K0033	P0025	
*Ivory Coast	6.5a	17.2a	1.5a	-	O0004	V0002	O0015	
*Madagascar	.0	-	-	-	C0061			
*Mali	1.4	27.4a	-	-	M0054	B0022		
*Mauritania	.0b	.0	-	-	C0093	M0015		
*Morocco	.0	.0b	-	-	B0009	B0009		
*Mozambique	2.2	1.1	-	-	D0020	D0016		
*Namibia	.0	-	-	-	L0040			
*Nigeria	1.2	3.5a	.1	.7	N0052	A0043	W0028	W0028
*Rwanda	.0	-	.0	-	G0029		G0029	
*Sao Tome & Principe	.0	-	-	-	L0022			
*Senegal	.5a	10.5a	.0b	-	M0089	K0047	R0002	
*Sierra Leone	5.0a	1.8a	-	-	K0060	A0032		
*Tunisia	.0	.0	-	-	G0015	G0015		

- No data found
* See table 1 for HIV-1 data.
a Rate represents infection with HIV-2 only and dual infection (HIV1 & HIV2), therefore addition of rates from table 1 and 2 is not advised.
b Data are best available but not necessarily reliable due to small sample size (<100).
c Data reference to prior 1986.

NOTES:
Definition: High risk -- prostitutes and clients, STD patients, or other persons with known risk factors.
Low risk -- pregnant women, blood donors, or others persons with no known risk factors.

Table A-5: Estimates of HIV-1 Seroprevalence by Residence and Risk Factor, for Developing Countries: Circa 1988

- No data found
* See table 2 for HIV-2 data
a Rate represents infection with HIV1 only and dual infection (HIV1 & HIV2), therefore addition of rates from table 1 and 2 is not advised.
b Data are best available but not necessarily reliable due to small sample size (<100).
c Data reference to prior 1986.

NOTES:
Definition: High risk--prostitutes and clients, STD patients, or other persons with know risk factors.
Low risk--pregnant women, blood donors, or others persons with no known risk factors.

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