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MONITORING the AIDS PANDEMIC

The Status and Trends *of* the HIV/AIDS Epidemics in Sub-Saharan Africa

FINAL REPORT

Abidjan, Côte d'Ivoire
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A human rights perspective on HIV/AIDS in sub-Saharan Africa

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Introduction

Awareness of the fundamental connection between HIV and human rights has led to increasing collaboration between public health officials and human rights workers. In sub-Saharan Africa, those concerned with HIV/AIDS prevention and control initially became interested in human rights because they recognized that discrimination against HIV-infected people and people with AIDS was counterproductive to the effectiveness of public health prevention efforts [1,2]. Interest expanded because of increasing recognition that lack of respect for human rights and dignity at the personal and society levels was closely linked to individual and collective vulnerability to HIV/AIDS [3]. Prevention of HIV transmission, as well as good care for people with HIV/AIDS, requires rectifying the adverse impact of discrimination toward groups considered vulnerable to HIV/AIDS, including women, racial, ethnic, linguistic and sexual minorities, people with disabilities and economically disadvantaged groups [4].

There has been an intense debate, that sometimes continues, about the measures most useful for responding to the AIDS pandemic. For example, tensions remain between those who emphasize protection of the public health in the traditional sense, and thus the restriction of rights of certain individuals considered 'dangerous', and those who advocate a minimum amount of interference with the lives of individuals. Policy makers often have to reconcile these conflicting concerns and, although the importance of full recognition of human rights as an integral part of HIV/AIDS policies and programs is increasingly acknowledged, numerous actions by governments reinforce existing patterns of discrimination and clearly violate human rights norms [5,6].

HIV/AIDS has an increasing impact on the lives of adults and children in sub-Saharan Africa [7]. As HIV/AIDS takes its toll on the physical, mental and social well-being of individuals, one can see the force of the pandemic where everyone in the region is concerned in one or several ways by the HIV/AIDS epidemics. Women, men and children may be infected, affected or vulnerable to HIV/AIDS. People infected with HIV continue to face marginalization and discrimination, as well as violations of many of their rights relating to health, education and social services, including inadequate or inaccessible health services, treatment, education and social programs [8]. People are affected by HIV/AIDS in that their close or extended families, their communities and, more broadly, the structures and services which exist for their benefit are strained by the consequences of the HIV/AIDS pandemic. For example, systems that are already poor in resources are affected not only by the loss of health professionals but by the overwhelming magnitude of the burden of HIV/AIDS on health-care systems [9–11]. One of the most devastating impacts is, of course, on children when their immediate family environment and support system is challenged by the sickness, disability and premature death from AIDS of one or both of their parents [12–14]. Vulnerability to HIV/AIDS concerns the extent to which individuals are born, grow and become sexually active in a world which has added the risk of acquiring HIV infection to their lives. The specific vulnerability of young people is reflected by the fact that the majority of new infections occur in this age group. In addition, in many societies, the unequal role of women and their social status makes them unable to refuse unwanted or unprotected sexual intercourse, thereby increasing their vulnerability to HIV [15–17]. In sub-Saharan Africa in particular, low intensity and open conflicts, massive refugee flows, migration, population displacement, and austere circumstances also contribute to the vulnerability of individuals to the HIV/AIDS pandemic [18–20].

Here we attempt to set out some of the major concepts relevant to human rights thinking and practice in sub-Saharan Africa, to call attention to official documents

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relevant to these concepts and to provide a perspective for protecting human rights in the context of HIV/AIDS in the region. Human rights law offers an approach for negotiating differing perceptions of public and private 'good' in an effort to secure a safe and healthy environment for all individuals. Our initial discussion of human rights law will, by necessity, focus on the recognized international framework as it sets out standards equally applicable to countries in all regions and at all stages of development.

Human rights law is concerned with the obligations of governments to ensure the conditions that make life as humane as possible. The focus is generally on the relationship between the individual and the state, and includes civil, political, economic, social and cultural rights which human beings everywhere are entitled to enjoy. States are responsible for not violating our rights directly as well as for ensuring the conditions which enable us to realize our rights as fully as possible. This is understood as an obligation on the part of governments to respect, protect and fulfill rights. For example, a government violates its responsibility to respect the right to education when children are barred from attending school on the basis of their HIV status [21]. A government's responsibility to protect rights includes making it illegal to deny housing or employment to people on the basis of their HIV status, as well as offering some means of redress should such a situation arise [22,23]. The obligation to fulfill is violated when States do not take appropriate legislative, administrative, budgetary, judicial or other measures towards full realization of rights, for example, if a State fails to develop a national HIV/AIDS prevention and care strategy realistically targeted to the needs of the population, including marginalized populations.

A major human rights problem in the context of HIV/AIDS involves discrimination against those known or perceived to be infected and those affected by HIV/AIDS, as well as discrimination leading to denial of access to entitlements and services, resulting in increased vulnerability to HIV/AIDS [24,25]. Each of the major human rights treaties specifically sets out the principle of non-discrimination with respect to certain categories such as race, color, sex, language, political or other opinion, national or social origin, property, birth and, as it is called, 'other status'. Adverse discrimination ensues when a distinction is made against a person which results in their being treated unfairly and unjustly on the basis of their belonging, or being perceived to belong, to one of these categories. The principle of non-discrimination is central to human rights thinking and practice. The prohibition of discrimination does not mean that differences should not be acknowledged, only that different treatment must be based on reasonable and objective criteria [26].

Most human rights are not absolute. Governments can justify interference with most rights if necessary for an overriding public good. Public health is recognized as an overriding public good and is therefore considered a legitimate ground for restricting human rights. Nonetheless, interferences with human rights are only considered acceptable under narrowly defined circumstances. Any interference with the enjoyment of rights must be: provided for and carried out in accordance with the law; in the interest of a legitimate objective of general interest; strictly necessary in a democratic society to achieve such a goal; imposed without a less intrusive means being available to reach the same goal; and not imposed arbitrarily, in other words in an unreasonable or otherwise discriminatory manner [27].

In the context of HIV/AIDS, legitimate interferences with human rights can only occur in very exceptional circumstances. Interferences with the rights of individuals, even if they are justified as necessary to protect the public health, must be recognized as human rights violations if they do not satisfy the criteria for valid restrictions on rights.

The United Nations (UN) Charter establishes general obligations that apply to all its member states, including respect for human rights and dignity [28]. Under the auspices of the UN, more than 20 multilateral human rights treaties exist which create legally binding obligations on the nations that have ratified them [29,30]. In addition, the Organization of African Unity has put into place its own regional human rights treaty which is open for signature and ratification to all countries in Africa [29,30]. A chart detailing the status of human rights commitments by the nations of sub-Saharan Africa is given in Table 1.

HIV/AIDS policies and human rights

The international response to HIV/AIDS has acknowledged the importance of protecting human rights from the very beginning. Starting in 1987, the World Health Organization (WHO) Global Programme on AIDS incorporated human rights concerns into its global AIDS strategy and its guidelines on a range of issues including testing, travel and immigration policies, blood safety, prison health, mother-to-child transmission and employment. A selected chronology of international and regional documents mentioned here and relevant to the human rights aspects of HIV/AIDS appears in Table 2.

By 1990, every country in the African region had a National AIDS Program (NAP) in place [31]. The focus of every NAP was on prevention, and human rights issues were given some attention in program design, notably with respect to issues concerning privacy and freedom of movement. As the impact of HIV on the lives of individuals put increasing demands on health systems in countries throughout the continent, the lack of attention to care and support for HIV-infected people became apparent [32]. The need to devise programs that include strategies for the care of HIV-infected people became

Table 1. Status of human rights commitments in sub-Saharan Africa by country.

Country	A	B	C	D	E	F	G	H
Angola	1990	1992	1992	–	1990	1986	–	1981
Benin	1986	1992	1992	1967 (s)	1990	1992	1992	1962 (d)
Botswana	1986	–	–	1974	1995	1996	–	1969
Burkina Faso	1984	–	–	1974	1990	1987	–	1980
Burundi	1989	1990	1990	1977	1990	1992	1993	1963
Cameroon	1989	1984	1984	1971	1993	1994	1986	1961 (d)
Cape Verde	1987	1993	1993	1979	1992	1980	1992	–
Central African Republic	1986	1981	1981	1971	1992	1991	–	1962 (d)
Chad	1986	1995	1995	1977	1990	1995	1995	1981
Comoros	1986	–	–	–	1993	1994	–	–
Congo	1982	1983	1983	1988	1993	1982	–	1962 (d)
Côte d'Ivoire	1992	1992	1992	1973	1991	1995	1995	1961 (d)
Djibouti	1991	–	–	–	1990	–	–	1977 (d)
Equatorial Guinea	1986	1987	1987	–	1992	1984	–	1986
Eritrea	–	–	–	–	1994	1995	–	–
Ethiopia	–	1993	1993	1976	1991	1981	1994	1969
Gabon	1986	1983	1983	1980	1994	1983	1986 (s)	1964
Gambia	1983	1978	1979	1978	1990	1993	1985 (s)	1966 (d)
Ghana	1989	–	–	1966	1990	1986	–	1993
Guinea	1982	1978	1978	1977	1990	1982	1989	1965 (d)
Guinea-Bissau	1985	1992	–	–	1990	1985	–	1976
Kenya	1992	1972	1972	–	1990	1984	1997	1966
Lesotho	1992	1992	1992	1971	1992	1995	–	1981
Liberia	1982	1967 (s)	1967 (s)	1976	1993	1984	–	1964
Madagascar	1992	1971	1971	1969	1991	1989	–	1967
Malawi	1989	1993	1993	1996	1991	1987	1996	1987
Mali	1981	1974	1974	1974	1990	1985	–	1973 (d)
Mauritania	1986	–	–	1988	1991	–	–	1987
Mauritius	1992	1973	1973	1972	1990	1984	1992	–
Mozambique	1989	–	1993	1983	1994	1997	–	1983
Namibia	1992	1994	1994	1982	1990	1992	1994	1995
Niger	1986	1986	1986	1967	–	–	–	1961 (d)
Nigeria	1983	1993	1993	1967	1991	1985	1988 (s)	1967
Rwanda	1983	1975	1975	1975	1991	1981	–	1980
Sao Tome & Principe	1986	1995(s)	1995(s)	–	1991	1995 (s)	–	1978
Senegal	1982	1978	1978	1972	1990	1985	1986	1963 (d)
Seychelles	1992	1992	1992	1978	1990	1992	1992	1980
Sierra Leone	1983	1996	1996	1967	1990	1988	1985 (s)	1981
Somalia	1985	1990	1990	1975	–	–	1990	1978
South Africa	1995 (s)	1994(s)	1994(s)	1994 (s)	1995	1995	1993 (s)	1996
Sudan	1986	1986	1986	1977	1995	–	1986 (s)	1974
Swaziland	–	–	–	1969	1995	–	–	–
Togo	1982	1984	1984	1972	1990	1983	1987	1962 (d)
United Rep. of Tanzania	1984	1976	1976	1972	1991	1985	–	1964
Uganda	1986	1987	1995	1980	1990	1985	1986	1976
Zaire	1987	1976	1976	1976	1990	1986	1996	1985
Zambia	1984	1984	1984	1972	1991	1985	–	1969 (d)
Zimbabwe	1986	1991	1991	1991	1990	1991	–	1981

A, The African Charter on Human and People's Rights; B, International Covenant on Economic, Social and Cultural Rights; C, International Covenant on Civil and Political Rights; D, International Convention on the Elimination of All Forms of Racial Discrimination; E, Convention on the Rights of the Child; F, Convention on the Elimination of All Forms of Discrimination Against Women; G, Convention Against Torture and other Cruel, Inhuman or Degrading Treatment or Punishment; H, Convention relating to the Status of Refugees. Year given is ratification date. –, Not listed as having signed or ratified; (s), signature date; (d), succession date.

Table 2. Chronology of selected international and regional documents relevant to the human rights aspects of HIV/AIDS in Africa

Year	Document
Regional	
1990	Ethical and Social Aspects of AIDS in Africa, a background paper for a meeting of Representatives of Member States, Lusaka, Zambia 4–6 June 1990
1990	Maputo Statement on HIV and AIDS in Southern Africa, Fourth International Conference on Health in Southern Africa, Maputo, Mozambique, April 1990
1992	Declaration on the AIDS Epidemic in Africa, Organization of African Unity, Dakar, Senegal, 1992.
1994	Tunis Declaration on AIDS and the Child in Africa, Organization of African Unity, Tunis, Tunisia, 13–15 June 1994, AHG/Dec. 1.
1994	Proceedings of the Intercountry Consultation, African Network on Ethics, Law and HIV, UNDP, Dakar, Senegal, 27 June–1 July 1994.
1994	Dakar Declaration, African Network on Ethics, Law and HIV, Dakar, Senegal, 1 July 1994
1995	Brazzaville Declaration, 'Rights, Responsibilities and Principles for Action in the Response to the HIV Pandemic', Brazzaville, 2 December 1995.
1996	'Newsletter of the African Network on Ethics, Law and HIV', No. 1, June 1996, No. 2 December 1996, UNDP Regional Project on HIV and Development, Dakar, Senegal.
Global	
1987	WHO Consultation on International Travel and HIV Infection (Doc. WHO/SPA/GLO/87.1).
1987	Global Strategy of the Prevention and Control of AIDS (Res. WHA40.26).
1988	WHO Meeting on HIV Infection and Drug Injecting Intervention Strategies (Doc. WHO/GPA/SBR/89.1).
1988	Avoidance of Discrimination in Relation to HIV-Infected People and People with AIDS (Res. WHA41.24).
1988	Discrimination Against Persons with the HIV Virus or Suffering from AIDS (Decision 1988/111 of the Sub-Commission for Prevention of Discrimination and Protection of Minorities).
1989	Heterosexual Transmission of HIV and Certain Common Social Situations (Doc. WHO/GPA/INF/89.5).
1989	Consensus Statement of WHO Consultation on Partner Notification for Preventing HIV Transmission (Doc. WHO/GPA/INF/89.8).
1989	Non-discrimination in the Field of Health (United Nations Commission on Human Rights, res. 1989/11).
1989	Final Document of the International Consultation on AIDS and Human Rights (UN Doc. HR/AIDS/1989/3).
1989	Discrimination Against HIV-infected People or People with AIDS (Sub-Commission on the Prevention of Discrimination and Protection of Minorities, res. 1989/38).
1989	Prevention and Control of Acquired Immunodeficiency Syndrome (AIDS) (UNGA re. 44/233).
1990	Avoidance of Discrimination Against Women in National Strategies for the Prevention and Control of AIDS (CEDAW, General Recommendation No. 15).
1990	Discrimination Against HIV-infected People or People with AIDS (United Nations Commission on Human Rights, decision 1990/65).
1990	*Note verbale* of the WHO Director General referring to Avoidance of Discrimination in National AIDS programs Worldwide (Doc. C.L.7.1990).
1990	Preliminary Report on Discrimination Against HIV-Infected People and People with AIDS, from the Special Rapporteur of the Sub-Commission on the Prevention of Discrimination and Protection of Minorities (E/CN.4/Sub.2/1990/9).
1991	Progress Report on Discrimination Against HIV-Infected People and People with AIDS from the Special Rapporteur of the Sub-Commission on the Prevention of Discrimination and Protection of Minorities (E/CN.4/Sub.2/1991/9).
1992	Rights and Humanity Declaration and Charter on HIV and AIDS, submitted by the Gambian government to the Commission on Human Rights at its 48th session (E/CN/.4/1992/82).
1992	Final Report on Discrimination Against HIV-Infected People and People with AIDS, from the Special Rapporteur of the Sub-Commission on the Prevention of Discrimination and Protection of Minorities (E/CN.4/Sub.2/1992/10).
1993	Conclusions and Recommendations from the Special Rapporteur on Discrimination Against HIV-Infected People or People with AIDS, Sub-Commission on the Prevention of Discrimination and Protection of Minorities (E/CN.4/Sub.2/1993/9).
1993	Decision on The Protection of Human Rights in the Context of HIV or AIDS, United Nations Commission on Human Rights (E/CN.4/1993/L.74).
1993	Discrimination in the Context of HIV or AIDS, United Nations Sub-Commission on the Prevention of Discrimination and Protection of Minorities (E/CN.4/Sub.2/1993/L.11/Add.2)
1994	The Protection of Human Rights in the Context of HIV and AIDS, United Nations Commission on Human Rights (E/CN.4/1994/L.60)
1994	Discrimination in the Context of HIV or AIDS, United Nations Sub-Commission on the Prevention of Discrimination and Protection of Minorities (E/CN.4/Sub.2/1994/L.29/Add.2).
1994	United Nations, Report of the International Conference on Population and Development and Various Recommendations of the World Health Organization, Cairo, 1994 (UN Doc. A/Conf.171/13)
1994	Declaration of the Paris AIDS Summit of Heads of Government or Representatives Paris, 1994.
1995	United Nations, Report of the World Summit for Social Development Copenhagen, 1995 [UN Doc. A/Conf.166/9 (1995)].
1995	The Protection of Human Rights in the Context of HIV and AIDS, United Nations Commission on Human Rights (E/CN.4/1995/44).
1995	Discrimination in the Context of HIV or AIDS, United Nations Sub-Commission on the Prevention of Discrimination and Protection of Minorities (E/CN.4/Sub.2/1994/L.21/Add.2).
1995	Beijing Declaration and Platform for Action, Fourth World Conference on Women, Beijing, China, 15 October 1995 (UN Doc. A/CONF.177/20).
1996	Report of the Secretary General on Human Rights and HIV/AIDS (E/CN.4/1996/44, 10 January 1996).
1996	The Protection of Human Rights in the Context of HIV and AIDS, United Nations Commission on Human Rights (E/CN.4/1996/43, 19 April 1996).
1997	Report of the Secretary General on the Second International Consultation on HIV/AIDS and Human Rights (E/CN.4/1997/37).
1997	The Protection of Human Rights in the Context of HIV and AIDS, United Nations Commission on Human Rights (E/CN.4/1997/L.37, 4 April 1997).

UNDP, United Nations Development Program; WHO, World Health Organization.

progressively clearer, even though such strategies require a level of financial expenditure which might not seem immediately available or accessible [33–36]. Under the rubric of human rights law, governments have an obligation to take steps toward ensuring that those rights which require resources, such as access to health and social services, are progressively realized. This imposes an obligation on countries of the region to make efforts toward implementation of care and support strategies and, in the call for 'international assistance and co-operation' found in the relevant documents, for wealthier states to co-operate in this effort [37]. The human rights texts recognize that governments will be able to expand their actions and improve their human rights performance as resources become available, which is of extreme relevance to resource-constrained countries in Africa.

In response to the enhanced understanding of the relationship between HIV prevention, care and support at the national level, guidelines and policy statements issued by international health organizations and human rights bodies focused on the relationship between human rights protection and HIV prevention, with particular emphasis on the primacy of the non-discrimination principle. This approach has been carried forward in the work of the Joint United Nations Programme on HIV/AIDS (UNAIDS). For example, human rights are both explicitly included as an essential aspect of UNAIDS' commitment to a 'multi-faceted response to the epidemic' and set out as a 'core value and guiding principle' of the UNAIDS International Strategic Plan 1996–2000 [38]. These international standards and statements are meant to help guide work at the international, regional, national, local and community levels. They are therefore relevant to any review of human rights issues in the African region.

The gap between HIV/AIDS-related laws and practices and human rights

Governments of the region have ratified many of the human rights documents. A large number of standards concerning HIV/AIDS and human rights have been articulated at both the national and international level (Table 3). Government policies and actions relevant to HIV/AIDS, however, continue to fail to adequately protect human rights in many ways. A contradiction exists between international and national commitments and what takes place at the local level, both in terms of law and implementation. Those populations who should be able to hold their governments accountable for their commitments are often unaware of their rights, and do not demand them. Thus, few voices have been raised against restrictions imposed on those already infected with HIV or thought to be vulnerable to infection, such as migrants and sex workers.

In 1993–1994, the Global AIDS Policy Coalition conducted a survey of managers of governmental national AIDS programs (GNAP) on policies and programs forming the governmental national response to AIDS [39,40]. This is the last published survey of which we are aware which attempts to address both laws and practice relevant to human rights in the context of HIV/AIDS around the world. Questions to 187 GNAP managers focused on issues pertaining to testing policies and to restrictions based on HIV status. One hundred and sixteen responses were received in which 115 GNAP managers had completed, either partially or fully, the section pertaining to law and practice. Of these, responses were received from 31 countries in sub-Saharan Africa (Table 3).

The focus of this discussion is on the African region, although a review of reported national laws, policies and practices reveal a lack of consistent adherence to human rights standards everywhere in the world. For example, the survey found that in Africa, as in the rest of the world, involuntary testing remains part of many AIDS prevention and control programs. Governments continue to categorize individuals into 'high-risk' groups in order to impose testing as well as to restrict their activities. Categories subjected to testing include sex workers, pregnant women, prisoners, health-care workers, patients with tuberculosis, military recruits, gay/homosexual men, migrants, travelers, refugees, foreign laborers, students, nationals applying for certain forms of employment and blood donors. The choice of groups tested does not always follow the epidemiological pattern nor the dominant mode of transmission.

The responses also highlight the differences that exist between law and practice in some countries. For example, four out of the 31 sub-Saharan African countries surveyed reported that they test pregnant women, and at least another four reported that they test sex workers, although in both cases they reported no law in place which authorizes them to do so.

The compulsory testing of individuals continues to raise human rights concerns. When HIV testing is not voluntary, potential benefits associated with testing must be balanced against potential adverse consequences to the individual, and to their families, if test results become known. For example, throughout the region, in addition to violations of the right to privacy when test results are given to family members, employers and others, there continue to be reports that people known or suspected of being HIV infected are denied housing, health care, employment, scholarships and educational opportunities [39–45]. It hould be noted here that much of the testing of students applying for international scholarships results from guidelines imposed by academic institutions within the receiving countries. The HIV test is often part of what is required for an international student to be accepted by

Table 3. Government national AIDS programs (GNAP), laws and practices regarding HIV/AIDS restriction and obligatory testing of specified groups (as reported by GNAP managers), 1993.

	Countries imposing restrictions based on HIV status						Countries practicing obligatory (compulsory and mandatory) testing of specified groups																			
	1a		1b		1c		2a		2b		2c		2d		2e		2f		2g		2h		2i		2j		2k	
Country	P	L	P	L	P	L	P	L	P	L	P	L	P	L	P	L	P	L	P	L	P	L	P	L	P	L	P	L
Angola	No	No	No	No	–	No	No	–	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	No	Yes	No	No	No
Benin	No	No	No	No	No	No	Yes	–	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	No	Yes	Yes	No	No
Botswana	No	No	–	Yes	No	No	No	–	No	No	No	No	No	No	No	No	No	No	No	No	No	No	–	No	Yes	No	No	No
Burkina Faso	No	No	No	No	No	No	–	–	No	No	–	No	No	No	No	No	No	No	–	–	No	No	Yes	No	Yes	No	–	No
Cameroon	No	No	No	No	No	No	No	–	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	No	Yes	Yes	No	No
Cape Verde	–	No	–	No	–	No	–	No	–	No	–	No	–	No	–	No	–	No	–	No	–	No	–	No	–	Yes	–	No
Chad	No	No	No	No	–	No	No	–	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Comoros	No	No	No	No	No	No	Yes	–	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	Yes	No	No	No
Congo	No	No	No	No	No	No	No	–	No	No	Yes	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No
Côte d'Ivoire	No	No	No	No	No	No	No	–	No	No	No	No	No	–	No	No	Yes	No	No	No	No	No	No	No	Yes	No	No	No
Djibouti	No	No	No	No	No	No	Yes	–	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No
Ethiopia	No	No	No	No	No	No	No	–	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes	No
Gabon	No	No	No	No	No	No	No	–	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	No	No	No
Ghana	No	–	–	–	No	No	–	–	–	–	–	–	–	–	–	–	–	–	No	No	No	No	No	No	No	No	No	No
Guinea	No	No	No	No	No	No	No	–	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes	No	No
Guinee-Bissau	No	No	No	No	No	No	No	–	No	No	No	No	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	Yes	No	No	No
Lesotho	No	No	No	No	No	No	No	–	No	No	Yes	No	No	No	No	No	Yes	No	No	No	No	No	No	No	Yes	No	No	No
Madagascar	No	No	No	No	No	No	Yes	–	Yes	–	Yes	No	No	No	No	No	Yes	–	No	No	No	No	–	No	Yes	No	No	No
Mali	–	–	–	–	Yes	No	No	–	No	–	No	–	No	–	No	–	No	–	Yes	–	No	–	No	–	Yes	–	No	–
Mauritania	No	No	–	–	No	No	–	–	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No
Mauritius	No	–	No	–	No	No	No	–	No	–	No	–	No	–	No	–	Yes	–	No	–	No	–	No	–	Yes	–	No	–
Rwanda	No	No	No	No	No	No	No	–	No	No	No	No	No	No	No	No	No	No	–	–	No	No	No	No	Yes	Yes	Yes	No
Senegal	No	No	No	No	No	Yes	Yes	–	No	No	No	No	No	No	No	No	Yes	No	Yes	Yes	No	No	Yes	No	Yes	Yes	No	No
Seychelles	No	No	No	No	No	No	No	–	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No
South Africa	No	No	–	–	–	No	No	–	No	No	Yes	No	Yes	No	Yes	No	Yes	No	–	–	Yes	–	No	No	Yes	Yes	–	–
Tanzania	No	No	No	No	No	No	No	–	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Togo	No	No	No	No	No	No	No	–	–	–	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	No	No	No
Uganda	–	–	No	No	No	No	No	–	–	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes	No	No
Zaïre	No	No	No	No	No	No	No	–	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	No	No	No
Zambia	No	No	No	No	No	No	No	–	No	No	No	No	No	No	No	No	No	No	No	–	No	–	No	–	Yes	–	No	–
Zimbabwe	No	No	No	No	No	No	No	–	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes	No	No
Sub-Saharan Africa totals:																												
Yes	0	0	0	1	1	1	5	0	1	0	5	0	1	0	1	0	9	0	9	1	1	0	6	0	27	12	2	0
No	28	27	25	25	26	30	22	1	26	26	23	28	28	27	28	28	20	27	18	24	29	27	22	28	3	16	27	28
No response (–)	3	4	6	5	4	0	4	30	4	5	3	3	2	4	2	3	2	4	4	6	1	4	3	3	1	3	2	3

P, are these activities enforced in the absence or presence of laws? L, in your country, is there a law, regulation, or decree mandating the following activities? 1a, restrictions on persons with HIV to marry; 1b, restrictions against sex workers/prostitutes; 1c, compulsory admissions of persons with HIV or AIDS into special centers. 2a, sex workers/prostitutes (because of a survey design error, the law section of this question was not answered by a majority of respondents); 2b, gay/homosexual men; 2c, pregnant women; 2d, prisoners. 2e, health care workers; 2f, patients with tuberculosis; 2g, military recruits; 2h, nationals applying for certain employments (i.e. in the tourist sector). 2i, citizen applying for student fellowship; 2j, blood donors (although the question was asked about the HIV testing of blood donors, some respondents may have answered about HIV testing of blood donations); 2k, prior to marriage.

these institutions. In European Union countries, this practice runs contrary to their own internal regulations.

Strategies for action

The record concerning protection of human rights in the context of HIV/AIDS remains mixed throughout Africa. There is potential for increased attention to human rights concerns as a result of expanded partnerships between governments, non-governmental organizations (NGO) and AIDS support groups within countries and at the regional level. These efforts provide a crucial link between public health and human rights promotion and protection at the individual and community level. For example, the African Network on Ethics, Law and HIV is a regional network which, including national networks in 15 countries, was created to respond to the legal, ethical and human rights challenges created and exacerbated by the HIV/AIDS pandemic [46–48]. [Other related regional efforts include the regional secretariat of the International Council of AIDS Service Organizations (AfriCASO) and Environment and Development Actions (ENDA) in the Third World and the Southern Africa AIDS Information Dissemination Service (SAfAIDS). National networks currently exist in Botswana, Burundi, Central African Republic, Congo, Côte d'Ivoire, Ghana, Kenya, Nigeria, Rwanda, Senegal, South Africa, Tanzania, Uganda, Zaïre and Zambia. The work of the network is primarily funded through the UNDP Regional Project on HIV and Development, UNAIDS and the German Technical Cooperation Agency (GTZ).]

An information and education campaign within the framework of human rights, championed by Africans, is the critical next step if human rights protection within the context of HIV/AIDS is to take place. These efforts must address health workers, the general population and those in positions to make and implement policy-level decisions. A step in this direction is the emergence of NGOs, both in response to the HIV/AIDS crisis and those connected to development and human rights. A critical element necessary to progress will be increased links in the work of these organizations in mutually strengthening ways [49–51]. The usefulness of governmental commitments, both political and legal, are ultimately dependent on the ability of individuals and communities to hold their governments accountable.

Health workers trained and informed about appropriate policies and procedures for the management of HIV/AIDS within the framework of human rights will be central to this effort. Their role will include awareness of human rights concerns relevant not only to their patients known to be HIV infected, but to all their patients. Interaction with people with HIV/AIDS, social workers, and relevant support organizations could be first steps in progressive realization toward this goal. Specific training illustrating the applicability of the human rights framework to their work would also be of use [52,53]. Training manuals have been designed the bridge this gap [53] and, in addition, an increasing number of courses are being offered for professionals in a variety of settings. Relevant to this training are research, analysis and dissemination of comparative data showing the links between support of a human rights framework in HIV/AIDS management and the success of HIV/AIDS programs.

The extent to which people living with HIV/AIDS are aware of their rights and feel they have the support and tools at their disposal to fight for their rights both reflect and directly impact on a community's ability to bring the effects of HIV under control. In addition, without information and education, individuals and communities may be unable to exercise the leverage necessary to hold their governments accountable for their commitments or to work toward changing the policies and practices that make them vulnerable to HIV/AIDS. Therefore, education of the general population, with particular attention to segments of the population particularly vulnerable to HIV/AIDS, will be crucial. Realization of women's human rights will continue to be central to reducing the spread of HIV/AIDS in the African region [54–56]. If human rights are not respected, societies will continue to create and enhance individual and collective vulnerability to HIV, and more generally to ill health.

Those involved in policy and decision making, as well as implementation within each sector of the government, must be made aware of the commitments made by their representatives in both national and international forums, as these commitments are often neglected or overlooked. This applies equally to those specific to HIV/AIDS, and to broader health and human rights issues. The challenges illustrated through efforts at HIV prevention, treatment and care in the region have helped uncover fundamental dynamics in the broader relationship between health and human rights. Enhanced community participation in the implementation of strategies relevant to HIV/AIDS will help ensure attention to human rights concerns and improve their effectiveness. National level mechanisms concerned with HIV/AIDS and human rights must be strengthened, recognized and acknowledged as forming an integral part of the response to the pandemic.

Conclusion

The importance of bringing HIV/AIDS policies and programs in line with human rights law is generally acknowledged. The course of the AIDS epidemic has shown that public health efforts to prevent and control the spread of HIV/AIDS are more likely to succeed (e.g. lower HIV incidence, increase in the quality of life of those infected) if policies and programs promote and protect human rights. Information, education and advocacy in the context of a human rights framework

continues to provide an opportunity to ensure that public health efforts will positively impact the response to the HIV/AIDS epidemic in the next century.

The survey of GNAP managers, as well as the examples cited here, confirm two major conclusions. First, discrimination towards HIV-infected people, people with AIDS and people considered within each society at high risk for HIV infection remains an important and enduring problem. Second, bringing the general population, health workers, non-governmental and governmental sectors into conformity with the international consensus on non-discriminatory approaches to HIV/AIDS prevention, treatment and control will require vigilance and a sustained effort.

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HIV/AIDS epidemics in sub-Saharan Africa: dynamism, diversity and discrete declines?

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Keywords: HIV, epidemiology, Africa

Introduction

It has been more than a decade since the wide spread of HIV in sub-Saharan Africa was recognized. A considerable body of knowledge has emerged through research, the evaluation of prevention and care programs and the experience gained in combating the epidemic in communities and within health-care settings. Much of the knowledge acquired in sub-Saharan Africa has impacted the ways the HIV/AIDS global pandemic is understood and responded to around the world. Drawing from an abundant literature on HIV/AIDS in sub-Saharan Africa, this paper reviews recently documented developments and has a deliberate single focus on HIV/AIDS. It highlights some of the current and most significant epidemiological features of the spread of HIV and attempts to describe the dynamism and diversity of ongoing epidemics. It does not, however, include such important features of the epidemiology of HIV/AIDS as other sexually transmitted diseases (STD), tuberculosis and other HIV-related diseases. In an attempt to provide a current perspective on the state and trends of HIV/AIDS in the region, an effort has been made to bring together only information drawn from publications and presentations dating after 1992.

There are clear signs today that the HIV epidemics in Africa are not insurmountable; they can be challenged and hopefully brought under control. There is some evidence that the HIV epidemics affecting certain communities are leveling off, or even declining, as is the case in parts of western and eastern Africa, where HIV had begun to spread rapidly in the early 1980s. These encouraging declines, however, are somewhat tampered by the more recent occurrence of abrupt and violent epidemics in southern Africa.

Overall status and trends of HIV/AIDS epidemics in Africa

With a population of 588 million (about 10% of the world total), distributed among 48 countries, sub-Saharan Africa accounted for an estimated 14 million adults and children living with HIV infection or AIDS (62% of the world total) as of December 1996 (Fig. 1). Of people living with HIV/AIDS around the world, six in every 10 adult men, eight in every 10 adult women and seven in every 10 children who are HIV-infected near or at birth are residing in Africa. Every day, over 4000 new HIV infections occur in this region where, since the mid–late 1970s, more than 20 million adults and children have acquired HIV/AIDS. By the end of 1996, close to 5 millions adults (divided almost equally among men and women) in sub-Saharan Africa and 1.5 million children born with HIV infection had developed AIDS. Of these, 3.8 million adults and more than 1 million children had died of AIDS. In sub-Saharan Africa, about 9 million children younger than 15 years of age have lost their mother to AIDS.

These figures, estimated by the Joint United Nations Programme on HIV/AIDS (UNAIDS), are extrapolated from seroprevalence estimates made on a country-by-country basis by the World Health Organization (WHO) Global Program on AIDS (GPA) in 1995 for a mid-year point in 1994 [1,2]. The model applied to estimate AIDS cases and deaths from HIV prevalence rates assumes that: (1) HIV incidence rates in African countries reached a plateau in the early 1990s; (2) the mean incubation period (interval between HIV infection and the onset of AIDS) is 10 years, an interval drawn from cohort studies in North America; and (3) a mean survival after the onset of AIDS in adults of 2 years. Studies have recently shown, however, that the latency period in sub-Saharan Africa may actually

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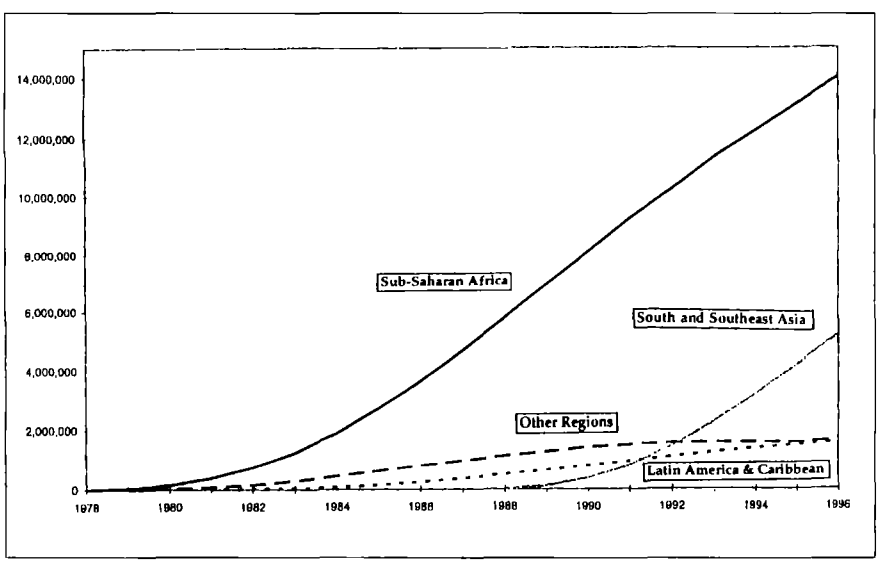

Fig. 1. Persons living with HIV/AIDS.

be in the order of 5–7.5 years and the survival interval only about 1 year [3,4]. These rates may vary considerably with age; in Uganda, the median survival time from HIV infection to death was estimated at 7 years for those aged 13–54 years, but only 2.5 years for those aged 55 years and older, with little difference between men and women [5]. The application of shorter intervals to the WHO model would result in higher back-estimates of AIDS cases and AIDS deaths than those that have been published [6]. Other effects of postulating shorter incubation and survival periods would include recognition of a greater impact of the epidemics on demography, orphan-hood and population structure [7].

The geography of HIV/AIDS in Africa: dynamism and diversity

The application of the term 'HIV/AIDS pandemic' to Africa tends to convey a misguided impression of homogeneity about the ways HIV spreads and affects communities across the continent. The HIV/AIDS 'pandemic' in Africa must be regarded as a mosaic of HIV epidemics of varied intensity and maturity, in many cases linked to one another and fueled through a complex array of intertwining bridges within and between countries. Each of the many concurrent HIV/AIDS epidemics that are currently under way could be individually characterized on the basis of traditional epidemiological principles: by the viral agents involved (e.g. HIV virus types and subtypes), the hosts (e.g. defined by their age, sex and sexual behaviors) and the environment (e.g. social and economic features, local sexual networks, patterns of residence and mobility, quality and coverage of health and social services) [8]. At a first level of analysis, Africa can be schematically divided into five areas, each composed of countries with similar epidemiological features (Fig. 2).

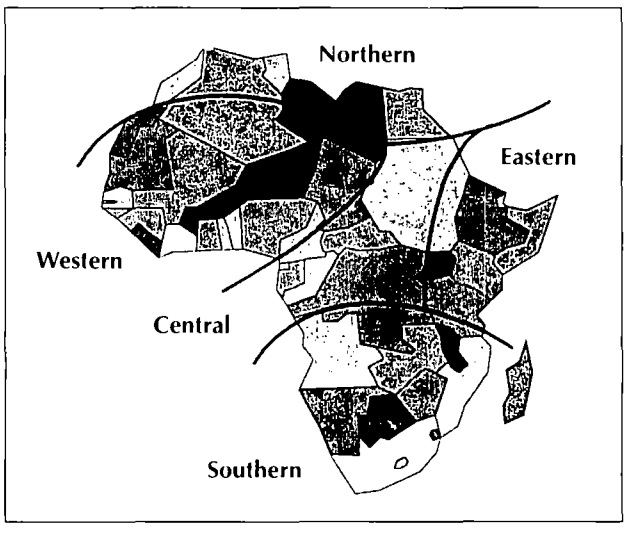

Fig. 2. HIV/AIDS areas of affinity in Africa.

Western Africa

The western African area includes Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo (Fig. 3). It is dominated by the epidemiological situation in Côte d'Ivoire, which has for several decades acted as an economic magnet in the region, drawing intense migration from neighboring and other countries [10,11]. In Abidjan, the capital city, prevalence rates in women attending urban antenatal clinics (ANC) have fluctuated between 10–15% for HIV-1 since 1990, while the prevalence rate for HIV-2 has remained stable at about 1% and the rate of dual serologic reactivity at about 4% [12]. A significant feature of the HIV epidemics in Côte d'Ivoire is the narrow difference in the HIV prevalence rates noted in Abidjan and in smaller towns and rural areas, attesting to the extent of sexual networks in this country. Uncertainties about

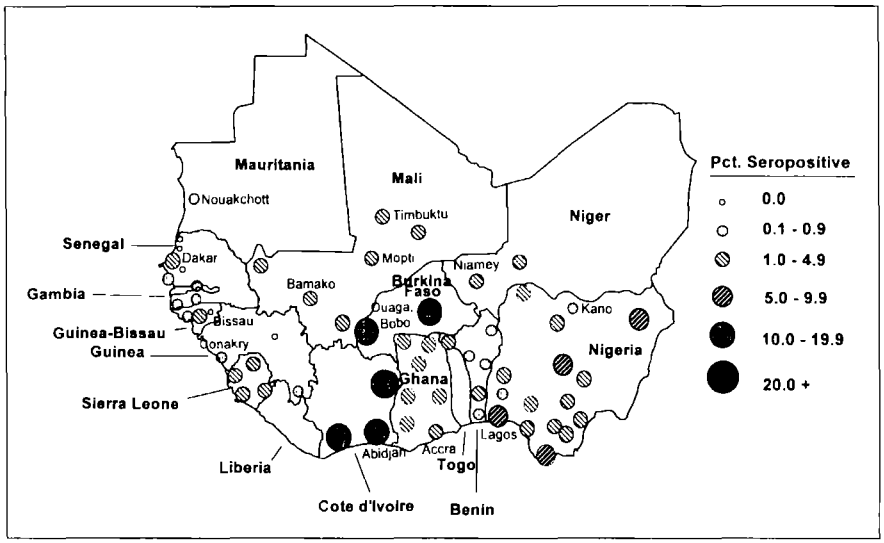

Fig. 3. Seroprevalence of HIV-1 for low-risk populations in west Africa, January 1997. Data from [9].

the degree of correlation between dual reactivity to HIV-1 and HIV-2 antibody detection tests and dual infection with HIV-1 and HIV-2 are discussed in this supplement [13]. Eight per cent of women attending antenatal clinics in rural areas in Côte d'Ivoire were HIV-infected in 1993, attesting to the wide geographic spread of the virus in the country [14].

In Ghana in 1994, a seroepidemiological survey conducted at nine sentinel surveillance sites found rates of 1.6, 2.1 and 2.8% in samples of pregnant women in the northern, upper east and upper west regions, respectively [15]. Since 1994, the seroprevalence of HIV-1 in sex workers has been approximately 30% or higher in Abidjan as well as in Bamako (Mali), Ouagadougou (Burkina Faso), Conakry (Guinea), Cotonou (Benin) and Lagos (Nigeria) [16,17].

A spread of HIV-2 also characterizes this area; HIV-2 is found in population samples in nearly all west African countries, with infection rates exceeding 7% in women attending urban ANC in Guinea Bissau. The wide spread of HIV-2 in this area in the 1970s and 1980s preceded that of the more transmissible and pathogenic HIV-1 [18,19]. In most of these countries, increasing HIV-1 infection rates now tend to exceed those of HIV-2, or rates of dual reactivity, both of which have remained stable over the past several years. In Abidjan, the dynamics of HIV spread, reconstructed from mortality data attributed to HIV/AIDS, suggest that two successive epidemic waves have occurred since the early 1980s (see The future course of the HIV epidemics on page S17). HIV infection rates among people prone to engage in high-risk behaviors remain at remarkably high levels; in Abidjan, in 1992–1994, 80% of a sample of female sex workers were found seropositive for HIV, including 47% seropositive for HIV-1, 3% for HIV-2 and 30% for both HIV-1 and HIV-2 [20].

Additional evidence of the gradual introduction of HIV-1 comes from Guinea Bissau, a country where prevalence rates of HIV-2 in the general population are higher than in any other country [21]. In Bissau, the capital city, in 1994, seroprevalence rates of 1.4, 6.7 and 0.3% for HIV-1, HIV-2 and dual HIV-1 and HIV-2 serologic reactivity, respectively, were found in pregnant women attending ANC [22]. A cohort study of police officers of both sexes in 1990–1995 showed a prevalence of HIV-1 and HIV-2 at 1.0 and 10.9%, respectively. Significantly, a disproportionately high incidence of HIV-1 in relation to prevalence (0.9 and 0.7%, respectively) compared with a low incidence of HIV-2 in relation to prevalence (1 and 10.9%, respectively), suggested that the spread of HIV-1 was more recent and powerful than that of HIV-2 [23].

Empirical seroepidemiological data and the modeling of the apparent competition between HIV-1 and HIV-2 indicate that HIV-1 is likely to displace HIV-2 in populations when both viruses are being transmitted concomitantly [24,25].

Central Africa

The central African area consisting of Chad, Cameroon, the Central African Republic, Congo, Equatorial Guinea, Gabon, Sao Tome and Principe, Southern Sudan and Zaïre (now called the Democratic Republic of the Congo) has been somewhat less affected than west Africa, with rates of HIV infection typically at 5% or less in most samples of pregnant women (Fig. 4). Between 1989 and 1991, a relatively low (3.1%) and stable prevalence of HIV was found in pregnant women attending ANC in the Shaba province of Zaïre and 5% in the capital, Kinshasa [26,27]. A similar pattern was observed in Gabon where a 2.1–2.2% prevalence of HIV in the general population appeared to have remained stable over the period 1986–1994 [28]. Higher HIV prevalence rates have, however, been found more recently in pregnant women in the Congo (about 7% in Brazzaville and 10% in Pointe-Noire in 1994) and in Bangui, Central African Republic (16% in 1993) [9,29].

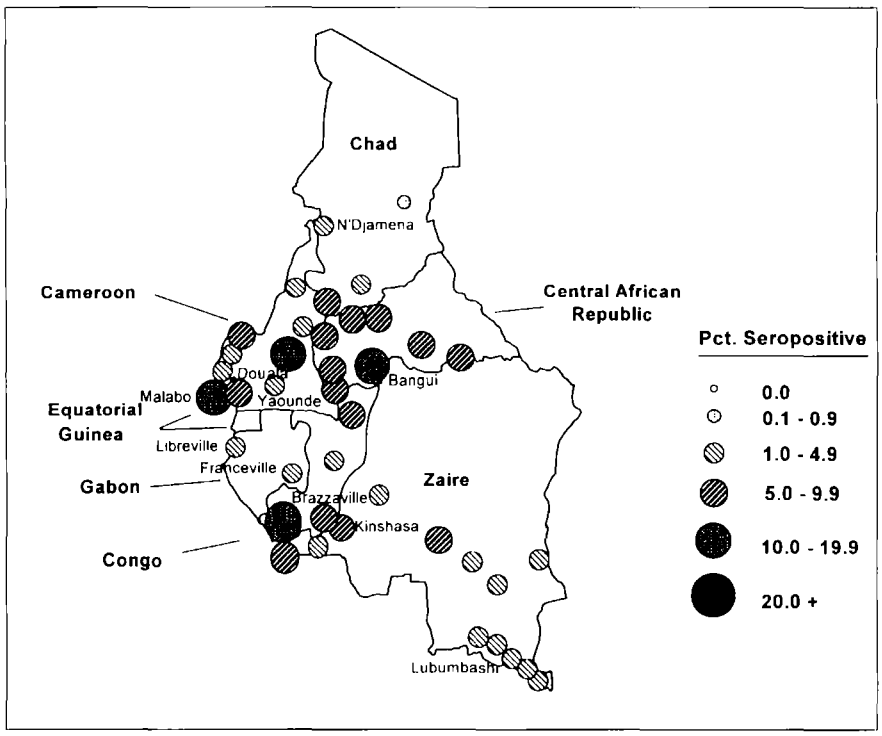

Fig. 4. Seroprevalence of HIV-1 for low-risk populations in central Africa, January 1997. Data from [9].

When compared with neighboring western, eastern and southern Africa, this area seems to have benefited from a few years delay in the spread of HIV. However, the apparent stabilization or relatively slow rise of HIV prevalence in the area should not be considered as a sign of epidemic recess. In Kinshasa, Zaïre, HIV prevalence rates among sex workers attending one STD clinic, at 35% in 1989, had remained unchanged by 1994, but this apparently stable epidemic was in fact fueled by a constant 10% annual incidence of HIV during this period [30]. By the mid-1990s, HIV prevalence rates in samples of sex workers were 29% in Lagos, Nigeria, and 45% in Douala, Cameroon, underlining the potential for the HIV epidemics to gain momentum [31].

An example serves to illustrate the vulnerability of this area to the more intense spread of HIV. In the late 1980s, it was thought that Cameroon had been spared from major HIV spread but, by 1994, a population-based seroepidemiological survey in southwest Cameroon found a 9.9% HIV prevalence rate in the 15–44-year-old male and female population, with infection rates at 5.4, 13.6 and 8.7% in the 15–19, 20–34 and 35–44-year-old age groups, respectively [32].

Eastern Africa

The eastern African area, consisting of Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Somalia, Tanzania and Uganda, contains 25% of the sub-Saharan population and 36% of all current HIV infections in the subcontinent. In these countries, HIV began to spread rapidly and widely in the late 1970s and early 1980s (Fig. 5). HIV prevalence rates in samples of women attending ANC are generally between 15 and 25% in urban areas. An annual HIV incidence of 3–5% in women attending ANC in Kigali during 1989–1990 led, by 1995, to a prevalence of 25.4% which, surprisingly, involved not only HIV-1 but also HIV-2 and dual serologic reactivity (14.4, 1 and 10%, respectively) [33,34].

In many cities, HIV prevalence rates among sex workers exceed 20%, reaching a staggering 85.5% in a population of sex workers in Nairobi [35]. The epidemic is now driven by high mobility along the Trans-African Highway and other main transportation routes, as reflected in high HIV prevalence among truck drivers and the communities of sex workers with whom they have transactional sexual contact (see below). As discussed below, rates in rural areas tend to be lower than in urban and semi-urban areas, although the definition of 'rural' testing sites and the proximity to trading routes can considerably influence the measured levels of HIV infection.

Although the impact of recent regional conflicts in Burundi, Rwanda, Zaïre and southern Sudan has not been assessed and is hard to predict, persisting insecurity, military movements and civilian population displacements are likely to have further aggravated the HIV situation in these and neighboring countries.

Southern Africa

The southern African area includes Angola, Botswana, Malawi, Mozambique, Namibia, Lesotho, South Africa, Swaziland, Zambia and Zimbabwe (Fig. 6). Although, at

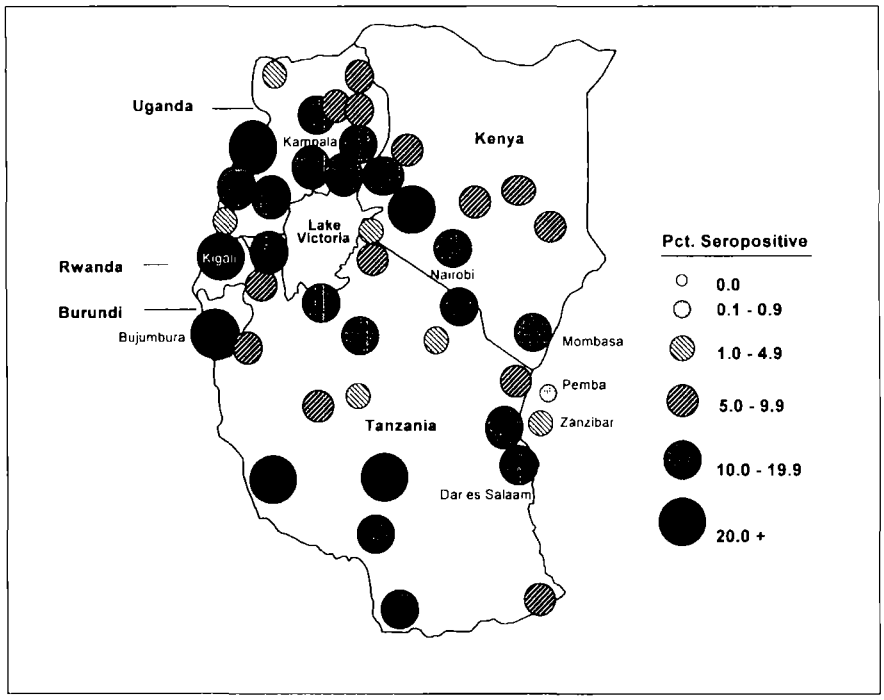

Fig. 5. Seroprevalence of HIV-1 for low-risk populations in east Africa, January 1997. Data from [9].

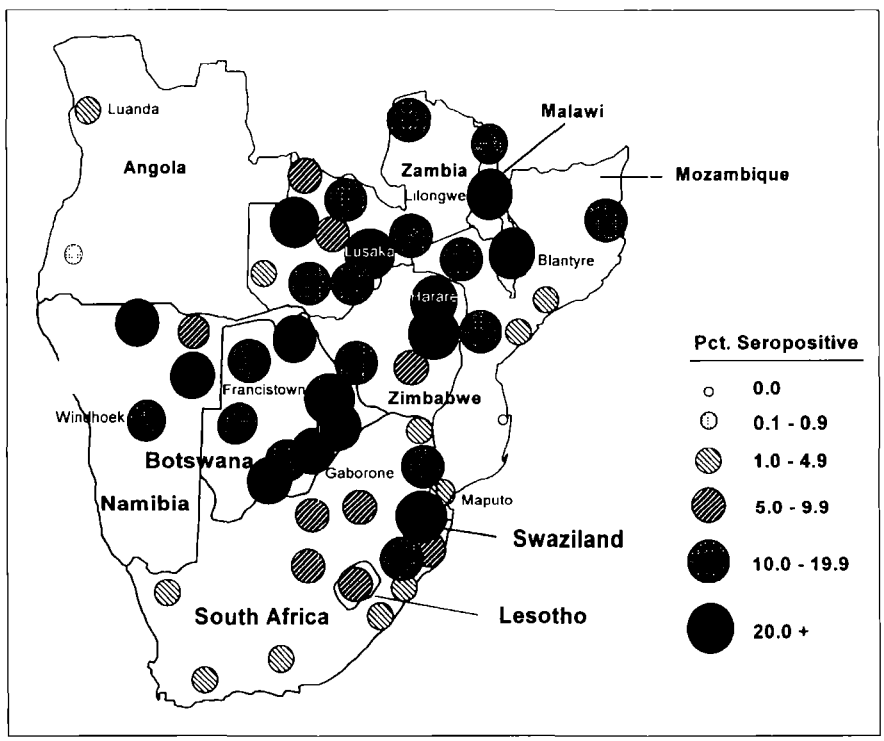

Fig. 6. Seroprevalence of HIV-1 for low-risk populations in southern Africa, January 1997. Data from [9].

first glance, few general epidemiological features differentiate the southern African area from the eastern African area, patterns of mobility within the area, and the major pole of economic migration created by South Africa, have been associated with sudden and severe epidemics. It can be postulated that social, cultural and family uprooting, combined with lower access to local health and social services as well as gender imbalance among domestic and international migrant populations, have increased the frequency of risk-taking sexual behavior and, as a result, the vulnerability of these populations to HIV infection. This area is characterized by both the high rate of growth of the epidemics (the highest noted in Africa in recent years) and by the persistent severity of more mature epidemics, reflected by prevalence rates in Zimbabwe and Zambia, for example, which are similar to those observed in eastern Africa (Boxes I and II).

Box 1. Continued rise in HIV trends in Zimbabwe

Tom Zhuwau

High levels of HIV prevalence and incidence have been recorded in Zimbabwe since the introduction of sentinel surveillance in 1990. Sentinel surveillance reporting from the nine administrative provinces of Zimbabwe indicates there was an explosive epidemic leading into this decade, relative stability between 1991 and 1993, then another upwards surge from 1994. Prevalence levels in excess of 40% are currently being recorded among women attending ANC in a number of urban centers. The HIV trend in Zimbabwe strongly mirrors that of the rest of sub-Saharan Africa in that it shows a peak in the 20–29-year-old age groups for females and 30–39-year-old age group for males (Fig. 1). It is estimated that young women between the ages of 15 and 19 years are more than five times as likely to be infected as males in the same age group (National AIDS Control Programme, unpublished data, 1997). More than 70% of AIDS cases are found among adults between the ages of 20 and 49 years, of which more male cases have been reported to date than female. This would seem to follow the usual pattern for a sub-Saharan HIV/AIDS epidemic in that more male cases occur during the initial states of the epidemic. As the epidemics continue and prevalence rates rise, as in the case of Zimbabwe, these differences disappear to the point that an equal number of males and females become newly infected.

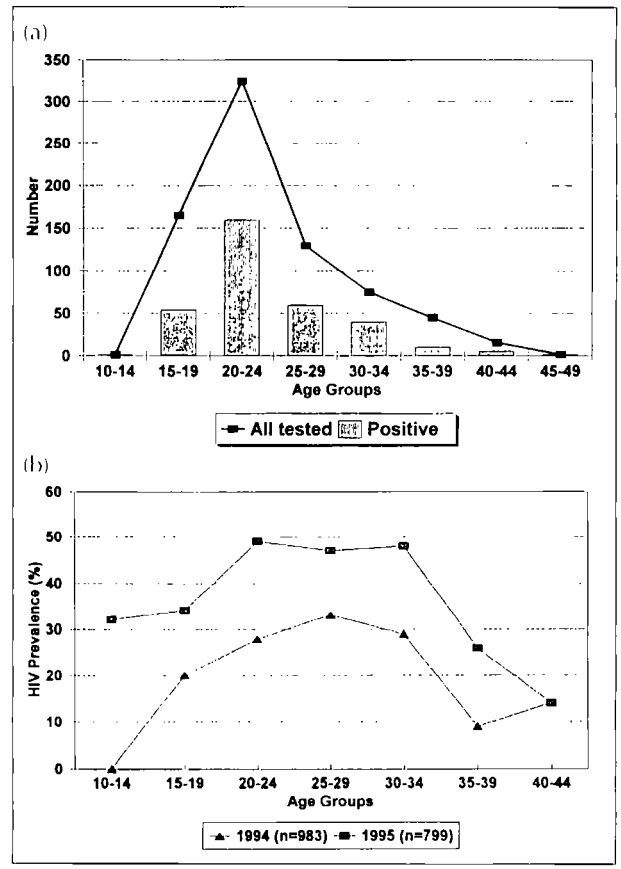

Fig. 1. (a) Age distribution in antenatal clinics in 1995 and (b) HIV seroprevalence 1994 and 1995, in the Masingo Province.

The national prevalence is currently estimated to be between 18–21% and is expected to continue to rise into the next millennium before leveling off and declining. HIV is widespread throughout the whole country although, according to 1995 surveillance figures (National AIDS Control Programme, unpublished data, 1996), levels of prevalence are slightly higher in urban areas, ranging from 36% in Harare to 42% in Masvingo. Prevalence levels in rural areas show a much wider variation ranging from 11% in Lupane to 43% in Beitbridge. However, rural areas (where 70% of the country's population are based) are experiencing some of the highest rates of incidence at the current time. In the Mberengwa rural district of Midlands Province, HIV prevalence among pregnant women increased from under 8% in 1992 to 25% in 1994 [36]. In Chiredzi, Masvingo Province, HIV prevalence rose from 40% in 1992 to 70% in 1995 and dropped to 47% in 1996. In a cohort study of male factory workers conducted in Harare between 1993 and 1995, 19% of participants were found to be infected at enrollment and an incidence rate of 2.93% per annum was recorded [37].

The current pattern of HIV prevalence in Zimbabwe is somewhat different from most countries in the region in that there is a mosaic of high and low HIV prevalence rates in both rural and urban areas. In contrast, in Uganda, Kenya, Malawi and Zambia, populations with high HIV prevalence are mostly found in specific geographical areas, such as the Rakai district in Uganda, the Copperbelt in Zambia, and in the city of Lilongwe in Malawi. Several factors appear to contribute to the diversity, rapid spread and severity of the epidemics in Zimbabwe. One of these may be the high levels of circular mobility of large numbers of people sharing their time between residences in urban areas and rural areas, in a country where this mobility is facilitated by a vast road network. Changing sexual behaviors associated with high mobility, rising levels of poverty and dislocation caused by such factors as unemployment and occasional droughts fuel the spread of HIV infection and other STD in Zimbabwe.

The dynamism of HIV spread in Zimbabwe is highlighted by the worrisome results of sentinel surveillance in Masvingo Province where, through the age of 39 years, HIV prevalence rates were consistently higher in 1995 than in 1994 (Fig. 1).

Ministry of Health and Child Welfare, Blair Research Laboratory, Causeway, Zimbabwe.

In Francistown, Botswana, the prevalence rate of HIV in women seen at ANC increased from 6% in 1991 to over 30% 2 years later. The rate of HIV infection in similar sentinel surveillance populations in Kwazulu Natal, South Africa, rose almost 10-fold within a 5-year period, from 1.6% in 1990 to 4.8% in 1992 and to 14.4% in 1994 [41]. By 1997, the South African government estimated that 2.4 million people (or 6% of the population), including 1.4 million women, were living with HIV in the country, a rise of one-third over 1995 [42]. Signs of similarly pronounced epidemic growth are unfortunately common in the area; the mean HIV rate in women attending ANC in Swaziland increased sharply from 3.9% in 1992 to 26% in 1996 and in Namibia, following the country's independence and the return of exiled populations, the rate of HIV infection among women attending ANC rose from less than 1% in the early 1990s to 17.6% in cities and 10.3% in rural areas by 1996 [43,44].

The low-intensity wars and open warfare which plagued the area also led to considerable population displacement but data are insufficient to establish the impact of these events on the spread of HIV. For example, Mozambique, one of the countries which has experienced long-lasting civil conflicts since the 1970s, displays lower HIV rates than neighboring countries: 2.7% among ANC attendees in the capital city, Maputo, in 1994 and 1.5% among pregnant women in displaced populations in a rural area near the border to Zimbabwe [45]. No recent HIV information is available from Angola, which has been the locus of civil strife for over a decade. The presence of HIV-2 has been documented in Angola and Mozambique, which both have historical links to Portugal and Guinea Bissau.

In Malawi and Zimbabwe, rates of HIV infection at ANC are comparable to those found in eastern Africa: leveling off at approximately 30% in urban ANC since the early 1990s, with high and rising rates in rural areas [46].

African neighbors: north Africa and island countries

HIV epidemics in countries of the Maghreb, Egypt, and the Indian Ocean do not conform to the same patterns as those observed in sub-Saharan Africa. The rates of infection among women seen at ANC remains lower than 1%, with rates of a few per cent found in sex workers and STD patients [9,47]. In north African countries, the modes of transmission of HIV acquired abroad involve a mix of heterosexual and homosexual contacts and injecting drug use, resembling more the patterns of HIV spread observed in Europe than those in sub-Saharan Africa. Indigenous transmission of HIV seems to result mostly from heterosexual contacts [48]. The lack of data in this composite group of countries seriously hampers an analysis of the status and the projection of trends of HIV infection in the area.

Predominant modes of HIV transmission

It has been estimated that 93–95% of all HIV infections in the 15–49 year age group in sub-Saharan Africa were due to heterosexual transmission and that, by 1996, more than half of these infections were in women [1,49]. Retrospective behavioral inquiries among HIV-infected people would tend to support these estimations, but there are unanswered questions concerning the contribution of other modes of HIV transmission to the epidemics in sub-Saharan Africa. For example, how much infection is acquired through the use of skin-piercing instruments within or outside the health-care setting, as well as the transfusion of contaminated blood and blood products [50]. Because of the lack of information, these questions will only be briefly addressed.

The male-to-female ratio of HIV infection, approximately 1:1 in population-based seroepidemiological surveys in sub-Saharan Africa, supports the assertion that heterosexual transmission is by far the predominant mode of HIV spread in the region. Yet, the patterns and extent of men having sex with men (and therefore of related HIV transmission) remain largely unexplored in sub-Saharan Africa as a result of strong stigma attached to, and denial of, this expression of sexuality. Studies in Sudan, Nigeria, Kenya and South Africa are among the few that have documented sexual contacts between men [51]. Increased knowledge of epidemiological, behavioral and social aspects of HIV transmission among men having sex with men is a prerequisite for effective prevention in this ignored population.

Heterosexual transmission of HIV

Early in the epidemics, HIV spread (in many countries with high velocity) in the context of transactional sex. HIV prevalence rates rose among commercial and casual sex partners when HIV was either not found or present at low prevalence rates among women attending ANC. A correlation between HIV prevalence rates among sex workers and among pregnant women in urban populations helped predict the spread of HIV when seroepidemiological surveillance systems were limited to occasional surveys conducted among sex workers [52]. As HIV was spreading, the rise in HIV prevalence among women attending ANC and the occasional conduct of population-based surveys which included both women and men provided a growing body of knowledge about factors influencing the heterosexual spread of HIV and the great diversity in epidemic patterns within populations in the same country.

Women throughout the region tend to become HIV infected at younger ages than men, as illustrated by community-based seroprevalence surveys conducted in Masaka, Uganda (Fig. 7). Population-based studies have shown a 5–10 year interval between the peak of HIV prevalence in women (reached between the ages of 25

Box II. Comparing sentinel surveillance and population-based HIV prevalence rates in Zambia

Knut Fylkesnes*†, Kevin Kasumba*‡, Zacchaeus Ndhlovu*‡ and Rosemary M. Musonda§

Zambia's sentinel surveillance system has been gradually expanded and the data drawn from it are now relatively comprehensive. Surveillance data show an overall stability in HIV infection in both urban and rural sites in recent years, suggesting that the current difference in urban and rural rates (now about 27% in urban areas and around half that in rural areas) will persist in the near future.

In 1995–1996, the first of a series of planned cross sectional HIV surveys in random population samples (n = 4196) was conducted to: (1) establish a baseline for follow up; (2) assess the reliability of the sentinel surveillance system; and (3) examine patterns and determinants of HIV infections and sexual behavior [38]. As the first population based-survey of this type, the collection of saliva specimens for HIV testing was included in the survey [39]. The use of this non-invasive method of specimen collection resulted in a high compliance rate of 93.5% with no recognizable bias.

Figure IIa, in which HIV prevalence rates are shown by 5-year age group, by sex and by sampling method, reveals that: (1) in the younger age group (15–19 years of age), the rate of HIV prevalence in the sentinel surveillance sample is about twice the rate found among women in the population-based sample. This is possibly because the latter includes teenage women who are not (or less) sexually active and, perhaps as well, teenage women who may be more likely to use condoms; (2) in older age groups, the HIV prevalence rates among women in the population-based sample exceeds those found in antenatal clinic samples, perhaps because of an association between lowered fertility and HIV infection; and (3) in the population-based sample, the HIV prevalence rate is consistently and considerably higher among women in the general population than among men in the 15–29 year age group while in older age groups the rate is higher among men.

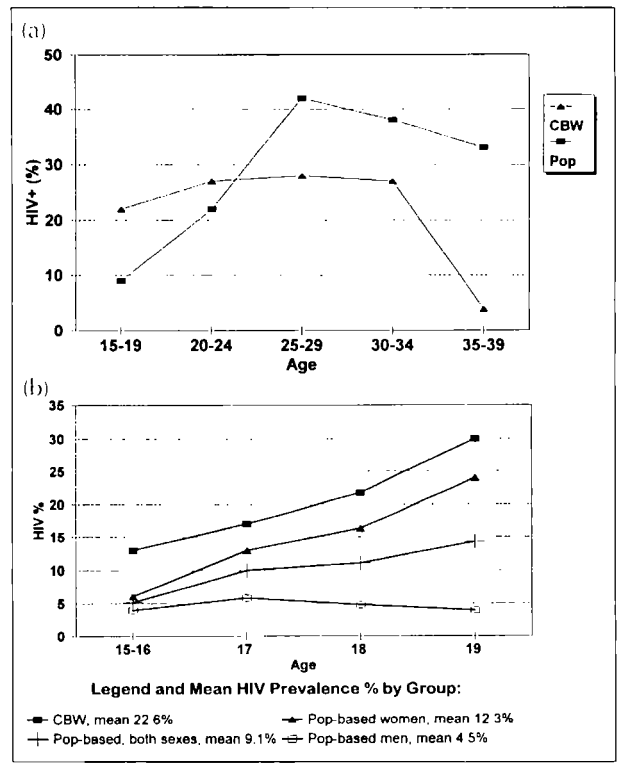

Fig. II. Age-specific HIV prevalence in child-bearing women (CBW) (a) attending an antenatal clinic in Chelston, Lusaka and (b) results of a population-based (pop-based) HIV prevalence study, by age and sex.

Figure IIb shows a further analysis of HIV prevalence rates in the younger age group (15–19 years of age), although the 15–16 year age group was combined for reasons of sampling [40]. Several additional features of the spread of HIV are unveiled: (1) within the 15–19 year age group, the age structure of the sentinel surveillance sample and of the population-based sample differ significantly, with an under-representation of 15–16-year-old women in the sentinel surveillance sample (17 versus 44% in the population-based sample) and an over-representation of the 18–19 year age group (accounting for 63.6% of the sentinel surveillance sample versus 34% in the population-based sample), thus tipping the mean HIV prevalence rate in the sentinel surveillance sample toward the higher HIV rates found in the 18–19 year age group. Adjusting the age structure of the sentinel surveillance sample on the basis of the age structure of the population-based sample gives a mean HIV prevalence rate of 19% in the sentinel surveillance sample instead of the mean rate of 22.6% in the unadjusted population sample; (2) across ages, the HIV prevalence rates were consistently higher in teenage women seen at ANC than among teenage women in the population-based sample which, in turn, were higher than the rates among men of the same age; (3) the prevalence rates increased among teenage women in both samples by a factor of two between the ages of 15–16 and 19 years; and (4) by the age of 15 or 16 years, more than 6% of female teenagers in the population-based sample and more than 12% of female teenagers seen at ANC were already infected with HIV.

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Box II (continued)
The comparison of HIV prevalence rates between the population-based sample, analyzed by age group and sex, and the sentinel population drawn from antenatal clinics, analyzed by age group, leads to a much better understanding of the current dynamics of HIV spread in the population, particularly when HIV prevalence rates are analyzed by single year of age in younger age groups. This approach facilitates the 'calibration' of the HIV prevalence results obtained from sentinel surveillance, thereby increasing the accuracy of extrapolation of HIV prevalence rates in sentinel surveillance samples to populations located within the catchment area of sentinel surveillance sites. This study underlines the usefulness, limitations and options for improvements of ANC sentinel surveillance as a method to monitor HIV status and trends.

and 34 years) and the peak of HIV prevalence in men (observed in the 30–39 year age group). A similar interval in the peak of AIDS incidence in women and in men can be observed, with an upwards shift of 5–10 years towards the older age groups for both [19]. Among women attending periurban ANC and assumed not to be associated with high-risk sexual behavior, the risk of HIV infection is largely determined by their male partner's sexual behavior [54].

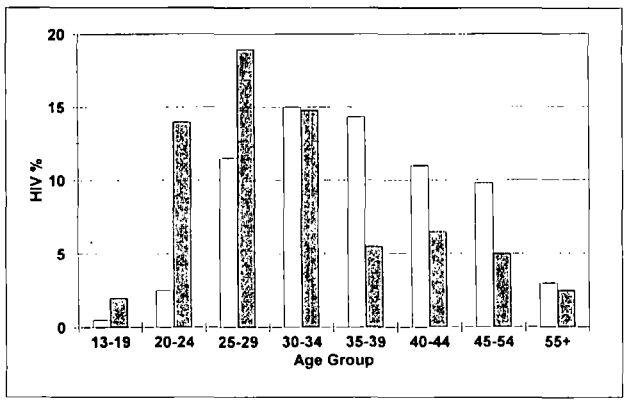

Fig. 7. HIV seroprevalence by age and sex in adults in 15 rural villages in the Masaka district of Uganda, 1995. □, Men; ■, women. Data from [53].

Residence and heterosexual transmission of HIV

Residence and mobility patterns have long been recognized as factors influencing vulnerability to HIV/AIDS. Bridges between higher and lower HIV prevalence populations are influenced by a number of social factors, including occupational mobility, economic migration or population displacements, particularly when these result in the building of communities with a severe gender imbalance, as is seen in Abidjan and around industrialized sites of southern Africa (Fig. 8).

Throughout Africa, differentials between the high HIV rates in urban populations and lower rates in rural populations persist but are constantly narrowing. Communities located along trade routes and highways are often at intermediate levels of vulnerability to HIV. Some illustrations of this pattern come from studies in several districts in Tanzania. In rural Mbeya in 1988–1995, for example, the prevalence rates of HIV in women attending ANC along the roadside were consistently higher than the rates found in remote rural areas [55]. However, by 1995, the difference between rates in roadside and remote population samples (14 and 12.8%, respectively) had narrowed considerably. In the Mwanza district, the prevalence rate of HIV in adults was twice as high in the community living along the roadside (7.7%) than in villages distant from the main road (3.8%) [56]. In the Arusha district, a population-based survey found rates of 14.4, 6.9 and 2.3% in women in urban areas, semi-urban areas and rural areas, respectively. A history of urban residence or of having traveled within or outside the country were among factors associated with increased rate of HIV prevalence [57]. There are notable exceptions, however, to the general picture of important differences between urban and rural HIV prevalence rates. Such exceptions can be found in Côte d'Ivoire and some areas in Zimbabwe and Uganda where urban and rural HIV prevalence rates only differ by a few per cent.

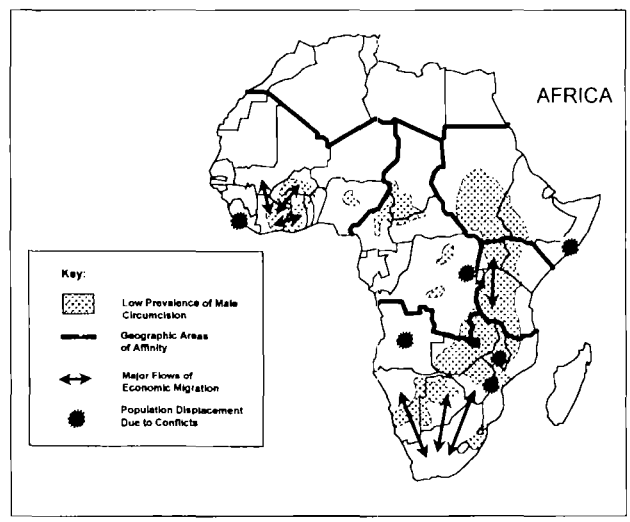

Fig. 8. HIV/AIDS prevalence among low-risk populations in Africa, prevalence of male circumcision and major patterns of population mobility in the mid-1990s.

Similarly, in the Rakai district, Uganda, populations living close to the highway had a 38.5% HIV seroprevalence, compared with 25.4% in trading centers and 8.6% in rural villages [58]. Men are the predominant source of new infections in rural villages, as shown in the southwestern

Ugandan population where the use of condoms was higher in couples in which the man was known to be the uninfected partner (17.1%) rather than the woman (9.5%) [59]. The seroincidence rate was about 10-times higher in men and women in discordant relationships (8.7 and 9.2 per 100 persons-years, respectively) than in concordant seronegative couples (0.82 and 0.87 per 100 persons-years, respectively).

Finally, in Kenya in 1995, HIV prevalence in adults between the ages of 15 and 44 years was estimated at 13–14% in urban populations and at 6–7% in rural populations, for an overall rate in the country of 7.5%, more than twice the 3.5% prevalence estimated in 1990, and rising [60].

Mobility and heterosexual transmission of HIV

Migration, combined with declining age at first sexual intercourse can, in the absence of targeted prevention programs, lead to increased risk-taking sexual behavior. For example, the combined findings from two surveys in Senegal indicated that seasonal migration correlated with at-risk sexual behavior and, as was shown in an earlier study, with higher HIV infection rate [61]. In this population, age at first marriage increased from 25 to 32 years for men and from 21 to 24 years for women between 1989 and 1994, while age at first sexual intercourse decreased by about 10 years on average during the 30 years preceding the survey [62].

Migration and mobility between rural areas and cities involves two-way traffic. Single men and women tend to move to cities for reasons of employment and return home to visit their family or to seek treatment when they fall ill [63,64]. This mobility pattern impacts both the spread of HIV and the fragile economy of rural households which have to rely on remittances from urban areas.

Higher rates of HIV infection have been found in people who travel frequently and over long distances, such as truck drivers and their assistants, traders and military personnel [65]. Behavioral studies have shown that occupational travel was often associated with high rates of changes in sexual partners, participation in transactional sex and unsafe sex practices, suggesting that these populations play a role in bridging epidemics in higher and lower HIV prevalence areas [66–69].

The tenuous nature of sexual mixing between urban and rural populations may be one of the factors delaying the leveling-off between urban and rural HIV prevalence rates [70]. In Uganda, apart from a small group of men with high rates of partner change, small urban/rural traders did not seem to represent a significant bridge population as movements between towns and rural areas involved little sexual mixing between rural-based and urban-based populations [71].

Biological factors

The history of STD in women and men and the lack of male circumcision have been identified as relevant to the spread of HIV infection in sub-Saharan Africa. The synergy between HIV infection and STD has been well established and is particularly powerful in women [72]. Male circumcision has been found to be associated with a lower rate of HIV infection in adult males in Africa [73–75]. Most, but not all, studies have demonstrated the relative protective role of male circumcision against the acquisition of HIV infection [76]. The Mwanza trial in Tanzania, in fact, found a significantly higher rate of HIV infection in circumcised males [56].

Mother-to-infant transmission of HIV

Over 70% of infants born with permatally acquired HIV infection are residing in Africa. The rate of infection in infants born to HIV-infected mothers in sub-Saharan Africa ranges between 24–42%, threatening to offset the reduction in childhood mortality achieved through several decades of disease prevention and control programs [77,78]. Two studies, one in Abidjan, Côte d'Ivoire, and the other in Dakar, Senegal, showed that HIV-1 transmits from mother to infant at a higher rate (24.7 and 30.4%, respectively) than HIV-2 (1.2 and 3.8%, respectively) [79,80].

A share of this transmission is attributable to breast-feeding, raising the daunting challenge of developing prevention strategies that strike the optimal balance between reducing the rate of HIV infection transmitted through breast milk while enabling children to draw maximum benefits from breast-feeding [81–85]. In a Kinshasa study, the HIV transmission risk for intrauterine, intrapartum/early postpartum (0–2 days), and late postpartum (3–5 months) were estimated at 6, 18 and 4%, respectively, confirming that if most transmission occurred during labor and at or shortly after delivery the risk of HIV transmission through breast-feeding was substantial [86].

It has become increasingly clear that the likelihood of transmission from HIV-1-infected mothers to their infants is strongly influenced by the mode of delivery and breast-feeding practices. In Soweto, South Africa, cesarean sections performed before the onset of labor are associated with a high reduction of transmission (from an overall rate of 38.1 to 14.3%) while no significant reduction was noted when cesarean section was performed after the onset of labor (associated with a transmission rate of 35%) [87]. Importantly, transmission to breast-fed infants was 46%, against 18% to those who were not breast-fed. Yet another factor which seems to influence the vertical transmission of HIV is the pregnant woman's stage of evolution of HIV disease. In Uganda, for example, the median plasma RNA in women whose infant became infected (184 000 copies/ml) was, at study entry, over 10-times that of women whose infant did not become infected (16 000 copies/ml) [88].

HIV transmission in the health-care setting

The transmission of HIV through contaminated blood and blood products in Africa remains poorly documented. Estimates suggest that, in 1995 alone, 550 000 of the 2.3 million blood units donated in the region (23.8%) had not been screened for HIV antibodies [50]. Assuming that the rate of HIV infection among blood donors ranges between a most conservative 2% and a more likely 10%, between 1100 and 55 000 HIV infections might have been acquired in sub-Saharan Africa in 1995 as a consequence of the transfusion of unscreened blood.

Data are similarly lacking on HIV transmission which may be occurring in the health-care setting through the re-use of unsterile injection and other skin-piercing instruments. Surveys in several sub-Saharan countries have shown that half of the adult population may receive an average of approximately five injections per year, urban residents being more likely than rural populations to report having received injections for medical purposes, although the risk of HIV transmission through such practices has not been assessed [89]. One of the few illustrations of the risk of nosocomial HIV infection in children comes from Burkina Faso, where 60 children aged 4–48 months seen at a pediatric ward in Bob-Dioulasso for malnutrition were found to be HIV-infected. Mother-to-child transmission could be established in 77% of these but at least 23% had been infected through other means, presumably contaminated injection equipment or unscreened blood [90]. Among 10 HIV-infected 5–12-year-old children in Uganda, it was found that six had been perinatally infected, while blood transfusion and injections accounted for one case each. Of the remaining two, one was attributed to sexual exposure and the other unexplained [91]. It would be unreasonable to draw conclusions applicable to the whole sub-Saharan region from these results. They are, however, indicative of risks of HIV transmission through medical practices which have been insufficiently documented and addressed from the perspective of prevention.

Also poorly documented is the rate of HIV infection among health-care providers through occupational exposure. In a Zambian hospital in 1994, where the HIV seroprevalence in surgical patients was 22.3%, the relative cumulated seroconversion risk for surgeons was 15-times higher than in Western countries. It was estimated that each year, one out of 300 employees working in this type of setting may become infected with HIV as a result of occupational exposure [92].

The threatening increase in substance abuse in sub-Saharan Africa

A worrisome factor in projecting future trends is the increasing availability of illicit drugs in Africa, in particular substances that may be injected such as heroin. The risk associated with injecting drug use in Africa is real as drugs most often find their way into local populations around transit points. The routes of international drug trafficking pass through coastal cities (Abidjan, Accra, Banjul, Dakar, Lagos, Monrovia), international airports (Kigali, Nairobi) and Indian Ocean island countries (Mauritius) [93]. There may have been as many as 50 000–100 000 injecting drug users in Nigeria in 1992 [94]. The use of smoked or injected heroin has also been documented in Côte d'Ivoire and in the Cameroon [95]. Reinforced surveillance and prevention programs are needed in sub-Saharan Africa to better understand the patterns and curb the growth of substance abuse, while investigating its impact on health, including HIV infection.

Information gaps concerning HIV transmission in sub-Saharan Africa

Overall, abundant data exist on HIV prevalence status and trends drawn from pregnant women seen at ANC selected for the purpose of epidemiological sentinel surveillance (ESS), and from several community-based cohort and cross-sectional studies. Although a compelling need remains to improve the understanding of the heterosexual spread and impact of HIV in adolescents and in adults of reproductive age as well as in infants, unexplored or insufficiently known aspects of the dynamics of HIV spread and impact should also receive more attention. These include: (1) estimation of the incidence of HIV throughout the life-cycle resulting from nosocomial infection, homosexual sex, as well as from drug-injecting practices and associated to other forms of substance abuse; (2) HIV prevalence and incidence in relation to specific modes of transmission in children below the age of 15 years, in particular sexual abuse, skin piercing practices (health-care related or not) and female genital mutilation; and (3) patterns of HIV prevalence, incidence and HIV disease in populations older than 54 years (Fig. 9).

Discrete declines in HIV trends?

In several countries, studies have documented that the average age at first sexual intercourse for women is slowly rising, the number of men and women reporting non-regular and/or multiple sexual partners is declining, the age differential between occasional sexual partners is narrowing (although still involving the pairing of younger women and older men) and the frequency of transactional sex is declining in several populations of young adult males. In contrast, few favorable trends have been noted concerning regular condom use.

In Tanzania, during a 2-year observation period in the mid-1990s, the proportion of men reporting more than one sexual partner within the last month declined from 22.3 to 12.2%. The proportion of men reporting casual sex over the last month was almost halved (from 9.8 to 5.2%), but condom use remained low [96]. In Uganda, major and widespread changes toward safer sexual

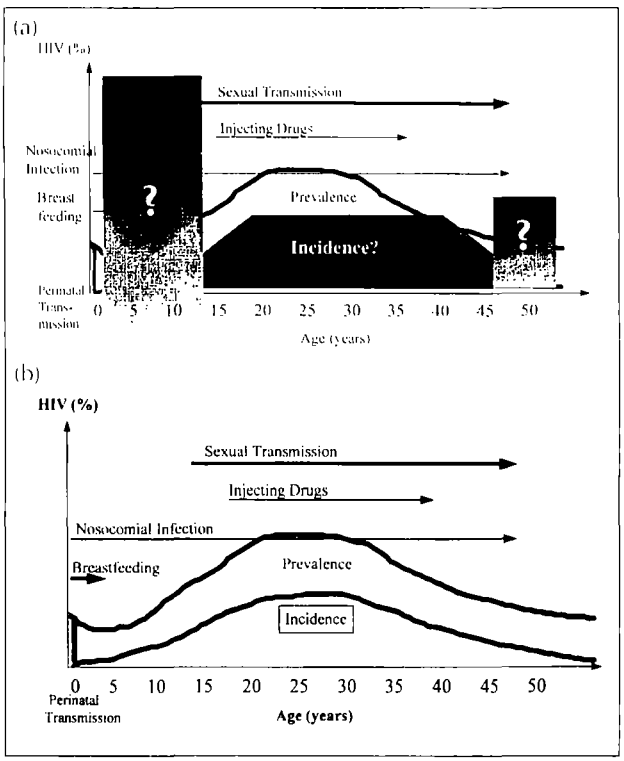

Fig. 9. HIV prevalence and incidence throughout the life-cycle: a hypothetical country scenario. (a) What we know and do not know and (b) what we would like to know.

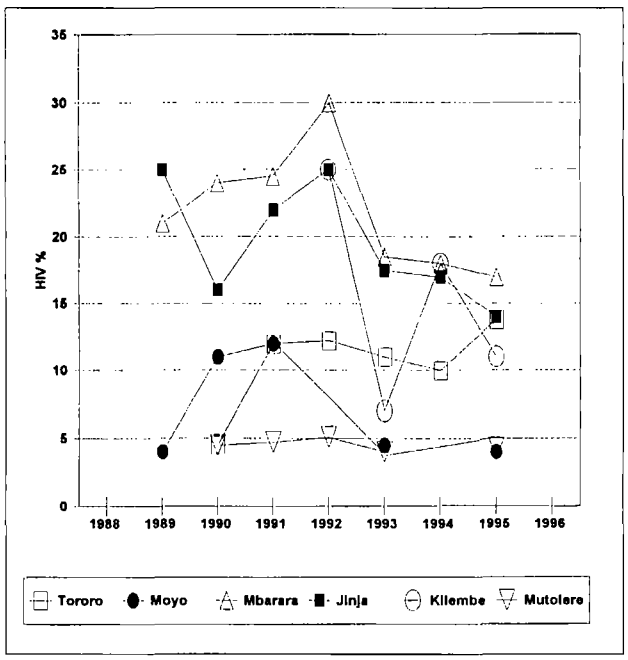

Fig. 10. HIV seroprevalence for pregnant women in selected cities in Uganda in 1989–1995. Data from [98].

behaviors have also been documented, including in this case an increased level of experience with condoms to an albeit modest 20–25% of the currently sexually active population [97].

While these behavioral changes were being noted, HIV prevalence declines were reported to have occurred in younger age groups in several HIV testing sites in Uganda (Fig. 10) [99,100]. In the Karakole district of western Uganda in 1994, the decrease of HIV prevalence in 11–20-year-old women attending ANC seemed to indicate a similar declining trend in incidence. This trend was more pronounced in urban than in semi-urban or rural areas [101].

Although the discrete declines in HIV prevalence observed in several populations are encouraging and are occurring concurrently with shifts toward safer sexual behaviors, other factors could also be associated with these trends. One of these factors might be the changing velocity of the spread of HIV as it shifts its main focus from individuals with high levels of exposure to HIV (for example, individuals with a high rate of unprotected sexual contacts with multiple partners) to others (for example, regular sexual partners of these individuals). These declines do shed some hope on the future of the epidemics, however, and should add vigor to ongoing prevention programs.

In addition to observed changes in behavior, there are other indications that HIV epidemics can respond to effective prevention. The first randomized, controlled trial on the impact of STD treatment on the transmission of HIV was conducted in Mwanza, Tanzania, in 1995–1996 [102]. The aim of this study was to implement improved STD treatment services and fully integrate them into the primary health-care system, thus rendering them easily accessible to the population. For comparison, six communities with improved services and six with pre-existing STD services were included in the study. A random sample of 12 000 adults was followed over 2 years to record the prevalence of selected STD and the incidence of HIV. Baseline prevalence of HIV was about 4% and incidence of HIV infections during the follow-up period was 1.2% in the communities with the improved services and 1.9% in the comparison communities, showing a reduction of about 38%. Similarly, the prevalence of active syphilis was reduced by up to 40% and of active urethritis in men by 50%.

The results of this intervention study should stimulate increased interest in, and commitment to, the strengthening of STD prevention and care programs in Africa and elsewhere in the world.

The future course of the HIV epidemics

The course, both present and future, of each of the HIV epidemics affecting sub-Saharan Africa depends on a variety of factors, including the virulence of the HIV virus genotype involved, the prevalence of STD and of

male circumcision, sexual mixing patterns within and across communities, as well as social variables [103,104].

The assumption that HIV epidemics have peaked in several populations in sub-Saharan Africa is supported by studies of HIV prevalence and incidence in women from younger age groups attending ANC, by community-based cohort studies, by the analysis of AIDS incidence, and by retrospective analyses of adult mortality [105,106]. An initial decline in incidence should not, however, distract from the possibility of a subsequent increase in incidence as populations at lower risk, but in greater number, than those initially infected by the virus run the risk of exposure. The resulting epidemic curve would show a temporary decline in the incidence of HIV followed by a slow but long-lasting rise, as less immediately vulnerable populations with attenuated links to high-risk sexual networks become infected.

The evolution of the HIV epidemics in Abidjan, Côte d'Ivoire, reconstructed from mortality data, helps illustrate these dynamics of spread, although this example involves complex and incompletely documented factors such as the gradual displacement of HIV-2 by HIV-1 viruses and changing patterns of migration [107]. Back-calculation from mortality data suggests that the incidence of HIV in Abidjan rose in the early and mid-1980s, reaching a peak in 1985–1986. It then declined, but rose again to reach a second peak in 1992. The hypothesis put forward by the authors is that the first epidemic 'wave' was predominantly associated with transactional sex, while the second resulted from sexual contacts within stable relationships.

Projecting the course of the HIV epidemics in sub-Saharan Africa today must take into consideration the fragmentation and diversity of the epidemics. In 1995, an assessment of the HIV situation in the region was performed by the WHO GPA on a country-by-country basis for a mid-point in the year 1994 [2]. It was estimated that, in a population of 260 million adults aged 15–49 years, 11.3 million were living with HIV/AIDS, giving a prevalence rate of 4.35%. No breakdown of these data by sex was available. Several trends have marked the evolution of the HIV epidemics in the region in the last few years: (1) as discussed earlier, the incidence of HIV has shown some signs of decline in some populations, particularly in younger age groups in eastern Africa where the epidemics are more mature; (2) epidemics have suddenly increased in other areas, in particular in southern areas; and (3) the rates of HIV prevalence in many rural areas (where over 70% of the African population live) continue to rise. It would seem fair to assume that the number of people currently living with HIV in sub-Saharan Africa is at least at the 1994 level. UNAIDS is conducting a new country-based analysis of HIV situations and trends which should be completed by the end of 1997. It can be anticipated that the accuracy of these data will be hampered by the difficulties in reaching meaningful estimates in a context of increased fragmentation and diversity of HIV epidemics.

Toward improved monitoring of HIV status and trends epidemics

In the mid-1980s, the acquisition of knowledge about the state and trends of HIV epidemics in sub-Saharan Africa relied on diverse methods which have evolved over time. The initial approach was to rely on occasional cross-sectional seroepidemiological surveys conducted in groups considered to be at high risk of acquiring HIV, for example sex workers or patients attending STD clinics. Similar, occasional surveys were carried out among women attending ANC. The results of these ad-hoc surveys received much attention as prevalence rates in populations considered to be at 'low risk', mostly women attending ANC, began to climb. In the late 1980s, the WHO GPA developed a method to systematize these cross-sectional surveys and allow for comparisons of their results both over time and between testing sites [108]. The method was based on anonymous and unlinked cross-sectional seroprevalence surveys performed at regular intervals in selected sites. The so-called 'sentinel sites' included ANC, blood transfusion centers and STD clinics. These ESS systems fitted the needs at the time they were created. Their purpose was to provide some broad indication of the presence or absence of HIV infection in selected groups, and of crude trends across age groups when these trends began to be measurable. Since that time, ESS has generated a wealth of information which, unfortunately, has not always been published, reported to international organizations or presented publicly. Currently, all but four sub-Saharan African countries are implementing ESS systems [109]. These remaining four have not set HIV surveillance on their list of priorities.

ESS needs further refinements today if it is to help discern HIV-incidence trends in younger age groups or to interpret these and other trends in the context of social and behavioral changes. There is a critical need to protect the anonymous nature of the ESS, first and foremost in order to preserve privacy and, second, because the potential for loss of privacy would introduce biases in women tested at ANC. Only limited amounts of social information and the lack of behavioral information are currently collected under ESS schemes. This is justified by the concern that collection of behavioral and social data in ANC could lead to a chain of events involving identification of respondents, fear or occurrence of breaches of confidentiality, possible stigma and negative impact on women, their families and their community, self-exclusion from antenatal services where essential care is provided, and the concomitant loss of sources of precious epidemiological information.

Another limitation of ESS is that data collected at sentinel sites are only applicable to the non-random sample of the population tested, and thus not applicable to the entire population from which they are drawn. Such issues as care-seeking patterns (who comes to ANC and who does not?), fertility patterns (what is the HIV prevalence in girls and women who are not currently sexually active or who are not pregnant?), adjustments of the results of the sampled population to match the age structure of the general female population (which age group is over- or under-represented in the sample?), patterns of sexual partnership and age-specific infection rates in boys and men have to be addressed in order to take fuller advantage of the information collected through ESS [110,111].

One of the issues limiting the interpretation of ESS information is the application of broad age groups to data collection and analysis. ESS relies on serological testing of populations of adolescents and adults seen at ANC. Results are analyzed and presented according to 5–10-year age groups starting at the age of 15 years, or as a mean prevalence rate for the entire 15–44-year-old population. The use of such broad age groups in collecting ESS data may currently mask trends in HIV incidence in younger age groups, such as teenagers and adults in their twenties, as shown in Zambia (Box II).

Collecting and analyzing HIV prevalence in single-year age groups among the youngest (15–24-year-olds) and adjusting the sample size accordingly would help to provide meaningful results and lead to a better understanding of the dynamics of the epidemics.

The extrapolation of data collected at ANC to the population at large requires the 'calibration' of sentinel surveillance data. This can be attempted through the comparison of sentinel surveillance data with seroepidemiological data collected through occasional, cross-sectional, population-based surveys. For example, in Mwanza, Tanzania, in 1990–1992, HIV prevalence rates in the general population were compared with rates derived from ANC-based sentinel surveillance. The rate for women in the general population was higher than that for the ANC population, suggesting lower fertility in women with HIV [112]. In the Karakole district of western Uganda, sentinel surveillance data tended to overestimate HIV prevalence rates in semi-urban and rural areas, while underestimating them in the urban area [113]. The approach applied in Zambia (Box II) provided, among other critically useful information, adjustment factors for the interpretation of sentinel surveillance data.

Community-based cohort studies have also been conducted to estimate the incidence of HIV infection, probe into the association between HIV trends and socioeconomic determinants, and explore the evolution of HIV disease and its impact on morbidity, fertility and mortality. These studies provide quality data but their design, implementation and data analysis are complex and costly, thus limiting their replication [114].

Alternate approaches for exploring a possible association between social and behavioral variables and trends in HIV infection rates include collecting behavioral and social data in catchment areas surrounding sentinel surveillance sites or, when this is the only available option, in populations away from these sites but deemed to share the behavioral and social characteristics of the population covered by sentinel surveillance. Information collected through these approaches may provide crude indications of a possible association between trends in HIV infection, behavioral and social determinants, and the impact of prevention programs. This type of information is critical to the evaluation and refinement of prevention strategies. Surveillance methods should, however, be adapted to meet specific country needs and capacity; these methods are contingent on the intended use of surveillance data, the stage of maturity reached by the epidemics, the availability of resources and the strength of the local infrastructure [115].

Conclusion

The abundant information generated from HIV epidemiological surveillance and research in sub-Saharan Africa has contributed to a great extent to advancing the global knowledge of the dynamics of HIV epidemics in populations where the heterosexual transmission of HIV predominates. The development and progressive refinement of surveillance methods, now applied in many countries around the world, is in its own right a major contribution to the collective capacity to understand the epidemics and respond to them more effectively.

The HIV epidemics in sub-Saharan Africa remain as powerful and diverse as ever, but there are clear signs that, when appropriately addressed, they can be challenged and destabilized. There is unfortunately little doubt that the future holds rather predictable developments, such as the increased impact of HIV on people already infected, on those who provide them with needed care and support, and on nations who are reaching or have already surpassed the limits of their coping capabilities. The future also holds a number of uncertainties; for example, the nature and determinants of abrupt and devastating outbreaks of HIV, as being witnessed in southern Africa, are inadequately understood.

Expanding the capacity of epidemiological surveillance should provide the needed information on evolving patterns of HIV incidence, the occurrence of behavior change associated with these trends, and on the effectiveness of prevention efforts. It is hoped that this constant process of discovery will stimulate increased interest on the part of decision-makers to more systematic applications of the growing body of knowledge to policy

and program development in sub-Saharan Africa as well as in the rest of the world.

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Madagascar	✔	✔	Alphonse	Randrianambinin	Min of Commerce	2/17/99, ANTANARI
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Malawi	✔	—	Elexander	Gomani	Principal Secretary for Commerce & Indu	
Malawi	✔	—	Hary	Monoga	Dir. International Relations	
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Mauritania	✔	—				2/13/99, NOUAKCHO
Mauritius	✔	—				
Morocco	—	—				
Mozambique	✔	—	Oldemiro	Baloi	Min. of Industry, Commerce and Tourism	2/11/99, MAPUTO, 63
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Tanzania	✔	✔	M.M.	Matiko	Ambassador, Director for Europe and The	
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Cameroon	✔	✔	Bello Bouba	Maigari	Min. of State for Industrial Development	
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IGAD	✔		Dr. Tekeste	Ghebray	Executive Director of IGAD	2/25/99. DJIBOUTI
IGAD	✔		Professor Benson E.	Mochoge	Director, Division of Agriculture & Envir	2/25/99. DJIBOUTI
IGAD	✔		Mrs Atsed	Zerfu	Chief	2/25/99. DJIBOUTI
Kenya	✔					
Lesotho						
Liberia	✔		Monie	Captan	Foreign Minister	2/25/99. MONROVIA

Visit by USA delegation to GWAPA

Time	Activity	P. Responsible
0830 Hours	Arrival of visitors to Medical center Song We welcome you	P. Educators
08 35 Hours	Prayer	
08 40 Hours	Introductions	P. Educators
08 45 Hours	GWAPA -Historical background	P. Govathson
08 55 Hours	Drama-Plight of a women	P. Educators
09 05 Hours	Song- In Gweru	P. Educators
09 10 Hours	Speech –Dilemma of a disadvantaged women	B Nyamunga
09 20 Hours	Speech-Ms S. Thurman	P. Educators
09 30 Hours	Travel to Mc Fadden Farm	
09 40 Hours	Viewing of Mc Fadden Farm	
09 55 Hours	Speech- Catering Team	S.Sarudzai
10 00 Hours	Speech- Poultry Team	R. Phiri
10 05 Hours	Speech- Market Gardening	G. Chidende
10 10 Hours	Speech- Soap Making	
10 15 Hours	Closing remarks	C. Chikaza
10 20 Hours	Vote of thanks	Dr Xaba

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AIDS Analysis Africa

Vol. 9 No. 5 Feb/Mar 1999

Analysing the impact of the AIDS epidemic on organisations, business and the economy

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AIDS and employment: the changing legal environment

Important developments in labour law are codifying the responsibilities of employers in Southern Africa.

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Under the Mupundu Tree

Volunteerism allows a home-based care programme to achieve a remarkable level of support for sufferers.

Evidence from the Developing World

A supplement to ***Confronting AIDS***, this collection of background papers forms a valuable reference work.

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Officials ignore them, but gay men, married or not, are a significant minority in African society.

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Guide to financial planning for people with HIV/AIDS.

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METROPOLITAN

Special Report

Ten years of the AIDS epidemic in Zululand

by Dr David Wilkinson

I have seen the face of medicine change. In 1991, when I started work as a medical officer at Hlabisa hospital in the Zululand area of KwaZulu-Natal province, South Africa, no more than a handful of cases of HIV infection had been diagnosed. Whenever we saw a suspected case in the clinic or wards, we would call our colleagues to come and see and discuss our findings. However, the trickle of illness and suffering gradually increased, so that within two to three years we were admitting several patients with HIV-related disease every day. By the late 1990s, the health service has become overwhelmed with HIV/AIDS.

More than half of all adults admitted to the acute medical service in the hospital in 1998 were HIV-infected. Tuberculosis is the commonest HIV-related disease in Africa, and in Hlabisa the number of patients with tuberculosis treated each year has increased from around 300 to over 1 200. A quarter of all children admitted to the paediatric medical service are HIV-infected. All this at a time when almost a third of pregnant women and more than half of all patients with a sexually transmitted disease are HIV-infected. The epidemic is awesome in its magnitude and its impact.

South Africa has moved rapidly from the hidden epidemic of infection to the very visible epidemic of disease. Attitudes in the community have changed just as quickly. In the early 1990s it was very difficult to talk openly about HIV/AIDS; by contrast, however, in 1998 President Mandela visited Hlabisa district on World AIDS Day and openly and frankly discussed sex, sexuality and condoms. People from the local community who are living with HIV/AIDS spoke openly about their lives and their concerns, without fear of discrimination, but with immense sadness.

We seem to be reaching a kind of plateau in the epidemic. In Zululand, at least, prevalence is beginning to level off, albeit at extremely high levels. This of course simply reflects a balance between the number of new infections and the number of deaths: there is no evidence that fewer new infections are occurring. Health systems can no longer ignore the increasing burden of disease and the impact it is having on staff, expenditure, and ability to provide a service. [*to page 2*]

General Board of Higher Education and Ministry
The United Methodist Church
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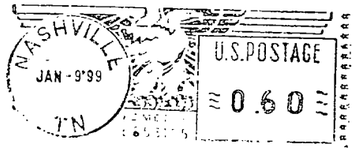

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Resources

The following materials are provided free by United Methodist Communications. They may be ordered by contacting the UMCom Order Department, P.O. Box 320, Nashville, TN 37202-0320; telephone 615-742-5110.

Countdown to 2000 and *Faces of the Future*, informational brochures; a bulletin insert featuring a student from Zaire; offering envelopes; and an Africa University "partner" button. *Graduates in Action* is a video highlighting four AU alumni/ae. For a free copy, call EcuFilm at 1-800-251-4091.

UMCom also has Africa University T-shirts for purchase. T-shirts featuring the Africa University acacia tree logo in sizes L, XL, or XXL, are available in black or white for $12 each. Contact the UMCom Order Department at the address and telephone number listed above.

Africa Praise I, a recording featuring the AU choir, is available either in compact discs ($12.95) or cassette ($8.95). Contact the Service Center, 7820 Reading Road, Cincinnati, OH 45222-1800; telephone 1-800-305-9857.

Cynthia Wilson-Felder Lights Up Carnegie Hall

More than 1,500 attended a benefit concert by the Rev. Cynthia Wilson-Felder at Carnegie Hall in New York City on Oct. 11. Musical accompanists, singers, dancers, and her five brothers joined her on stage for a rousing and inspiring program. Actor Ossie Davis served as master of ceremonies for the evening's program. Awards were presented to outstanding supporters. Two young men and two young women who represented AU students spoke to the audience about their lives and dreams. Tsidii Le Loka, a vocalist from South Africa, and her backup group also performed. Bishop Ernest S. Lyght and his staff at the New York Annual Conference Office were recognized for the months of preparation and planning that went into the making of the benefit concert.

AFRICA UNIVERSITY
A United Methodist-Related Institution

- Africa University is the only United Methodist-related, degree-granting university approved by General Conference for all of Africa.
- AU is located in Old Mutare, Zimbabwe, and is the first fully accredited private institution in Zimbabwe.
- There are four faculties or colleges including theology, education, agriculture and natural resources, and business administration.
- The university opened for classes in 1992 with 42 students and currently has an enrollment of approximately 784.
- Africa University is supported by congregations and individuals across The United Methodist Church.

AFRICA UNIVERSITY JOURNAL
February, 1999 No. 27

Jester Kenyatta

Roger Ireson, general secretary of the General Board of Higher Education and Ministry (left), with chancellor and chair of the Board of Directors, Bishop Emilio J. M. de Carvalho (right) take Rukudzo Murapa through the pledge of service and present him with the medallion as a symbol of his authority as vice chancellor. Not pictured: Bishop Felton May.

Murapa Installed As Vice Chancellor

Andra Stevens

Andra Stevens is director of information at Africa University.

"Guests and friends filled the Kwang Lim Chapel to capacity and overflowed into the amphitheater built into the hillside behind it."

Hundreds gathered in Kwang Lim Chapel on the Africa University campus Nov. 8 for the formal installation of Rukudzo Joseph Murapa as the second vice chancellor of the United Methodist-related university.

Murapa, an academic and former inter-regional adviser in the Governance and Public Administration branch of the Department of Development Support and Management Services at the United Nations, took over the day-to-day administration and leadership of Africa University in April 1998.

The inaugural events were spread over three days, Nov. 6-8, and drew persons from across the continent of Africa, Europe, and the U.S. Among them were 11 United Methodist bishops representing the episcopal areas of Eastern and Western Angola, North Katanga in the Democratic Republic of Congo, Mozambique, Nigeria, Zimbabwe, Washington D.C., Northwest Texas/New Mexico, and Indiana areas.

Senior diplomats, government officials, church leaders from many denominations, business people, and many friends from the Mutare community joined students and staff in celebrating the capital and academic development at the university and the quality of its leadership. Guests filled the chapel to capacity and overflowed into the amphitheater built into the hillside behind it.

Inaugural day opened with a worship service with Bishop Felton E. May of the Baltimore-Washington Annual Conference as guest preacher. Using scripture from Genesis and Acts, Bishop May drew parallels to the story of Joseph and touched the congregation deeply with his sermon on dreams, vision, and leadership as inspired by God.

When Africa University was just a dream in the minds of African bishops and the site of the campus was empty fields, people must have scoffed and called the idea of building a university foolish, Bishop May said, yet now we have a beautiful campus and a learning community by the grace of God.

A dedication ceremony for the University Spiritual Life Center and Wesley Foundation, named for Joyce and Richard Reeves and located in the Kwang Lim Chapel, followed the worship service. The development of the Center and Wesley Foundation is supported by a grant from the Illinois-Great Rivers Conference. (*See related story on page 3.*)

The chancellor and chair of the Board of Directors, Bishop Emilio J. M. de Carvalho and Bishops Christopher Jokomo of the Zimbabwe Area and Felton E. May together with Tove Odland representing the UMC in Norway, Doreen Tilghman from the General Board of Global Ministries, and Roger Ireson, general secretary of the General Board of Higher Education and Ministry, took Dr. Murapa through the pledge of service and presented him with the medallion as a symbol of his authority as vice chancellor. His formal induction, robing, and capping followed.

In his inaugural address, Murapa praised the pioneering effort of his predecessor, John W. Z. Kurewa. He spoke of consolidating the achievements thus far and laid out his vision for the future of Africa University.

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"This is an opportunity for us to look collectively at the circumstances and attitudes that prevent women from realizing their full potential for leadership in our societies, especially with regard to education."
—Rukudzo Murapa

A breakdown of apportioned giving by jurisdiction through Sept. 1998 is as follows:

North Central	
Apportioned	$523,735
YTD	$280,154
Percentage	53%
Northeastern	
Apportioned	$456,447
YTD	$202,945
Percentage	44%
South Central	
Apportioned	$513,073
YTD	$228.815
Percentage	45%
Southeastern	
Apportioned	$830,195
YTD	$405,192
Percentage	49%
Western	
Apportioned	$176,014
YTD	$ 77,423
Percentage	44%
Puerto Rico	
Apportioned	$ 536
YTD	$ 179
Percentage	33%

Inaugural Program Includes Symposiums

Empowerment of women for leadership and the social and economic development of private higher education in Africa were topics of discussion at two symposiums held as part of the inaugural ceremonies for Africa University's second vice chancellor, Rukudzo Joseph Murapa.

The program began Nov. 6, with a public lecture and panel discussion on "Empowering Women for Leadership in Africa: A Special Focus on the Role of Education."

Wanjiku Mwagiru of Kenya, an international consultant on the environment, gender, and development issues, highlighted some of the critical obstacles to women's empowerment in Africa.

"Private Universities in Africa: Challenges and Opportunities in the 21st Century," was the theme for a Nov. 7 symposium led by Anderason Shankanga, director of the United Nations Educational, Scientific, and Cultural Organization (UNESCO) in Zimbabwe.

Dr. Mwagiru, appointed as the first woman director of the environment in Kenya in October 1989, is keenly aware of the demands of leadership in nontraditional sectors for women in Africa.

"Economic reforms and structural adjustment programs have eroded many of the basic economic and social gains made by African women in the past three decades leading them to redirect their initiatives and energies towards survival," she said.

The lecture on leadership for women was sponsored by the Women's Division of the General Board of Global Ministries and was held in honor of Mai Gray, a former president (1976-80) of the Division.

In spite of the obstacles, Dr. Mwagiru was optimistic and excited about the potential for women's leadership in the transformation of Africa. In both her presentation and the discussion that followed, early childhood education (as provided by mothers and others in the home) and formal and informal education were raised as crucial factors in women's empowerment.

Bexley Kenyatta

Mai Gray, former president of the Women's Division, General Board of Global Ministries, talks with Rukudzo Murapa, AU vice chancellor before a symposium that addressed empowering women for leadership in Africa.

"This is an opportunity for us to look collectively at the circumstances and attitudes that prevent women from realizing their full potential for leadership in our societies, especially with regard to education," said Rukudzo Murapa, AU's vice chancellor.

From its inception, Africa University has given particular attention to ensuring access to higher education for young women and to preparing them for leadership in their respective fields. More than 40 percent of students at Africa University are women.

In 1995, the Africa University Board of Directors voted to establish the Mai H. Gray Endowed Chair and the Women's Division agreed to create a permanent fund to support the chair and provide resources for lectures, research, and outreach activities which focus on women and children.

Mrs. Gray, an elementary school teacher and instructional facilitator in the U.S., was honored with a grant of $50,000 for formal and informal education of women and children in transition in Zimbabwe, Namibia, and South Africa on leaving the presidency of the Women's Division. She chose Africa University to be the recipient of a portion of the funds designated in her honor.

"The Women's Division and Africa University are forming a partnership that will creatively provide women with an opportunity for expanding their horizons and making a difference in the world. This initiative will empower women in areas of leadership development, spiritual growth, and justice issues," Mrs. Gray said.

The Nov. 7 symposium, led by Anderason Shankanga, brought together university vice chancellors and other senior administrators, leaders in business and industry, and a number of academics from across Africa for discussions on the future of private higher education initiatives on the continent.

Discussions focused on topics such as the relevance of programs, financial management, governance and management structures, and government/university relations in Africa. Presenters and participants paid particular attention to issues of access, relevance, and sustainability.

Africa University hopes to make a significant contribution to the ongoing discourse on private universities, their role in national development planning, and their ability to help meet the urgent needs of African communities and economies.

Construction Begins on Residence Hall

Officials at Africa University broke ground on Nov. 8 for construction of another 3-story student residence hall. The building project is being funded by United Methodist churches in the North Indiana Annual Conference.

The South Indiana Annual Conference is in the middle of a similar fund-raising campaign to build another 3-story hall. The conferences and their bishop, Woodie White, are committed to assisting Africa University in meeting the demand for student housing.

Site preparation work for the university library complex has been completed and the university expected to begin construction of phase one of the multimillion dollar project before the end of 1998. Phase one of the university library complex will house the stacks, offices, an archive section, and a small exhibition space.

Provision has also been made for a bindery and book restoration unit. Phase one will provide space for more than 200 readers at a time.

The new construction—the residence hall, library complex, and staff housing—comes at a crucial time because campus residences are full and teaching space is at a premium. The university has about 475 students living on campus this academic year. The majority are undergraduates and are living three to a room.

Rukudzo Murapa, Bishop Woodie White, center, and Bishop Christopher Jokomo, right, at the groundbreaking of new residence hall.

Photos by Bexley Kenyatta

Bishop Joao Somane Machado of Mozambique (first on left) prepares to cut the ribbon on the door of the Wesley Foundation Center as Bishop Christopher Jokomo, Bishop Woodie White, Richard Reeves, Rev. Jack Cramer-Heuerman, Ray Owens, LaVon Wilson (left to right), and other guests observe the ceremony.

Wesley Foundation Dedicated to Reeveses

Following the inauguration of the vice chancellor on Nov. 8, the dedication of the University Spiritual Life Center and Wesley Foundation, named for Joyce and Richard Reeves, was held in AU's Kwang Lim Chapel.

Reeves, a consultant to the building and grounds committee of the AU Board of Directors, has been involved from the beginning with construction and the finding of water resources at Africa University.

In naming the Wesley Foundation Center in honor of Reeves and his wife, Joyce, the Illinois-Great Rivers Conference has recognized their lifelong commitment to mission service in the church that began with Wesley Foundation activities during their college days.

Although the major emphasis of the AU Wesley Foundation will be on programs for students' recreation and welfare, opportunities will also be provided for faculty and administrators to interact with students outside classroom settings.

Keep the dream alive!

Give to the Africa University Fund

AFRICA UNIVERSITY

Here is how you can help:

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General Council on Finance & Administration
The United Methodist Church
1200 Davis Street
Evanston, Illinois 60201

For information about Africa University resources and fund raising:

AU Development Office
P.O. Box 871
Nashville, TN 37202
615-340-7438
FAX 615-340-7290

Update on Funding

From Jan. 1, 1989, through Oct. 31, 1998, Africa University receipts are as follows:

Apportioned Funds
$18,874,707

World Service Special Gifts (#03-01-88)
$9,535,732
(endowment)

Library Fund
$168,413

Capital/Other Gifts
$500,340
(Jan.-Nov. 1998)

See the box on this page for how you can give to Africa University and be a part of this important churchwide effort.

Please encourage your church to send in their 1999 apportionments in full!

Africa University apportionment receipts from local churches are used for the university's operational needs.

Don't forget that you can remember Africa University in your will.

Gateway to Africa [Pamphlet] [8p]

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GATEWAY TO AFRICA

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HEADLINE: Parts of Africa Showing H.I.V. In 1 in 4 Adults

BYLINE: By LAWRENCE K. ALTMAN

DATELINE: GENEVA, June 23

BODY:

In certain areas of Africa, one in four adults is infected with the virus that causes AIDS, and around the world the disease now rivals the greatest epidemics of history, according to a United Nations report issued today.

In the first country-by-country analysis of the disease, the United Nations said that last year 30 million people carried the virus, H.I.V., and that 21 million of them were in Africa.

Countries south of the Sahara account for the world's 21 highest rates of H.I.V. among adults aged 15 to 49 years, the most sexually active segment of the population. In 13 of the countries, H.I.V. has infected at least 10 percent of adults, and in Botswana and Zimbabwe, a quarter of adults are infected, a rate that even an expert described as "shocking."

The report, released ahead of the 12th international AIDS conference that begins here on Sunday, paints the gloomiest pictures of the H.I.V. epidemic since it was first recognized in 1981.

AIDS is hitting Africa so fiercely that it now compares to the great epidemics of history -- the Black Death of the Middle Ages that killed 20 million people, or one-quarter of Europe's population, in four years; and the influenza pandemic of 1918-1919 that killed 20 million people, including half a million Americans.

But where plague and influenza killed in days, death from untreated AIDS takes about a decade, making it a quieter epidemic that national leaders have too easily ignored, officials from the United Nations AIDS Program said.

"If H.I.V. killed as rapidly as plague and influenza, the epidemic would be controlled by now," Dr. Peter Piot, the head of the United Nations AIDS Program, said in an interview.

The report contained a glimmer of good news, showing that infection rates have been slowed in countries that have adopted strong prevention programs, including Senegal, Tanzania, Thailand and Uganda.

But Dr. Piot and other officials warned that South Africa, Namibia and other African countries could soon reach a 25 percent adult infection rate unless national leaders undertook similar programs.

Infection rates exceed one-third of the adults in some major African cities and reach 70 percent of women tested in some prenatal clinics. Many infected wc n who go without treatment pass the virus on to their babies.

The overwhelming majority of the infected Africans are doomed to die from AIDS, United Nations officials said, because they live in countries that cannot afford the costly combinations of drugs that have helped keep the virus in check among infected people in developed countries.

The African figures compare with a worldwide adult H.I.V.-infection rate of 1 percent for adults and 0.76 percent in the United States. Moreover, officials said, 90 percent of the African patients probably do not know they are infected because testing is not widely available.

Worldwide last year, 5.6 million people were newly infected while 2.3 million died from AIDS. AIDS is now on the verge of moving into the top five leading causes of death in the world. The viral infection now kills as many people as malaria and is second only to tuberculosis, which itself is a common complication of AIDS.

Dr. Piot, a Belgian who has worked with AIDS in third world countries for more than 15 years, called the new H.I.V. figures staggering and said he was "shocked" when he learned that 25 percent of an entire country's adults were infected. At first, both Dr. Piot and Dr. Bernhard Schwartlander, the United Nations epidemiologist who led the analysis, said they suspected a statistical error.

But checking found them accurate and erring on the side of underestimates, they said. It took the United Nations AIDS program more than a year to gather and verify the figures with each country, and the figures on AIDS are probably the most reliable of any international health statistics, Dr. Piot said.

Health officials have been hampered since AIDS was first recognized in 1981 in getting a handle on such information because of the notoriously poor quality of health statistics in most of the world and the early reluctance of many African and other countries to acknowledge the presence of the disease within their borders.

The United Nations researchers obtained data from published material, surveys conducted in clinics and health department data. Among the methods used was computer modeling, involving census data and infection rates, to verify trends reported by the countries.

Dr. Piot said the epidemic could eventually be controlled if other countries matched successful prevention programs.

Uganda was the first country to respond to a huge burden of H.I.V. infection, and it has cut H.I.V. prevalence by more than a quarter, to 9.5 percent in 1997 fr 13 percent in 1994.

Thailand, which has experienced what the United Nations said was probably the best-documented epidemic in the developing world, has cut its prevalence by nearly 15 percent -- to 2.3 percent in 1997 from 2.7 percent in 1994. A drop in new infections was noted especially among sex workers and their clients.

"Even in the industrialized world, reductions of this magnitude are virtually unheard of," Dr. Piot said.

Senegal instituted campaigns for safer sex that has kept its infected rate low at about 2 percent. "Senegal acted before it had a major problem, but there are not enough of those countries," Dr. Piot said.

But more than money will be needed to match such efforts elsewhere, he said. "The overriding need is political courage -- deciding to move ahead with effective approaches -- despite cultural constraints -- such as promotion of condom use, sex education in schools and widespread health education programs," he said.

As H.I.V. is spread, it insinuates itself into communities little troubled in the past and strengthens its grip on areas where AIDS is already the leading cause of death.

In Botswana, the infection rate has more than doubled to 25.1 percent in 1997 from 10 percent in 1992. Surveys have found 43 percent of pregnant women infected in 1997 in the major urban center of Francistown. In 1995 in Harare, the capital of Zimbabwe, 32 percent of pregnant women were infected.

In one town on the Zimbabwe-South African border, 70 percent of women attending prenatal clinics in 1995 were found to be infected.

H.I.V. rates are lower in Asia, Eastern Europe and South America. But an alarming trend is the doubling and tripling of transmission rates in some countries in these areas since 1994, including Russia, Ukraine and Moldova. Because over half the world's population lives in these regions, "small differences in rates can make a huge difference in the absolute numbers of people infected," the United Nations report said.

In expressing alarm about the widening gap in infection and death rates between industrialized and developing countries, Dr. Piot said the gap "shines the spotlight on the have-nots of the epidemic."

The United Nations group attributed the gap to inadequate measures to stop transmission of H.I.V. and to make available the combinations of anti-H.I.V. drugs that help forestall development of deadly AIDS-related infections and cancers.

Last year, deaths from H.I.V. left 1.6 million children without at least one parent. From the time the epidemic was first recognized in 1981 to the beginning of 1998, 8.2 million children lost their mothers to AIDS. Many also lost their fathers as well. In East Africa, 40 percent of children 15 years or younger have lost their mother or both parents.

"As the number of orphans grows and the number of potential care-givers shrinks, traditional coping mechanisms stretch to the breaking point," the report said.

The United Nations program cited four reasons why the infection rates are so high in Africa.

One is that more women of childbearing age are H.I.V.-infected in Africa than elsewhere. A second is that African women have more children on average than those on other continents. Thus, one infected woman may pass the virus on to a higher average number of children.

A third reason is that nearly all children in Africa are breast-fed. But breast-feeding is thought to account for between a third and a half of all H.I.V. transmission from mother to child.

A fourth reason is that new drugs are less readily available than in the industrialized world.

Many experts also believe that the rate is high because other sexually transmitted diseases like syphillis, which are known to facilitate transmission of H.I.V., often go untreated in poor countries.

The United Nations said it had seen early-warning signs that epidemics of similar magnitude could occur in Asian countries, where H.I.V. has been a relative late-comer. But the report said the figures for Asia were less reliable than elsewhere because only a few Asian countries have developed sophisticated systems for monitoring the spread of the virus.

India has the largest number of H.I.V.-infected people -- four million -- in the world.

One survey in Pondicherry found 4 percent of pregnant women infected. The prevalence of infection among truck drivers in Madras quadrupled to 6.2 percent in 1996 from 1.5 percent in 1995. In Manipure state, 73 percent of the patients in a clinic for injecting drug users were infected in 1996.

Although H.I.V. has infected fewer than 1 percent of adults in India, the figure is 10 times higher than in neighboring China.

Two major epidemics are occurring in China, the United Nations said. One is among injecting drug users. The other is among heterosexuals on the prosperous eastern seaboard where prostitution is re-emerging as the gap grows between rich and poor.

The incidence of sexually transmitted diseases in China has soared in recent years. Health officials regard the trend in sexually transmitted diseases as a warning sign of H.I.V. rates because sexually transmitted diseases can enhance the spread of the virus.

With a vaccine against H.I.V. a distant hope, Dr. Schwartlander said, "the AIDS epidemic has no end in sight."

GRAPHIC: Photo: Many H.I.V.-infected women who go untreated in Africa pass the AIDS virus on to their children, as did this woman in Nairobi, Kenya, shown with her dying two-year-old child, the third she will have lost to the disease. (Reuters)(pg. A6)

Map/Chart: "The Geography Of H.I.V."
Map shows percentage of people in each country ages 15 to 49 infected with H.I.V. or suffering from AIDS in 1997. Map highlights nation with the highest percentage, Zimbabwe, at 25.8%. Map also highlights the spread of H.I.V. in

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Human Immunodeficiency Virus Infection Dynamics in East Africa Deduced from Surveillance Data

Rand L. Stoneburner,[1] Daniel Low-Beer,[1] George S. Tembo,[2] Thierry E. Mertens,[1] and Godwill Asiimwe-Okiror[3]

Knowledge of human immunodeficiency virus type 1 (HIV) incidence patterns in East African HIV epidemics like that in Uganda is fundamental for guiding interventions and forecasting the future course of the pandemic, yet they are difficult to determine from surveillance data. The authors deduce hypotheses of HIV incidence dynamics from birth cohort analyses of Ugandan acquired immunodeficiency syndrome (AIDS) incidence from 1987 to 1992 and from the age and sex distribution of sexually transmitted disease: an age dependency for HIV risk; a period effect of varying HIV incidence growth; and a replenishment of HIV-susceptible populations through demographic renewal. The hypotheses are tested by incorporating them into a model that generates patterns of HIV incidence, prevalence, and AIDS cases that are consistent with empiric data. When applied to Uganda, the modeled HIV incidence is characterized by a short temporal concentration of high incidence, followed by a decline, stabilization, and concentration in younger ages. The ensuing HIV dynamics result in a rapid build-up and subsequent stabilization of prevalence and mortality in years 10 and 13, respectively, after epidemic onset. When this model is used to forecast scenarios from 1980 to 2000, HIV prevalence declines in some populations, which is different from earlier scenarios. The techniques presented provide an empiric basis to better direct interventions, forecast epidemic impacts, and evaluate determinants of changing incidence and prevalence patterns. *Am J Epidemiol* 1996;144:682–95.

cohort effect; cohort studies; epidemiologic factors; forecasting; HIV infections; models, theoretical; population surveillance

Since its recognition in the early 1980s (1), the pandemic of human immunodeficiency virus type 1 (HIV) has most severely affected sub-Saharan Africa. In some areas, HIV prevalence in the general population has attained levels as high as 30 percent (2, 3), and the proportion of adult mortality related to HIV infection has been estimated at 50 percent (4–6). In countries with longer experiences of the epidemic (7, 8), there are reports of stabilization of HIV seroprevalence in restricted groups (9–11) and of declines in HIV prevalence and incidence in young adults in a rural district of Uganda (12). It is important to develop methods to determine the basic HIV incidence dynamics that have created these trends and will sustain further spread. This will contribute to better strategies to focus prevention to new infections and methods to forecast the epidemic in sub-Saharan Africa and other areas of the world.

The objective of the paper is to apply methods to national surveillance data to define the underlying patterns of HIV incidence that have resulted in the distributions of acquired immunodeficiency syndrome (AIDS) cases and HIV prevalence. We analyze Ugandan AIDS case reports using birth cohort methodology (13, 14). The magnitude and growth rates of AIDS incidence in a birth cohort are a function of the distribution of past HIV incidence and the incubation time to AIDS (15). Thus, this method offers a window into the past HIV incidence experience of cohorts, identifying age patterns and periods of particularly high or lower HIV incidence density. It provides an empiric basis on which hypotheses explaining antecedent patterns of HIV incidence by age, sex, and period can be formulated.

We formulate three simple hypotheses regarding HIV incidence patterns deduced from our analyses.

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Abbreviations: AIDS, acquired immunodeficiency syndrome; HIV, human immunodeficiency virus type 1.

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First, HIV incidence patterns are highly influenced by differential age- and sex-related sexual behavior. Second, the intersection of this pattern of sexual activity and epidemic spread of HIV results in a relatively brief period of high growth in HIV incidence followed by saturation of the most susceptible age groups in many areas. Third, demographic renewal replenishes the susceptible population, resulting in a substantial shift of infection to younger cohorts. The validity of these hypotheses is tested by incorporating them into an epidemiologic model and comparing its output to surveillance data on AIDS cases and HIV prevalence.

MATERIALS AND METHODS

We analyzed AIDS cases reported to the Uganda National AIDS Control Program from 1987 to 1992 among persons aged 12 years and older by 5-year birth cohort, sex, and year of diagnosis. We also analyzed the age and sex distributions of 5,240 persons who sought treatment for any sexually transmitted disease at clinics in Kampala, Uganda, from 1989 to 1991, and who were enrolled in a study for HIV risk factors (16). Trends in reported AIDS cases were smoothed using 5-year moving averages that satisfactorily reduced bias associated with age digit misreporting (17, 18). The annual AIDS incidence was then reconstructed to minimize bias from suspected differential surveillance coverage and resultant underreporting of AIDS until 1988 compared with reports from 1989 to 1992 (19, 20). A two-term polynomial was fitted to AIDS case reports from 1989 to 1992 by sex, and the onset of quadratic growth in AIDS incidence was set to 1982, 1983, and 1984 (21). If $A(t)$ are the reported AIDS cases and $Y(t)$ are the modeled AIDS cases for year t, where t is the number of years since the beginning of the epidemic, then $Y(t)$ took the quadratic form:

$$Y(t) = a + bA(t) + c[A(t)]^2$$

with $A(1983) = 0$ (for the year of onset of AIDS incidence). Least squares methods were used for the solution of the equations. Using different years of onset of AIDS incidence, where $A(1982, 1983, \text{or } 1984) = 0$, did not vary the values of $Y(t)$ for the years in the analysis by greater than 10 percent.

AIDS cases were then disaggregated into 5-year birth cohorts, and the annual AIDS incidence was modeled separately for each birth cohort to reconstruct the trends and growth rates in figure 2. Least squares methods were used to fit all possible polynomial models with terms of at most the third degree. In each case, a two-term polynomial was chosen to capture the basic aspects of increasing, decreasing, or stabilizing trends, since the fit with AIDS case data, as measured by r^2 (the squared multiple correlation coefficient), was generally within 5 percent of the fit for third order polynomial models. Correlation between the resulting 14 models and the reconstructed AIDS case data showed an average adjusted r^2 value of 0.86, and all cohorts born in 1960 or at a later time exhibited an r^2 of at least 0.9, with slightly lower fits in some older cohorts, possibly related to smaller numbers of AIDS cases.

An epidemiologic model was created to test hypotheses regarding antecedent HIV incidence patterns deduced from the cohort analyses of AIDS cases. Using inputs based on readily available surveillance data, the model simulates three processes: HIV infection, the natural history of disease, and aging and natural mortality. Its output includes HIV incidence and prevalence, as well as AIDS cases and deaths, by sex, age, and birth cohort. HIV incidence is generated from a profile of sex- and age-dependent risk for sexual transmission and an epidemic growth curve. The age profile of risk of HIV infection related to sexual activity was developed by the analysis of Kampala sexually transmitted disease data by sex and age, divided by the age-specific Kampala population from the 1991 Uganda census (22). This provided sexually transmitted disease rates S_a for each age group a (i.e., an age profile of risk for sexually transmitted disease, with a varying as age in single years from 10 to 60) that were multiplied by a constant across all ages to give a peak age-specific HIV prevalence of 26 percent for females and 24 percent for males to reflect the 1987–1988 Ugandan national HIV serosurvey (giving an overall 15 percent adult HIV prevalence) (unpublished serosurvey data, World Health Organization, country files, National AIDS Control Program, Ministry of Health, Uganda).

HIV incidence was modeled in relation to S_a (the risk of exposure to HIV by age) to a saturation condition (relating S_a to past HIV incidence that has already affected those at risk) and to a process of demographic renewal of the sexually active population. The initial growth in incidence to reach peak exposure S_a follows a logistic curve:

$$S_{at} = S_a(x + e^{t-y})^{-1}$$

where x and y are constants, $x < 1$, y determines the rate and length of rapid epidemic growth, and t is a variable representing the time since the beginning of epidemic growth in HIV incidence (year 1980). The saturation condition used in this paper related HIV

incidence (I_{at}) to S_{at} minus the cumulative past HIV incidence in a cohort. The population at risk of HIV infection is renewed because of aging into sexual activity, where N_{at} is the number of people at age a and time t, and because of a proportion E across all ages (E was set at a low rate for the model of 5 percent of S_{at}, so that demographic renewal is the major source of new susceptibles). Thus,

$$I_{at} = [S_{at} - \sum_{n=1}^{t} (I_{(a-n)(t-n)} / N_{(a-n)(t-n)}) +$$

$$\sum_{n=1}^{t} (E \cdot S_{(a-n)(t-n)} / N_{(a-n)(t-n)}) + E \cdot S_{at}]N_{at}$$

N_{at} is defined by the 1991 Ugandan census and by applying annual non-AIDS mortality according to the relevant Coale-Demeny West life table (23, 24) for a mortality rate in the first year of life $Q(0) = 0.104$–0.108 (25) and annual aging and age-specific fertility according to the Uganda 1991 census. After S_{at} has reached its peak value, the saturation term in the equation dominates and I_{at} is determined largely by demographic renewal assuming that behavioral and biologic factors maintain S_{at} at a constant level (the baseline scenario). The above equation leads to a period of HIV prevalence stability, where infection due to demographic renewal occurs as cohorts age through sexual activity, S_{at}, and due to E, the expansion parameter renewing susceptibles via migration into the population or into the age profile of risk (S_{at}) at later ages.

The HIV prevalence rate is calculated by accumulating past incidence in a cohort and subtracting those who have died:

$$P_{at} = (\sum_{n=1}^{t} I_{(a-n)(t-n)}(1 - d_n))/N_{at}$$

where d_n is the proportion who die because of AIDS n years after HIV infection, including any difference in natural mortality between those with and without AIDS. The incubation interval between HIV infection and the development of AIDS is modeled using a Weibull distribution (26, 27):

$$A_{t+n} = I_t \cdot \exp(-yn^c)$$

where A_{t+n} is the incidence of AIDS from I_t HIV infections n years later, c and y are constants, and the median time from AIDS to death is set at 1 year. (Further details of the model can be obtained from R. L. S. and D. L.).

We generated two different 20-year epidemic scenarios (differing in the course of HIV incidence after year 8) involving an onset of HIV epidemic spread in 1980 with HIV incidence increasing rapidly over 5 years, a median incubation period to AIDS of 7 years, and 1-year median AIDS survival (28). The output includes sex, age, and cohort-specific HIV incidence, prevalence, and AIDS incidence as well as HIV prevalence in a simulated population of pregnant females (mean and modal age of 28.7 years and 23 years, respectively). The inclusion of demographics and fertility in the model allows estimates of fertility-weighted female HIV prevalence to be calculated for comparisons with HIV surveillance data in antenatal clinics. Fertility-weighted female HIV prevalence, P_f, is therefore calculated as:

$$P_f = \Sigma(N_a \cdot P_a \cdot F_a) / \Sigma(N_a \cdot F_a)$$

where F_a is the age-specific fertility rate, and all population, N_a, and HIV prevalence, P_a, are parameters referring to females. In the first scenario (baseline), the overall sex- and cohort-specific incidence rates calculated in 100 person-years of observation (as described in table 2 for cohorts born between 1945 and 1979) are applied for 12 years (1980–1992), after which each 5-year birth cohort entering the period of risk for HIV (at the onset of sexual activity estimated to be at age 14 in males and age 12 in females) experiences the same incidence rates as the preceding cohort. The second scenario (incidence reduction) has identical incidence rates to that of the baseline scenario, except that a 3 percent annual reduction in HIV incidence affecting all cohorts is introduced in year 8 (i.e., 1988). The validity of the model was assessed by comparing model outputs to AIDS case data by age, sex, and birth cohort, and the Uganda national HIV prevalence data by sex and age (see figure 3). The observed and modeled AIDS case trends and rank orders by birth cohort were compared using Pearson's product moment and Spearman's rank correlations (29).

To assess the plausibility of input values for the model deduced from the cohort analyses, sensitivity analyses of model inputs were used to test combinations of incubation distributions, years of epidemic onset, time periods of high HIV incidence growth, and age profiles of risk (S_a), comparing outputs with Ugandan surveillance data on AIDS case trends by birth cohort and HIV prevalence. Median incubation intervals of 5, 7, and 9 years (i.e., epidemic onset from

1977, 1983, and 1985), periods of high HIV incidence growth of 5, 7, and 9 years, were used. The age profile of risk, S_a, was varied so that the modal age of highest risk occurred 4 years earlier and 4 years later than in the baseline scenario. The results of simulations involving holding one input variable constant and then limiting the value of others to best fit modeled and empiric data with respect to birth cohort trends by sex and rank order and 1994 estimated HIV prevalence levels are compared with the baseline scenario and are shown in table 1.

RESULTS

The Uganda National AIDS Control Program received reports of 33,445 adult AIDS cases by January 1993, with rapid increases in annual incidence from 1987 to 1989 followed by relative stability in incidence from 1990 to 1992. Females comprise 52 percent of AIDS cases and an increasing proportion of all reports (30).

A comparison of the proportions of annual reported AIDS cases in the years 1987–1992 by sex, for each 5-year birth cohort from 1930–1934 to 1975–1979, and cases of sexually transmitted disease by sex and age (age of sexually transmitted disease cases and age of AIDS birth cohorts in 1984) is shown in figure 1. The proportionate distributions of AIDS cases from 1987 to 1992 by birth cohort show unimodal, positively skewed distributions for both sexes. The peak incidence of AIDS cases occurs in the 1960–1964 male cohorts and the younger 1965–1969 female cohorts, with a mean difference of 4 years. From 1987 to 1992, consistent changes in the annual proportional distribution of AIDS cases by birth cohort occur around the modal cohorts, with increases in birth cohorts younger than the mode and decreases in cohorts older than the mode in both males and females.

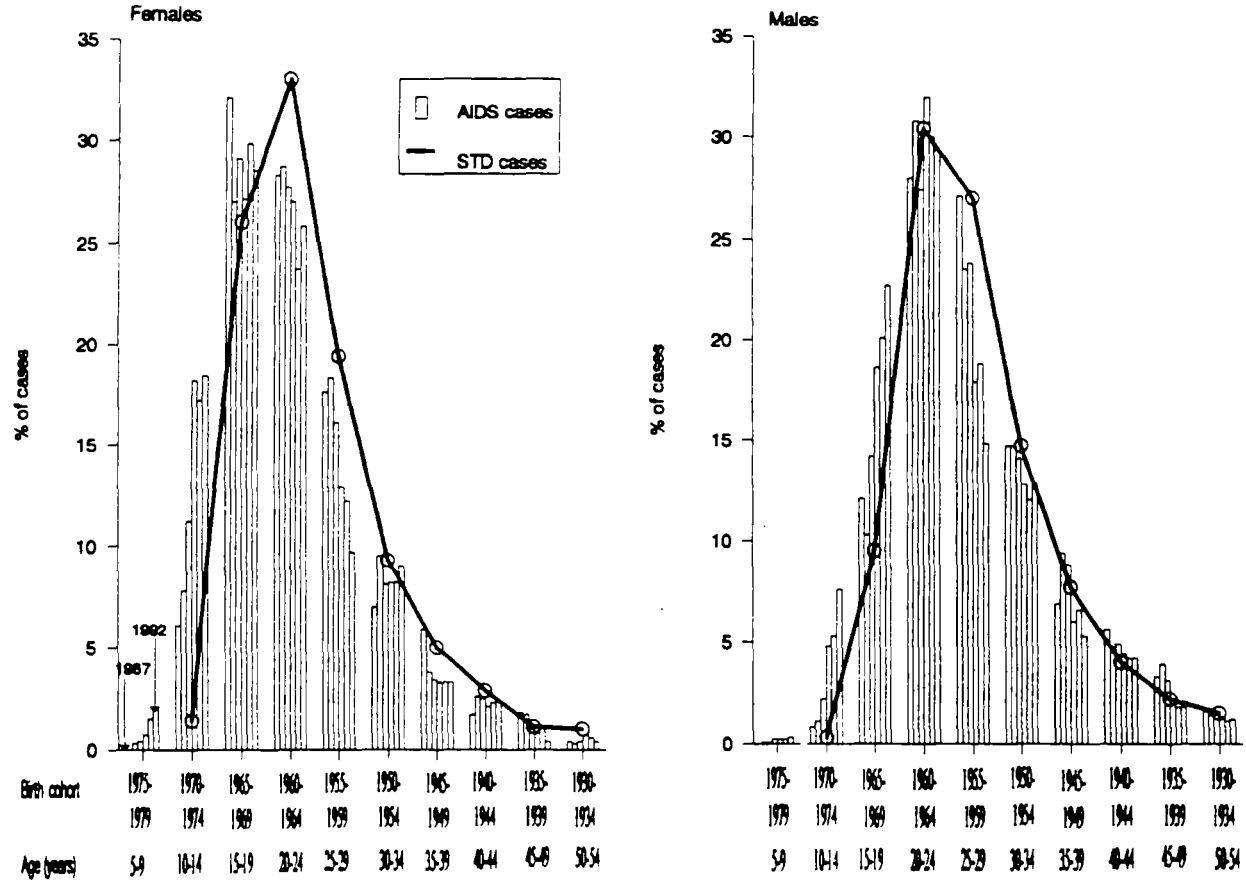

FIGURE 1. Uganda acquired immunodeficiency syndrome (AIDS) cases reported from 1987 to 1992 analyzed by year of diagnosis and birth cohort and cases of sexually transmitted disease (STD) in clinic attendees in Kampala, Uganda, during 1989–1991, analyzed by age. Bars, annual proportions of incident AIDS cases from 1987 to 1992 corresponding to each 5-year birth cohort (and age in 1984) for females and males; solid line, age distribution of female and male sexually transmitted disease cases.

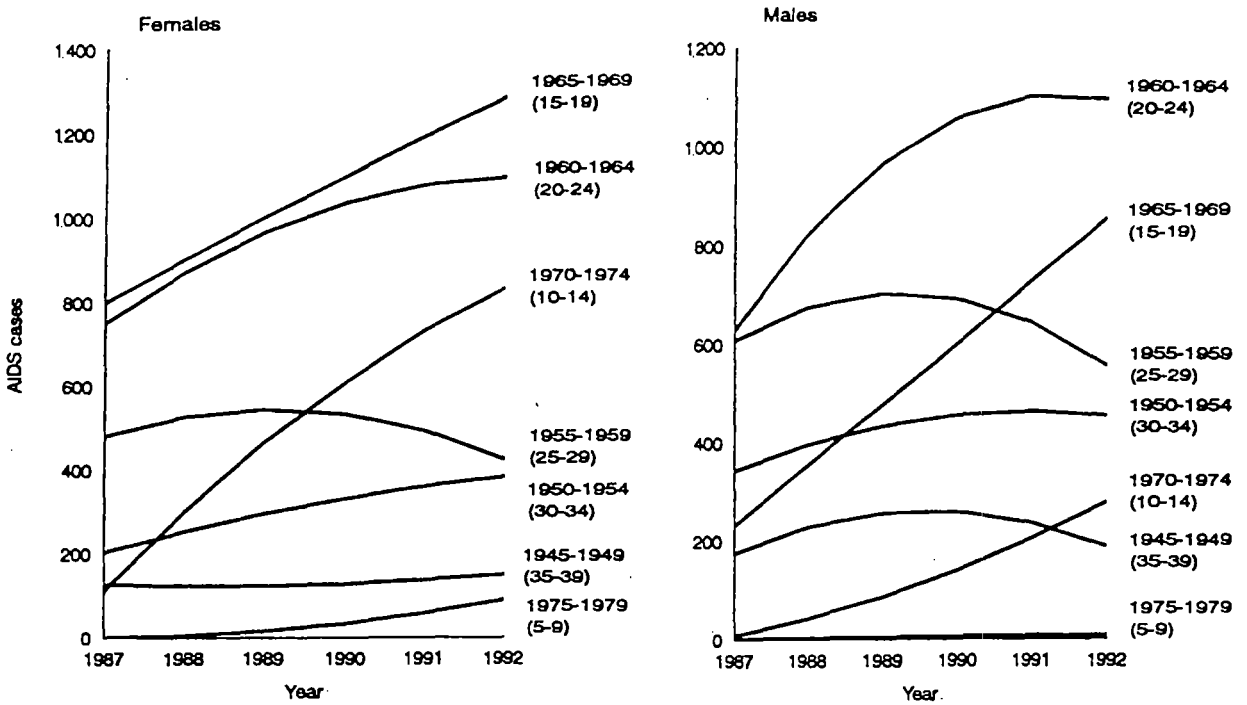

FIGURE 2. Reconstructed trends in annual acquired immunodeficiency syndrome (AIDS) incidence reported in Uganda from 1987 to 1992, by birth cohort (and age group in 1984) for females and males.

The comparison of sex- and age-specific distributions of sexually transmitted disease and AIDS cases by birth cohort illustrates an association between the age of acquisition of a sexually transmitted disease (age profile of risk) and the risk for AIDS. The age-specific distribution of sexually transmitted disease fits the overall age distribution of AIDS by birth cohort referenced to their age in 1984; however, from 1987 to 1992, there is an increasing proportion of AIDS cases in cohorts younger than the mode that exceed this profile. We propose the following explanatory phenomena: a period effect, of high incidence growth, causing AIDS cases in modal and older cohorts to be closely related to the age-specific profile of sexual risk of HIV infection during the mid-1980s; and a more recent diffusion of HIV incidence to younger cohorts evidenced by their increasing proportions of AIDS cases.

Differential trends of AIDS incidence by birth cohort in males and females are presented in figure 2. In males, the 1960–1964 cohort (aged 20–24 years in 1984) contributes the highest AIDS incidence for each year, but its rate of growth slows, stabilizes, and declines slightly by 1992. Growth rates in AIDS incidence are greatest in the younger 1965–1969 and 1970–1974 male cohorts, which exhibit at least constant linear increases through 1992. There is a consistent shift in AIDS incidence growth from older to younger cohorts, with the incidence in 1965–1969 cohorts surpassing the incidence in 1950–1954 cohorts in 1988–1989, and similarly surpassing the incidence in the 1955–1959 cohort in 1990–1991. The rate of growth in AIDS incidence in the 1965–1969 cohort exceeds that of the modal 1960–1964 cohort from 1990 onward; AIDS incidence in the 1965–1969 cohort in 1992 is at least at the level of the 1960–1964 cohort at the same age 5 years earlier. Females exhibit similar overall trends but a different rank order, with AIDS incidence shifted to one cohort younger. Unlike males, the female 1975–1979 cohort shows signs of accelerating growth in AIDS incidence by 1991, at an age of 12–16 years. Diverse trends in cohort AIDS incidence indicate that earlier cohort HIV incidence differed in magnitude and time. The HIV incidence curves of cohorts with declining or stabilizing AIDS incidence suggest ones that have peaked earlier and declined, while those of cohorts with increasing AIDS incidence suggest an HIV incidence curve of later onset that may have peaked more recently or may still be increasing.

From these surveillance data, we deduce hypotheses of prior HIV incidence dynamics: a period effect of varying HIV incidence growth; an age dependency for HIV risk; and a replenishment of HIV-susceptible

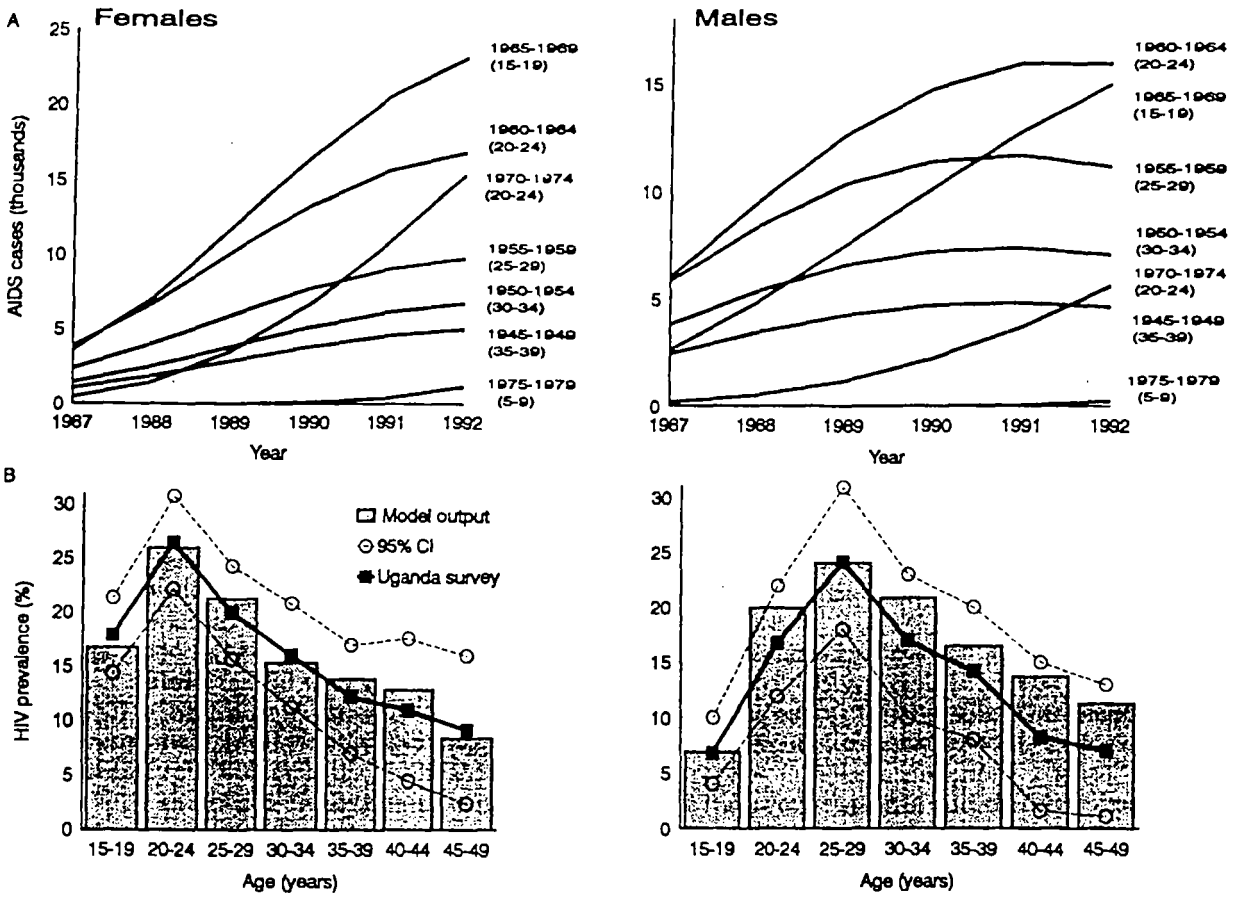

FIGURE 3. Acquired immunodeficiency syndrome (AIDS) incidence and human immunodeficiency virus type 1 (HIV) prevalence levels in Uganda, as generated by the epidemiologic model in a baseline scenario simulating an epidemic beginning in 1980 and reaching in 8 years an overall population HIV prevalence level of 15% with peak age-specific prevalence of 26% in females aged 20–24 years and of 24% in males aged 25–29 years. A, trends in annual AIDS incidence generated by the model by birth cohort (and age in 1984), for females and males, from 1987 to 1992; B, a comparison of age-specific HIV prevalence rates in 1988 as generated by the model (bars) with the age-specific prevalence from the results of a national population survey of HIV prevalence performed in Uganda in 1987–1988 for females and males (solid line) and estimated 95 percent confidence interval (broken lines). CI, 95 percent confidence interval.

populations through demographic renewal. The concentration of AIDS incidence in modal cohorts (males born in 1960–1964, aged 20–24 years in 1984, and females born in 1960–1969, aged 15–24 years in 1984), together with stabilizing or declining AIDS incidence trends in cohorts born before 1965, suggests a period effect of maximum HIV incidence experienced by these cohorts during the first 5 years (1980–1985) of the epidemic, after which HIV incidence most likely declined. The correlation of the cohort distribution of AIDS incidence with the age distribution of sexually transmitted disease relates the period effects of varying levels of HIV incidence experienced by cohorts to age-dependent sexual risk. The hypothesis of replenishment of HIV-susceptible populations through demographic renewal is suggested by the finding that the age profiles of sexually transmitted disease and AIDS distributions were similar in modal and older cohorts, while in younger cohorts, born between 1965 and 1979 (aged 5–19 years in 1984), AIDS incidence exceeds this profile, and trends in AIDS incidence exhibit at least linear growth. This suggests a more recent diffusion of new HIV infections to younger persons as they age into a period of increased sexual activity and of increased HIV risk. Thus, these hypotheses are incorporated into an epidemiologic model for testing and validation.

The HIV incidence patterns generated by the baseline model scenario produce trends in AIDS incidence by birth cohort that show validity against the trends in AIDS case data (figure 3A). The different modal cohorts (1960–1964 for males and 1965–1969 for females), rank orders of cohorts by sex, and trends of cohort growth curves and crossing points are generally

well replicated. The rate of increase in AIDS incidence in younger cohorts in the model is slightly higher than empiric trends, particularly for males. A comparison of HIV prevalence produced by the model with data from the Ugandan HIV prevalence survey in 1987–1988 shows similar distributions of prevalence by age and sex (figure 3B).

Sensitivity analyses of model inputs (incubation distributions, time periods of high HIV incidence growth, age profiles of HIV risk, and years of epidemic onset) indicate that the baseline model input parameters are plausible, producing the only scenario with a Pearson's correlation r with AIDS case data greater than 0.9; others range from 0.46 to 0.88. The outputs of model simulations with a 9- and a 5-year median incubation period, a 9-year period of high HIV incidence growth (1980–1989), a 4-year younger age profile of risk, S_a, and an epidemic onset in 1985 are compared with those from the model using the baseline inputs (7-year median incubation period, 5-year period of HIV incidence growth, S_a as generated from sexually transmitted disease data, and an epidemic onset in 1980) (table 1). It is evident that alternative model inputs produce inferior fits to the empiric data, despite varying all other parameters to maximize the fit (e.g., using a shorter incubation period with the 9-year period of high HIV incidence growth). The five scenarios in table 1 show that 1994 HIV prevalence rates in the general population would range from 13.7 percent to 20.3 percent. Furthermore, a median incubation interval of 9 years, even with epidemic onset in 1977, is unable to produce stabilizing AIDS incidence in older cohorts or the correct cohort rank order. Extending the period of high HIV incidence growth beyond the first 5 years of the epidemic (i.e., after 1985), even with a shorter median incubation period of 5 years, produces a different rank order of cohorts. The age profile of risk (S_a) is influential on model outputs, particularly in the ages from onset to peak sexual activity, and variations to shift its modal value by 4 years in either direction produce outputs that exhibit poorer fits to HIV prevalence rates by age. In addition, maintenance of overall prevalence 15–20 years after epidemic onset is sensitive to the size of the population aged 10–20 years (as it moves into a period of HIV risk). Overall, the statistical correlation of the model output data with AIDS surveillance data by birth cohort, rank order, and crossing points is lower in all sensitivity tests than the input values in the baseline scenario, which show a Spearman's rank and Pearson's correlation r of 0.88 and 0.89 for female and 0.94 and 0.96 for male cohorts, respectively.

Table 2 shows HIV incidence rates produced by the model, averaged over 2-year intervals during the first 12 years of the baseline scenario, by sex and cohort. Incidence rates are highest during the first 6-year period (1981–1986) of the epidemic, and levels relate to the age profile of sexual risk with peak incidences in males born between 1955 and 1964 (aged 20–29 years in 1984) and females born between 1960 and 1969 (aged 15–24 years in 1984). Following this period, the overall incidence falls as a result of declining incidence in all cohorts born before 1970 (aged 15 years or older in 1984), but incidence is maintained in younger cohorts. Thus, incidence rates increase, peak, and decline in successive cohorts as they age into periods of heightened sexual activity and risk for HIV infection; nevertheless, the peak incidence rate in the younger cohorts is slightly less than in older cohorts who were at peak levels of sexual activity during the first 6 years of the epidemic. The female:male rate ratio of average incidence for the 12-year period is 1.14:1 overall. Within the 1975–1979 cohort, females have a risk almost three times that of males; however, with increasing age and exposure time, the female:male rate ratios approach unity in the 1965–1969 cohort, after which the risk becomes greater among males. The temporal shift of incidence to younger

TABLE 1. Results of sensitivity analyses of model inputs (incubation distributions, time periods of high HIV* incidence growth, age profiles of HIV risk (S_a), and years of epidemic onset), comparing the fit of output for baseline and other simulations with empiric data with respect to AIDS* birth cohort trends by sex and rank order and with a simulated population HIV prevalence: Uganda model scenario, 1980–2000

	Correct cohort rank order	Trends in cohorts born		Pearson's correlation coefficient (r)			1994 HIV prevalence (%)
		Before 1965	1965 and later	Overall	Females	Males	
Baseline model	14/14	Stable/decreasing	Increasing	0.92	0.89	0.96	15
9-year median incubation	10/14	Stable/decreasing	Increasing	0.88	0.87	0.89	17
5-year median incubation	8/14	Decreasing	Increasing	0.82	0.79	0.85	13.9
9-year high incidence growth	8/14	Increasing	Increasing	0.82	0.8	0.85	18.1
S_a modal age 4 years older	10/14	Stable/decreasing	Increasing	0.85	0.83	0.89	13.7
1985 epidemic onset	8/14	Increasing	Increasing	0.62	0.64	0.6	20.3

* HIV, human immunodeficiency virus type 1; AIDS, acquired immunodeficiency syndrome.

TABLE 2. Human immunodeficiency virus (HIV) incidence as generated by the epidemiologic model in the baseline scenario over a 12-year period: Uganda model scenario, 1981–1992*

Birth cohort and age in 1984	1981–1982	1983–1984	1985–1986	1987–1988	1989–1990	1991–1992	Period late/ 100 person-years	Female/ male rate ratio
				Females				
1975–1979 (5–9 years)	0.00	0.00	0.00	0.44	2.21	4.28	1.14	2.80
1970–1974 (10–14 years)	0.01	0.58	3.91	4.80	4.16	2.55	2.66	1.61
1965–1969 (15–19 years)	0.78	4.43	8.26	1.90	1.17	1.07	2.99	1.11
1960–1964 (20–24 years)	1.56	4.72	6.23	1.00	0.86	0.76	2.58	0.89
1955–1959 (25–29 years)	1.30	3.41	4.15	0.74	0.69	0.68	1.86	0.71
1950–1954 (30–34 years)	0.94	2.75	3.97	0.67	0.65	0.63	1.63	0.78
1945–1949 (35–39 years)	0.84	2.61	3.81	0.61	0.53	0.43	1.50	0.86
				Males				
1975–1979 (5–9 years)	0.00	0.00	0.00	0.09	0.72	1.66	0.41	
1970–1974 (10–14 years)	0.00	0.25	1.23	2.21	2.89	3.43	1.65	
1965–1969 (15–19 years)	0.66	2.80	4.45	3.48	2.84	1.85	2.68	
1960–1964 (20–24 years)	2.49	5.87	5.24	1.34	1.09	0.99	2.91	
1955–1959 (25–29 years)	3.48	5.37	3.81	0.95	0.86	0.81	2.63	
1950–1954 (30–34 years)	2.91	4.18	2.95	0.78	0.72	0.66	2.09	
1945–1949 (35–39 years)	2.38	3.53	2.45	0.64	0.59	0.54	1.74	
Females	0.62	2.27	4.00	1.70	1.86	2.03	2.08	1.14
Males	1.22	2.47	2.50	1.43	1.58	1.75	1.83	

* HIV incidence rates averaged over 2-year periods and over the 12-year period (period rate) expressed as new HIV infections/100 person-years of observation are presented by sex and birth cohort (and reference age in 1984) from 1981 through 1992; differential sex- and age-specific age HIV incidences are expressed by comparing sex and cohort HIV incidence rate ratios (average HIV incidence rate in female cohort(s)/average HIV rate in respective male cohort(s)) during the 12-year period.

cohorts is illustrated by comparing distributions of incidence by age and sex for year 4 to year 12 of the epidemic in which the proportion of new infections in persons younger than age 25 increases from 43 percent to 74 percent in males and from 55 percent to 79 percent in females (figure 4).

Modeled HIV incidence, prevalence, and mortality, HIV prevalence by birth cohort, and HIV prevalence overall and by age group in a simulated population of pregnant females are presented for the two 20-year epidemic scenarios—baseline and incidence reduction—in figures 5 and 6. Figure 5A shows the incidence curve in both scenarios to be positively skewed with a concentration of high incidence followed by an abrupt decline to a relatively constant rate of new infections by year 8. A peak in HIV prevalence is achieved in 10 years, and it then stabilizes and declines slightly as the prevalence in cohorts infected during the period of high incidence growth is diminished by deaths occurring at similar rates to new infections. In the baseline scenario, prevalence increases again late in the time period and surpasses slightly the earlier peak by year 20. This second increase in prevalence is caused by the passing of peak mortality following the period of high incidence density and by baseline incidence being applied to younger cohorts, which are larger due to high population growth. Prevalence in the incidence reduction scenario indicates a slowly contracting epidemic to year 20. Mortality crests in year 13 in both scenarios. Figure 5B shows trends in HIV prevalence by birth cohort generated by both scenarios, and it illustrates how the monitoring of differential HIV prevalence, or resulting AIDS incidence, by cohort, particularly in cohorts born after 1970, may indicate whether recent HIV incidence has increased, stabilized, or decreased compared with earlier cohorts. In figure 6A, the HIV prevalence rates in a simulated population of pregnant women crest, transiently stabilize, and then decline in both scenarios; however, in the baseline scenario, prevalence rates stabilize at a second slightly lower level toward the end of the period. Figure 6B compares the age-specific prevalence in pregnant women for both the scenarios in 1991 and in 1995, illustrating a big prevalence decline in the 15- to 24-year age group evident in the incidence reduction scenario.

DISCUSSION

We describe how HIV incidence patterns can be inferred from national surveillance data, showing for Uganda how they are developed from the incorpora-

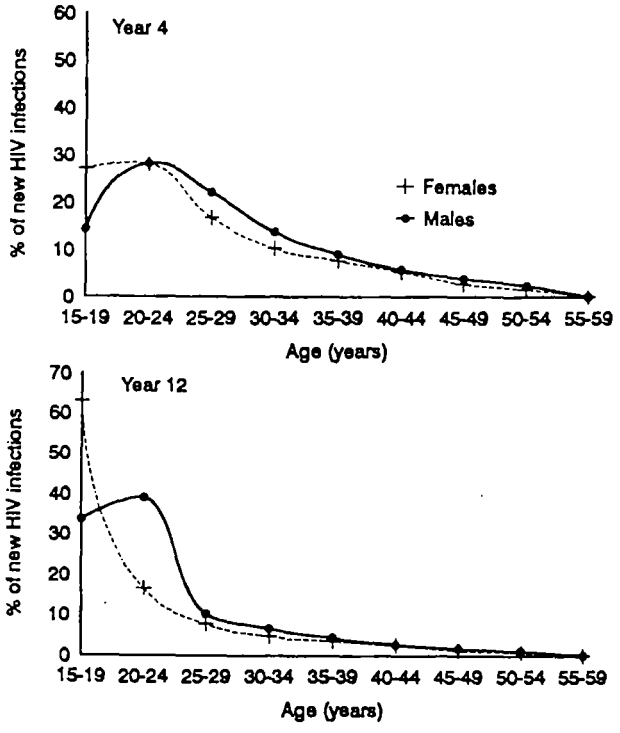

FIGURE 4. The proportional distribution of new human immunodeficiency virus type 1 (HIV) infections by age and sex in year 4 and year 12 of the epidemic, as generated by the epidemiologic model in the baseline scenario for Uganda, 1980–2000.

tion of three simple hypotheses deduced from AIDS cohort analyses into an epidemiologic model. The validity of the hypotheses is supported as the model generates patterns of HIV infections and AIDS that are close to those observed. HIV incidence is shown to be highly period and age dependent during the first 12 years of the epidemic. The positively skewed incidence curve is characterized by an initial period of high incidence growth in which incidence in year 5 is three times greater than in year 12 and is concentrated in the most sexually active cohorts at levels not equaled again. This high incidence growth period is followed by a substantial decline and shift of incidence to younger cohorts; by year 12 of the epidemic, it is estimated that 73 percent of male and 79 percent of female infections occur in persons less than 25 years of age.

The validity of the hypothetical incidence patterns is assessed by comparing the output of the baseline model with HIV and AIDS surveillance data. The HIV infection patterns produced by the model are similar to age- and sex-specific distributions of prevalence observed in the Uganda national HIV prevalence survey in 1987–1988; the AIDS incidence trends by cohort and sex show similar rank order, crossing points, and growth rates when compared with data on Uganda AIDS cases from 1987 to 1992. Sensitivity analyses assess the effects of varying model parameters and suggest good internal validity of the model. Furthermore, similar AIDS cohort trends were observed in the analyses of AIDS surveillance data from Rwanda, Tanzania, Zambia, and Kenya (unpublished data, World Health Organization, Global Program on AIDS country reports), suggesting that the incidence patterns that we describe may be characteristic of other epidemics in East Africa and are not likely related to surveillance biases or unique characteristics of the epidemic in Uganda.

The shape of the HIV incidence curve in a population over time governs the resulting dynamics of HIV prevalence and mortality. The incidence curve we describe results in HIV prevalence levels that tend to stabilize after 10 years as a result of earlier declines in HIV incidence and subsequent increases in mortality. Thus, the burden of prevalent infections is established rapidly, and a scenario of constant HIV incidence rates maintained in younger cohorts can coexist with stable or declining levels of prevalence, as the cumulative burden of infections created by the earlier period of high incidence is slowly eroded by mortality.

The reasons for the period of high incidence growth, affecting most severely the 1960–1969 cohorts (aged 15–24 years in 1984), followed by its diffusion (albeit at comparatively lower incidence rates) to younger age groups, are key to understanding how the epidemic will be sustained into the future and how it may be most vulnerable to interventions. Factors that may contribute to this period of high incidence growth include the following: the initial high proportion of susceptibles and unsaturated sexual networks (31); the role of sexual behaviors specific to the affected cohorts; the prevalence of transmission-facilitating cofactors that may characterize a period or subgroup, such as levels of sexually transmitted disease (32) or viremia (33, 34); or high community infectivity related to increased viremia shortly after seroconversion (35–37), which may depend closely on the concentration of HIV incidence by age, as well as by place and time (38, 39).

The subsequent decline in incidence and diffusion to younger cohorts may relate to the following: the increasing population of susceptible younger cohorts relative to saturated older cohorts and intercohort sexual mixing patterns that influence diffusion of incidence to younger cohorts (13, 40); behavior modification resulting in decreasing risk of exposure (S_{at} in the model) over time; declining community viremia as incidence density becomes less temporally concentrated; or possibly factors related to changing viral

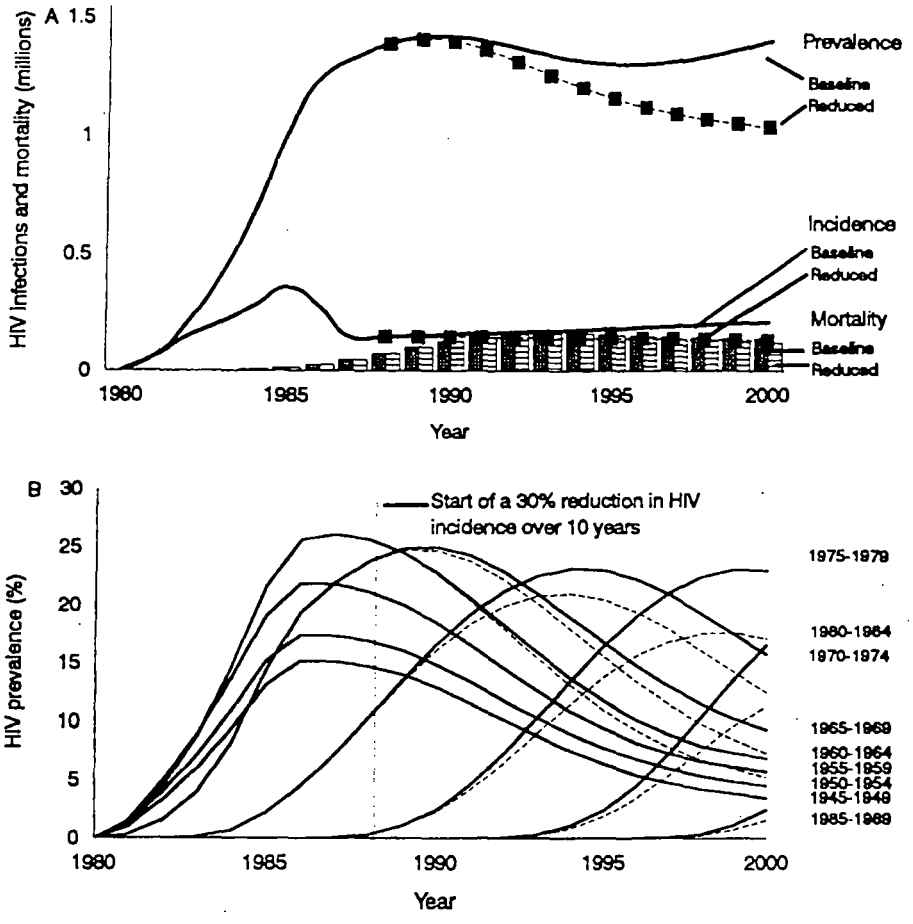

FIGURE 5. Human immunodeficiency virus type 1 (HIV) infection dynamics in Uganda from 1980 to 2000 as generated by the epidemiologic model in the baseline and incidence reduction (reduced) scenarios. A, relation of HIV incidence, prevalence, and mortality; B, HIV prevalence rates by 5-year birth cohorts according to baseline scenario (——) and incidence reduction scenario (- - - -).

virulence and decreasing infectivity over time (27, 41). In lieu of data to support substantial behavior modification, the most plausible explanation of such a large decline in incidence by 1986–1987 in Uganda is one that considers the interaction of saturation and natural declines in community infectiousness.

Similarly shaped HIV incidence curves are reported from cohort studies and modeling of the epidemics in homosexual/bisexual males in the United States (42) as well as in drug users and heterosexual males in Thailand (43, 44). In the Rakai district of Uganda, HIV prevalence declined from 23.4 percent in 1990 to 19 percent in 1992 in the population aged 15–59 years, with an underlying estimated HIV incidence of 2.1/100 person-years (45, 46)—findings similar to our baseline scenario at year 12 with an HIV incidence rate of 1.9/100 person-years. There is also supporting evidence for the concentration of HIV in younger age groups in mature epidemics in Africa. In a study in Kinshasa, Zaire, with stable HIV prevalence levels since 1986, HIV incidence remained high in women aged less than 26 years, with a rate ratio of 2.36 compared with women older than 26 years (47). In a study in the Masaka district of Uganda, 71.5 percent of total incident infections in women aged less than 55 years occurred in the age groups 13–24 years (4). There is evidence that this age shift will be applicable to other epidemics. For example, data from the United States suggest the extension of the epidemic to younger cohorts entering ages of risk (13, 48, 49). In addition, there is support in classic epidemic theory for similar incidence curves (50) and a shift of incidence in expanding populations to younger age groups (51). Our data also support the contention that HIV risk in younger women is greater than that in similarly aged men (52); however, this difference is reduced and then reversed as men age. The reasons, perhaps, relate to sex-specific differences in risk behavior and age se-

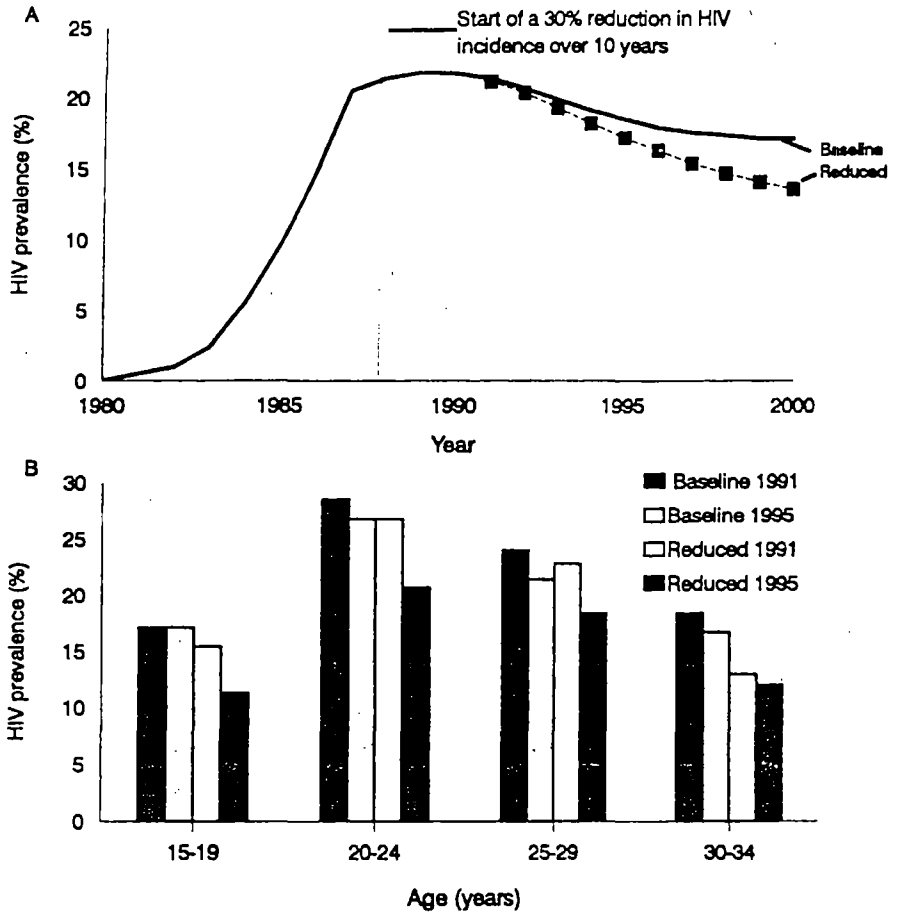

FIGURE 6. Human immunodeficiency virus type 1 (HIV) prevalence rates in a simulated population of pregnant females (A) and by age group (B) comparing 1991 with 1995 as generated by the epidemiologic model in both baseline and incidence reduction (reduced) scenarios for Uganda, 1980–2000.

lection of sexual partners rather than to sex-associated physiologic vulnerability (53). Finally, other models have been used to investigate age mixing as it relates to HIV incidence patterns, showing some similarities to our results. However, few have deduced their hypotheses from empiric data, applied their methods to national surveillance data of AIDS cases and HIV prevalence, or been subjected to vigorous validation (38, 49, 54, 55).

There are limitations to our study. Biases in AIDS case surveillance data due to underascertainment of actual AIDS incidence are well known (19, 20). For the purposes of hypotheses generation, relative cohort trends may be independent of absolute underreporting of AIDS cases over time; however, large nonrandom misreporting or differences in access to care and recognition by the surveillance system by cohort could influence cohort trends, though both are unlikely. A longer time series than the 6 years of AIDS case data may have been useful for improving trend interpretation. There were age and digit preference biases in the reporting of AIDS cases, and age-specific data relating to sexually transmitted disease were limited to Kampala. However, the consistency in cohort trends in both Uganda and other East African data, the high r^2 achieved in fitting quadratic curves to these trends, and the differential growth rates in AIDS cases by birth cohort suggest that the data reflect past changes in incidence by age and time. Our data also relate to a composite of epidemics at different stages of maturity, both urban (19) and rural (46, 56), and may not reflect the temporal pattern of incidence in smaller geographic areas or capture fully the time-lagged geographic diffusion of the epidemic over larger areas. HIV incidence may be underestimated by our model in older cohorts, after saturation, and the accuracy of the incidence rates assumed for younger cohorts is not easily verified because of the paucity of AIDS cases reported in 1992 for younger cohorts; however, HIV prevalence surveys provide empiric support and fur-

ther monitoring of cohort AIDS incidence, and HIV prevalence in pregnant women will guide the development of alternative HIV incidence scenarios. The recent reports of declining incidence and prevalence in areas of Uganda with older epidemics suggest that our incidence scenarios are plausible (12).

Our findings have implications for targeting interventions, interpreting surveillance trends, and forecasting epidemics like that in Uganda. First, an intervention to blunt the explosive period of high incidence in an epidemic will remain the ultimate goal of prevention (57). However, effecting changes in high risk behaviors during or before this period has seen frustratingly few successes. As incidence shifts to younger populations in more mature epidemics, prevention strategies, whether related to behavior modification or vaccination, must target youth before the ages of heightened sexual risk for HIV, which appear to occur at a younger age in females. Nevertheless, interventions in older persons should not be neglected as HIV incidence involves some degree of diffusion of infection from older to younger age groups (13, 49). Second, piecemeal observations of stability in HIV prevalence in Africa may relate to epidemic maturity and should not necessarily be attributed to the benefits of interventions. The rapid build-up and stabilization in prevalence portend stable AIDS case levels and mortality occurring earlier than expected in some regions (58), yet the burden of disease and mortality emanating from prevalent infections will extend for decades, even in the case of an optimistic scenario of declines in current incidence rates. Third, the nature of diffusion of HIV incidence to younger generations will be evident in the ratio of AIDS incidence and HIV prevalence in younger compared with older cohorts. Thus, AIDS incidence or HIV prevalence in successive younger cohorts, though sensitive to population growth rates, may provide insight into more recent HIV incidence patterns and their relation to changing transmission efficacy or changing exposure linked to behavior modification. Our epidemiologic model, when linked to such cohort analyses of AIDS cases and HIV surveillance data, particularly with regard to analyses of age-specific HIV prevalence trends of sentinel HIV surveillance data in pregnant women attending antenatal clinics, may offer a method to better determine whether incidence and prevalence will likely expand, stabilize, or decline over the long term in different areas. This information could provide a stronger empiric foundation for the evaluation of interventions and the validation of forecasting and impact scenarios developed for parts of sub-Saharan Africa (58).

There are several areas for future investigation that stem from our findings. It will be important to determine if these incidence patterns are generalizable to other epidemics with diverse risk groups. Cohort patterns observed in AIDS mortality and morbidity in the United States (13) suggest similarities to that in Uganda. Research on the determinants of changing incidence densities should explore how incidence in younger cohorts is generated from prevalence in older cohorts and in what way this may involve the hypothesis of variable infectiousness related to time of seroconversion. Outcomes can be used to target interventions to particular age groups in which HIV incidence is concentrated, which may disproportionately cut transmission. Finally, the forecasting scenarios we propose demonstrate the following: the incidence curve in epidemics like that in Uganda is different from the more commonly applied forecasting scenarios in sub-Saharan Africa (58); a decline in prevalence may be anticipated and may be independent of substantial reductions in recent incidence rates in younger age groups. The determinants of any such declines in prevalence should be evaluated, since a reduction in prevention efforts stemming from their misinterpretation may have negative health consequences for younger generations.

In conclusion, the paper shows how analyses of routine HIV/AIDS and sexually transmitted disease data can provide insight into the basic patterns of HIV risk and infection by age, sex, period, and cohort. Cohort analysis of AIDS case surveillance is the hinge in this procedure that, unlike analyses of successive prevalence surveys, represents a morbidity outcome that can be linked retrospectively by an incubation period to the temporal distribution of prior HIV incidence. Thus, AIDS and HIV surveillance systems need to be sustained and, when used for the rigorous validation of basic epidemiologic hypotheses, will provide an empiric basis to prevent more effectively the passage of HIV infection to successive generations and to forecast more accurately the impacts of epidemics like that in Uganda.

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