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Scenarios for the AIDS epidemic in Asia

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This Research Report is based on a lecture that Professor Chin presented as part of the Distinguished Lecturer Series commemorating the Program on Population's Twenty-Fifth Summer Seminar on Population, held in Honolulu and Taipei during June-July 1994. The seminar provided an opportunity for 80 population professionals from 25 countries to share their experience, increase their knowledge, and develop plans for collaborative research.

HIV, the AIDS virus, did not appear to be a serious health problem in Asia until the late 1980s, when explosive epidemics were documented in several South and Southeast Asian countries. Since then, complacency has given way to alarm over the virus's potentially devastating impact. This report traces the origin of HIV infection in Asia, estimates current levels of infection, and develops several scenarios for the future course of the epidemic in the region to the year 2010. Current and projected HIV infection levels for Asia are compared with those documented in sub-Saharan Africa and in North America and Western Europe. Alternative scenarios are also developed for the impact of AIDS on the adult populations of Hong Kong, where the infection rate is low, and of Thailand, where an HIV epidemic is in full swing. Recommendations for action include developing reliable estimates and projections of HIV prevalence and distribution in each country, giving greater priority to education, programs designed to minimize the epidemic's spread, and strengthening support to public health programs that might reduce risky sexual and drug-using behaviors rather than shunning such efforts because those behaviors offend social, cultural, and religious taboos.

Epidemiological and laboratory data indicate that the human immunodeficiency virus (HIV), which causes acquired immunodeficiency syndrome (AIDS), did not occur in epidemic proportions in any large human population until the mid- to late 1970s (Piot et al. 1988). During the early to mid-1980s, HIV spread extensively in sub-Saharan Africa; in the industrialized "Western" countries of North America, Europe, and Oceania; and in many countries of Latin America, including the Caribbean (Mann et al. 1988). Although a few HIV infections and AIDS cases were detected in Asia by the mid-1980s, epidemic spread was not noted. These observations led to speculation, accompanied by general complacency, that AIDS would not be a major problem in Asia. However, since the late 1980s, when explosive epidemics of HIV were documented in several South and Southeast Asian countries, the complacency

about AIDS in most Asian countries has given way to alarm about the potentially devastating impact of AIDS, not only on individuals' lives but also on the economies of the region.

ESTIMATING AND PROJECTING HIV INFECTION RATES

During the late 1980s the Global Programme on AIDS of the World Health Organization (WHO) developed a scenario and modeling approach for estimating and projecting the number of HIV and AIDS cases in specific populations from available data and observed trends (Chin, Lwanga, and Mann 1989). A scenario is an outline or script that can be developed for a series of events, real or imagined.

Researchers have used a variety of methods to develop HIV scenarios. One, called the Delphi method, employs AIDS experts ("seers") in a structured setting to estimate and project the course of an epidemic (Levine 1984; Chin, Sato, and Mann 1990). Another uses mathematical models to develop HIV scenarios (Auvert et al. 1990; Anderson et al. 1991; Way and Stanecki 1991). Yet a third "fits" the profile of a future HIV epidemic to trends observed in existing HIV epidemics. After an HIV scenario is developed, the number of resultant HIV-related diseases and deaths and of maternal AIDS orphans can be estimated and projected by means of a simple microcomputer program, called EPIMODEL (Chin and Lwanga 1991). These estimates and projections can be used for policy development and public health planning.

The HIV database compiled by the Center for International Research of the U.S. Bureau of the Census is a valuable source of HIV seroprevalence studies and surveys in developing countries (United States, BOC, 1994). Additional sources are unpublished HIV data, other epidemiological observations, and estimates made by national and regional experts. Together, they can be used first to estimate and then to project HIV prevalence levels and trends to the year 2000 or beyond for specific populations or entire countries.

The number of AIDS cases and deaths at any given time (i.e., the prevalence level) depends not only on the number and pattern of HIV infections but also on progression rates from infection to severe disease and subsequent death. EPIMODEL uses epidemiologically derived estimates of an HIV epidemic curve, along with such annual progression rates, to calculate annual AIDS cases. EPIMODEL also has modules for estimating pediatric AIDS and adult TB cases related to HIV infection.

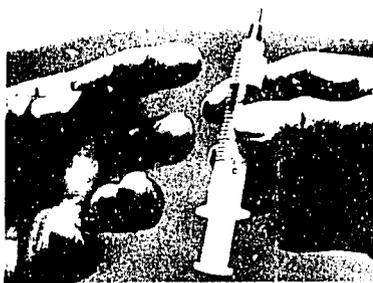
ASSUMPTIONS AND METHOD

Most of the data I used to derive HIV and AIDS estimates and projections for this report come from the June 1994 update of the U.S. Bureau of the Census's HIV-AIDS database. In addition, I was able to review many unpublished HIV prevalence studies and reports from several Asian and Pacific countries over the last couple of years as an invited consultant to these countries. My estimates and projections are derived from scenario construction and modeling based on the following assumptions:

- The virus did not begin to spread extensively (that is, to infect more than a few thousand persons per year) in sub-Saharan Africa until the mid-to late 1970s. Extensive spread did not begin in North America and Western Europe until the late 1970s to early 1980s or in Asia until the late 1980s. In sub-Saharan Africa, HIV was transmitted primarily through heterosexual contact, whereas in North America and Western Europe the infection initially spread primarily among homosexual men and injecting drug users, and in Asia the groups initially infected were drug users and commercial sex workers and their clients.
- By 1993, HIV-infected adults numbered about 6.5 million in sub-Saharan Africa, more than 1 million in North America and Western Europe, close to 2 million in Asia, about 30,000 in Oceania, and fewer than 10,000 in the Pacific Islands.
- The annual number of new HIV cases, or incidence, peaked in North America and Western Europe before the mid-1980s. In sub-Saharan Africa the rate of increase of new HIV infections appears to have slowed over the past few years, and the number of new cases is projected to peak

SHARING NEEDLES CAN GET YOU MORE THAN HIGH.

IT CAN GET YOU AIDS.



**STOP SHOOTING UP AIDS.
CALL 1-800-662-HELP.**

Intravenous drug use with shared, unsterilized needles has been a major factor in the initial spread of HIV in Asia. Poster campaigns like this one from the United States are becoming more common there.

around the mid-1990s. In Asia the peak is expected at the end of the 1990s or shortly thereafter.

- The median progression rate of 10 years from HIV infection to the development of AIDS is assumed to be similar for all males and females in all populations. This rate is derived primarily from cohort studies of white males.
- In all regions the annual HIV incidence from the start of an epidemic to peak occurrence is distributed along a theoretical epidemic curve that approximates a gamma distribution (see Figure 1). A gamma curve is a simple probability distribution that approximates the growth of a common-source epidemic.¹

For each of the major geographic or epidemiological regions, I developed conservative, or moderate, HIV scenarios by using conservative estimates of HIV prevalence rates and the assumptions just described. I also constructed a range of higher and lower HIV scenarios for Thailand. To construct the high HIV scenario, I increased the estimates of current HIV prevalence, increased the slope of the gamma curve used for projecting HIV incidence (which resulted in more infections over a shorter time period), decreased the "age" of the HIV epidemic—that is, placed the current year or HIV prevalence-estimate year at an earlier point on the ascending portion of the epidemic curve (which also resulted in more HIV infections in a shorter time period), and used combinations or per-

¹ A simple gamma function was selected— $t^{p-1}e^{-t}/(p-1)!$ —to describe the HIV incidence at time t . Parameter p defines the steepness of the HIV epidemic curve. A default value of $p = 5$ is used in EPIMODEL because this gamma distribution for HIV infections provides the best empirical fit to observed HIV epidemics.

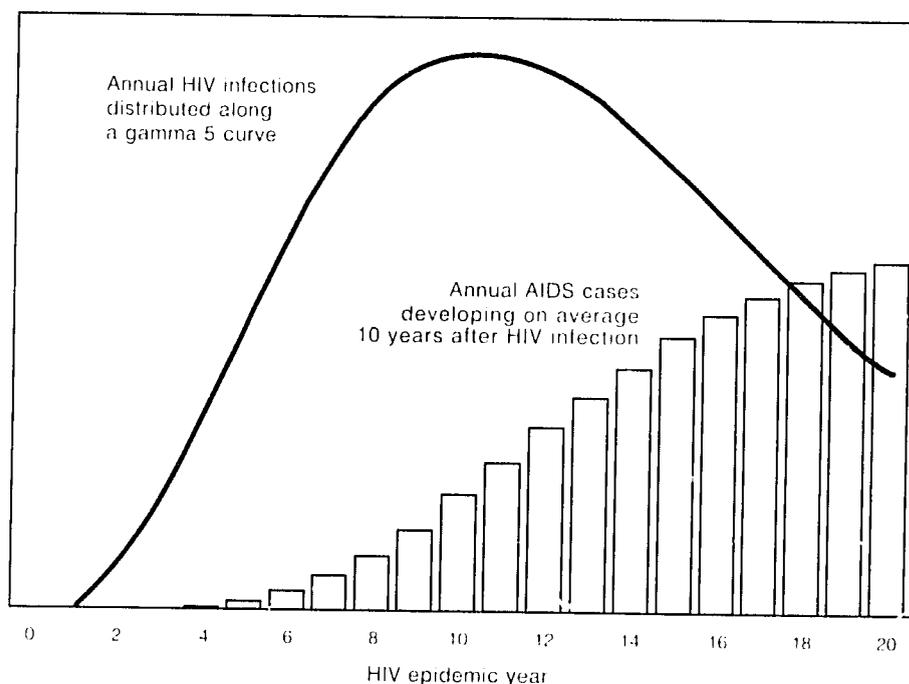


Figure 1. The annual HIV incidence, or epidemic curve, used in EPIMODEL and the resultant pattern of annual AIDS cases calculated by EPIMODEL

mutations of all of these manipulations. Low or more optimistic HIV scenarios were developed by reversing some of these factors. Whether low or high, all HIV scenarios should be plausible: all of the above factors should "fit" within a reasonable range of those values extrapolated from available data.

Using the pediatric module of EPIMODEL (Chin 1994), I also calculated estimates and projections of HIV infection acquired perinatally (at birth) and of children orphaned due to maternal AIDS deaths. This module employs age- and gender-specific HIV infection rates, age- and region-specific fertility rates, and a variable perinatal transmission rate to calculate the number of infected and uninfected children born to HIV-infected women. In addition, EPIMODEL has a new tuberculosis (TB) module that calculates the numbers of clinical TB cases related to HIV infection for specific HIV scenarios (Chin 1995).

FINDINGS

The following estimates and projections of HIV infections and AIDS cases are conservative. That is, they represent the lower range of current HIV estimates that have been made by various governments and organizations. For example, the range of the current HIV prevalence estimate for India is from 1 to 2 million, and I used the lower number here.

RECENT ESTIMATES OF HIV AND AIDS CASES

Figure 2, which presents my estimates of new HIV infections by two-year periods for sub-Saharan Africa, North America and Western Europe, and Asia and the Pacific from 1983 through 1994, shows that in sub-Saharan Africa the number of new infections rose to close to 1 million per year by the early 1990s but the rate of increase slowed during the early 1990s. As of mid-1994, an

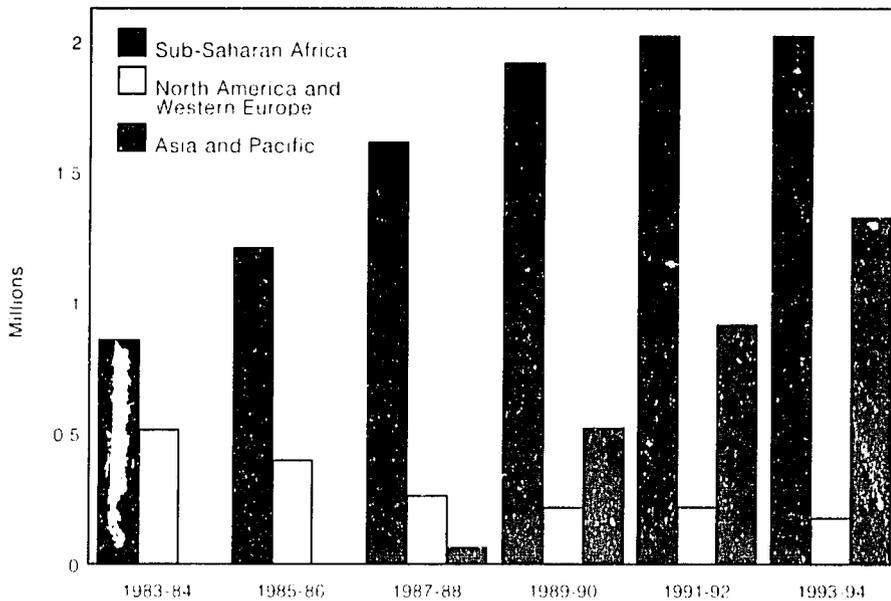


Figure 2. Number of new HIV infections estimated among adults aged 20-49, by two-year period: sub-Saharan Africa, North America and Western Europe, and Asia and the Pacific, 1983-84 through 1993-94

estimated cumulative total of more than 10 million adults had contracted HIV in that region. In North America and Western Europe, new HIV infections reached a peak of more than 200,000 per year by the mid-1980s. Since then, the annual number of new infections is estimated to have dropped to between 100,000 and 50,000. As of mid-1994, the cumulative total number of adults infected with HIV in these two "Western" regions is estimated at more than 1.5 million.

Extensive HIV transmission was documented in only a few countries of South and Southeast Asia starting during the late 1980s. Since then, the number of HIV infections has continued to rise markedly in several Southeast Asian countries—primarily Thailand, India, and Myanmar (formerly Burma)—where more than 1 million new HIV cases are estimated to have occurred over the past two years. As of mid-1994, an estimated cumulative total of more than 2.5 million adults were infected with HIV in Asia, 90 percent of them in South and Southeast Asia.

Although the absolute number of new HIV infections in Asia is already approaching the high level found in Africa, the *rate* of new HIV infections—that is, the number of new cases per year as a percentage of the adult population—is still much lower in Asia than in sub-Saharan Africa (Figure 3). This low rate has yielded the high incidence of cases shown in Figure 2 because the adult population of Asia, including China, is more than five times larger than the adult population of sub-Saharan Africa. Figure 3 shows that the rate of new infections in Asia is rising, not falling as in North America and Western Europe, or beginning to level off as in sub-Saharan Africa. If unchecked, the rising incidence rate in Asia will produce an unprecedented number of new cases in that region even if it does not reach the highest African incidence rate.

I compared estimated numbers of infected adults in the most sexually active age group of 20-49 living in selected countries in mid-1994 and also calculated this age group's corresponding HIV

prevalence rates. (A prevalence rate is the total number of existing cases at a particular time divided by the number of people in the population at risk. It is expressed as a percentage of the population at risk.) The limited HIV surveillance data available for most Asian countries allows only broad estimates of prevalence. The estimates I chose were generally on the low end of this broad range. For comparison I included estimated prevalence rates in the United States and Zambia.

An enormous range of prevalence rates can be seen among the countries studied—from a low of 0.002 percent of the population at risk (equivalent to 1 infection per 50,000 adults) in China, to a high of 30 percent (3 infections per 10 adults) in Zambia (Table 1). The last column of Table 1 shows a gradient of HIV infection prevalence, with China having the lowest prevalence estimate and a gradient value of 1 and Zambia the highest estimate, with a gradient value of 15,000. Thus the HIV prevalence rate in Zambia is about 15 times greater than in Thailand and 15,000 times greater than in China. HIV prevalence rates in Myanmar and Thailand are higher than those estimated for the United States, even though the HIV epidemic in the United States began about a decade before HIV began to spread in Myanmar and Thailand.

PROJECTIONS OF HIV CASES TO THE YEAR 2010

Using conservative, or optimistic, HIV scenarios constructed for sub-Saharan Africa, North America and Western Europe, and Asia, I projected the annual number of new HIV cases among adults to the year 2010 (Figure 4). The annual number of adult HIV infections in the sub-Saharan African scenario is projected to peak at slightly over 1 million around the mid-1990s and to decline

gradually thereafter. In North America and Western Europe, after a sharp burst of HIV infections during the first half of the 1980s, the scenario shows relatively low annual numbers of HIV infections during the remainder of the 1990s. This low level is projected to continue through the next decade. In Asia, however, the conservative scenario indicates that the incidence of HIV infection will rise steeply, overtaking the sub-Saharan African level by the mid-1990s, and then will decline fairly rapidly during the first decade of the twenty-first century.

On the basis of the conservative scenarios shown in Figure 4, the cumulative number of HIV infections among sub-Saharan African adults aged 20-49 is projected to reach about 15 million in the year 2000 (yielding a prevalence rate of about 3 percent), and about 20 million in 2010 (prevalence rate of about 1.7 percent). In North America and Western Europe the conservative scenario will result in about 2 million cumulative HIV infections in the year 2000 (prevalence rate of 0.23 percent) and about 2.7 million infections in 2010 (prevalence rate 0.17 percent). Cumulative HIV infections in Asia are conservatively projected at more than 10 million (prevalence rate of 0.46 percent) in the year 2000, and more than 18 million (prevalence rate 0.4 percent) in 2010.

EPIMODEL can be used to estimate and project the annual number of AIDS cases for each of these HIV scenarios. Because the average period of time between HIV infection and the onset of AIDS is about 10 years, the annual number of adult AIDS cases mirrors the estimated and projected number of adult HIV infections with an approximate 10-year lag (Figure 5).

In the conservative scenarios, the annual number of new AIDS cases in North America and Western Europe over the next two decades is expected

Table 1. Estimates of HIV prevalence and prevalence rates among adults aged 20-49: selected countries, mid-1994

| Country | Adults 20-49 (millions) | Estimated no. of HIV cases (thousands) | Prevalence rate (percentage infected) | Infection gradient |
|------------------|-------------------------|--|---------------------------------------|--------------------|
| China | 450 | 10 | 0.002 | 1 |
| South Korea | 20 | 3 | 0.015 | 8 |
| Indonesia | 75 | 20 | 0.025 | 13 |
| Philippines | 25 | 17.5 | 0.070 | 35 |
| Papua New Guinea | 1.5 | 2 | 0.130 | 65 |
| India | 360 | 1,000 | 0.280 | 140 |
| United States | 117 | 700 | 0.600 | 300 |
| Myanmar | 15 | 250 | 1.700 | 850 |
| Thailand | 23 | 500 | 2.200 | 1,100 |
| Zambia | 3 | 900 | 30.000 | 15,000 |

to remain fairly constant, at close to 100,000. This is so because almost all HIV-infected persons will eventually develop AIDS, and annual HIV incidence in these regions is projected to be close to 100,000. In sub-Saharan Africa, the peak occurrence of AIDS (about 750,000 cases per year) will not be reached until the middle of the next decade, around 2005. In Asia the annual number of AIDS cases will increase steadily over the next decade and not begin to level off until about 2010, at around 850,000 per year.

FIVE HIV SCENARIOS FOR THAILAND

In contrast to the meager data on HIV and AIDS available in most Asian countries, the epidemic in Thailand has been well documented (Weniger et al. 1991). The quantity and high quality of surveillance data on the distribution and prevalence of HIV, as well as behavioral surveillance data, have enabled many groups to develop estimates and projections of the AIDS epidemic in Thailand. The past and current estimates for

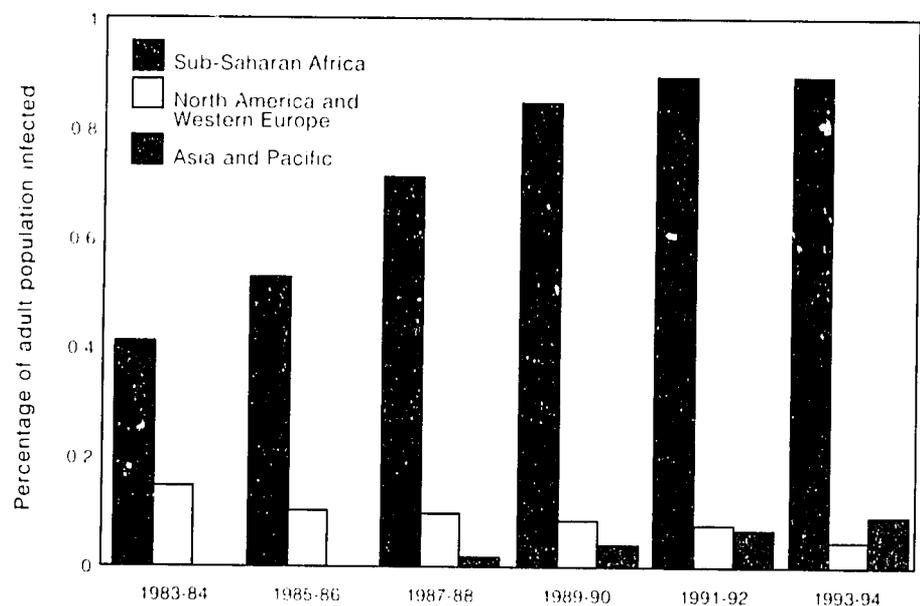


Figure 3. Rate of new infections estimated among adults aged 20-49, by two-year period: sub-Saharan Africa, North America and Western Europe, and Asia and the Pacific, 1983-84 through 1993-94

The conservative scenario for Asia projects the annual number of AIDS cases to rise steadily over the next decade and not begin to level off until about 2010, at around 850,000 per year.

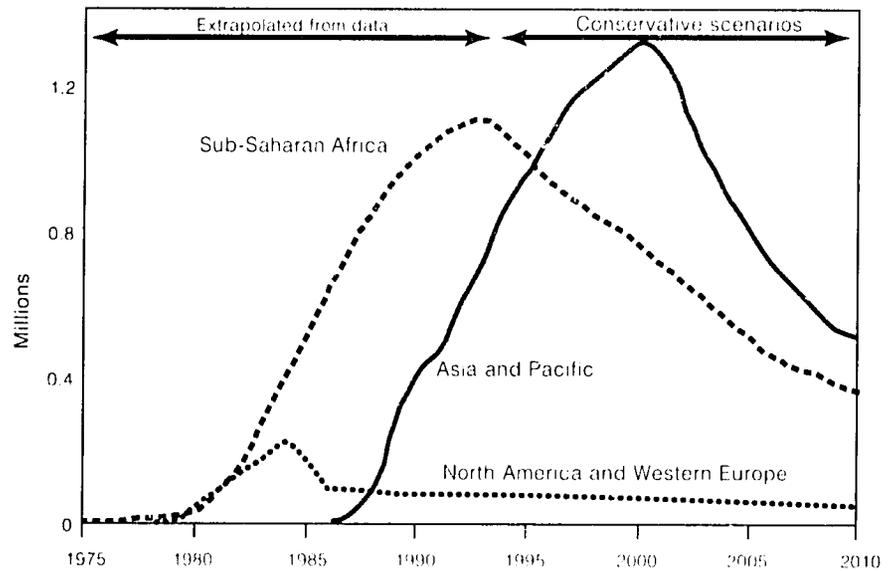


Figure 4. Annual number of HIV infections estimated and projected among adults aged 20–49: sub-Saharan Africa, North America and Western Europe, and Asia and the Pacific, 1975–2010

Note: Annual numbers of HIV infections were extrapolated from the available data through 1993 and projected to the year 2010 using conservative (moderate) HIV scenarios.

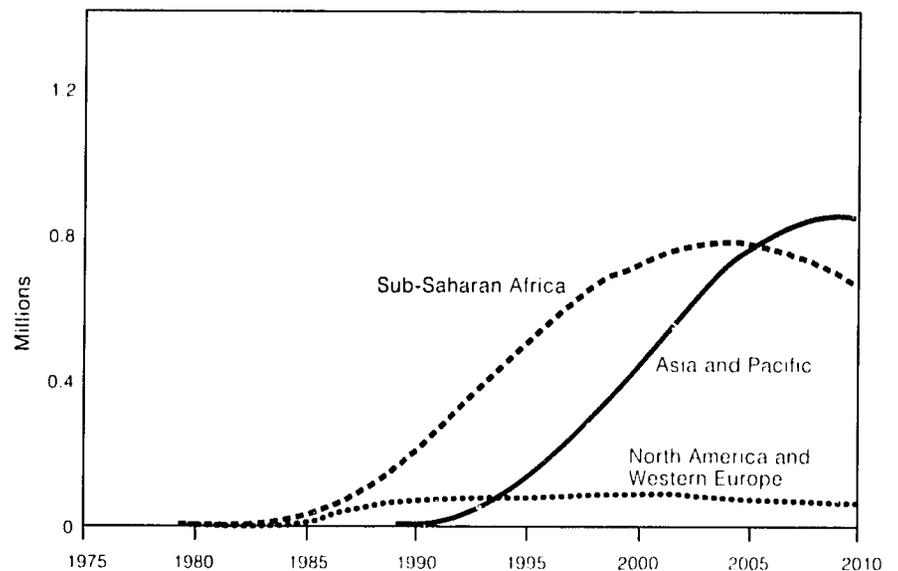


Figure 5. Annual number of AIDS cases estimated and projected among adults aged 20–49, calculated by EPIMODEL and based on the conservative HIV scenarios shown in Figure 4: sub-Saharan Africa, North America and Western Europe, and Asia and the Pacific, 1975–2010

Thailand are fairly well established or bounded by the available data. All HIV modeling and scenario construction for Thailand must fit the age curve of the Thai HIV epidemic and the current HIV prevalence estimates based on the abundant data collected over the past seven to eight years.

Almost no measurable HIV prevalence was detected in any high-risk group in Thailand until February 1988, when HIV prevalence among injecting drug users in Bangkok was estimated at more than 15 percent, up from less than 1 percent in December 1987. By July 1988, prevalence in this group had risen

to about 40 percent! The 1990 estimates of HIV prevalence for Thailand ranged from 50,000 to more than 200,000, and in 1991 official estimates ranged from 200,000 to 400,000.

I developed five HIV scenarios for Thailand, ranging from very low to very high, to determine the potential range of AIDS deaths that may need to be considered in health-care planning. The lowest (optimistic) scenario used a 1993 HIV prevalence estimate of 400,000 infections and also assumed that all HIV transmission would stop after 1995. The low scenario used the same 1993 prevalence estimate but did not assume a cessation of HIV transmission after 1995. The moderate scenario used an HIV prevalence estimate of 550,000 cases in 1993; the high (pessimistic) scenario, an estimate of 750,000 cases for the same year. Finally, a "Uganda" scenario used HIV prevalence rates and an epidemic curve extrapolated from the HIV epidemic in Uganda. Figure 6 illustrates the estimated and projected annual AIDS deaths in Thailand for each of these scenarios. Table 2 presents the annual number of new AIDS cases, the cumulative numbers of AIDS cases and HIV infections, and the HIV prevalence rate estimated for 1990 and projected for 2000 and 2010 for each scenario.

All of the HIV scenarios result in marked increases in AIDS deaths starting in the early 1990s. By 1995, projected annual numbers of AIDS deaths range from a low of about 20,000 to a high of about 40,000. Even if all HIV transmission were stopped after 1995, as in the most optimistic scenario, the number of projected AIDS deaths would not differ much from that of the low scenario, in which HIV transmission continues. Between 2000 and 2010, the low scenario results in nearly 50,000 AIDS deaths per year, the moderate scenario in 80,000 to 90,000, and the high

Table 2. Estimated and projected annual and cumulative HIV infections and AIDS cases among adults aged 20-49 (projections based on five HIV scenarios): Thailand

| Year and estimate/projection | Scenarios | | | | |
|------------------------------|---------------------------------|-----------|-----------|-----------|-----------|
| | No new HIV infection after 1995 | Low | Moderate | High | "Uganda" |
| 1990 | | | | | |
| Annual new AIDS cases | 500 | 500 | 700 | 1,000 | 400 |
| Cumulative AIDS cases | 600 | 600 | 800 | 1,100 | 500 |
| Cumulative HIV cases | 100,000 | 100,000 | 150,000 | 200,000 | 90,000 |
| HIV prevalence rate (%) | 0.44 | 0.44 | 0.61 | 0.83 | 0.44 |
| 2000 | | | | | |
| Annual new AIDS cases | 30,000 | 40,000 | 75,000 | 100,000 | 120,000 |
| Cumulative AIDS cases | 200,000 | 240,000 | 400,000 | 500,000 | 450,000 |
| Cumulative HIV cases | 500,000 | 750,000 | 1,400,000 | 1,800,000 | 2,900,000 |
| HIV prevalence rate (%) | 1.00 | 1.78 | 3.43 | 4.68 | 10.00 |
| 2010 | | | | | |
| Annual new AIDS cases | 15,000 | 45,000 | 95,000 | 125,000 | 250,000 |
| Cumulative AIDS cases | 425,000 | 650,000 | 1,200,000 | 1,650,000 | 2,600,000 |
| Cumulative HIV cases | 500,000 | 1,200,000 | 2,300,000 | 3,100,000 | 5,800,000 |
| HIV prevalence rate (%) | 0.22 | 1.49 | 3.17 | 4.33 | 10.67 |

scenario in 100,000 to 150,000. In the "Uganda" scenario, the annual number of AIDS deaths begins to increase markedly after 2000, resulting in about 250,000 AIDS deaths per year by 2010.

As for prevalence (Table 2), the moderate scenario projects a cumulative to-

tal of about 400,000 AIDS cases by 2000 and close to 1.5 million HIV infections, with a seroprevalence rate of about 3.5 percent of the adult population. By 2010, the cumulative number of AIDS cases triples to about 1.2 million and the cumulative number of HIV infec-

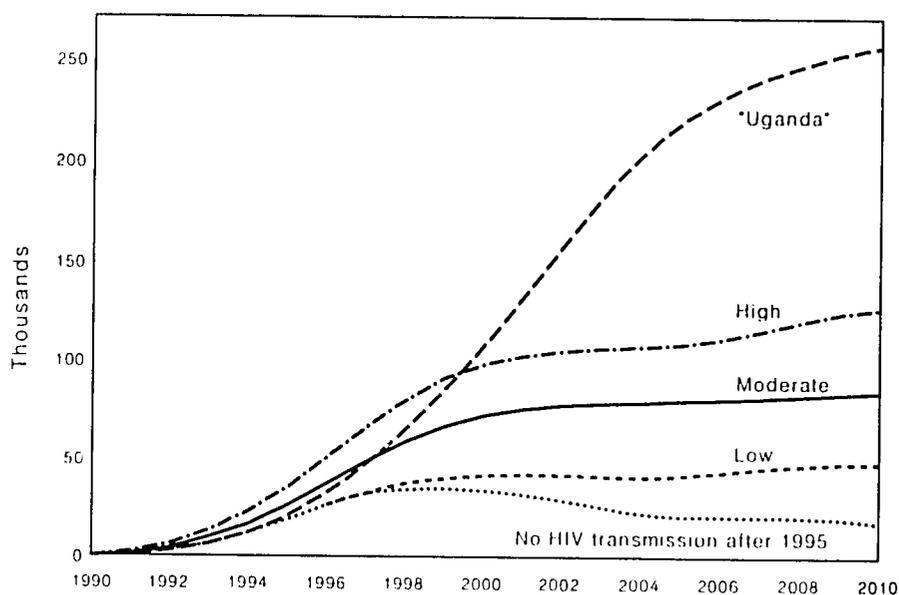


Figure 6. Annual number of AIDS deaths estimated and projected among adults aged 20-49, based on five HIV scenarios: Thailand, 1990-2010

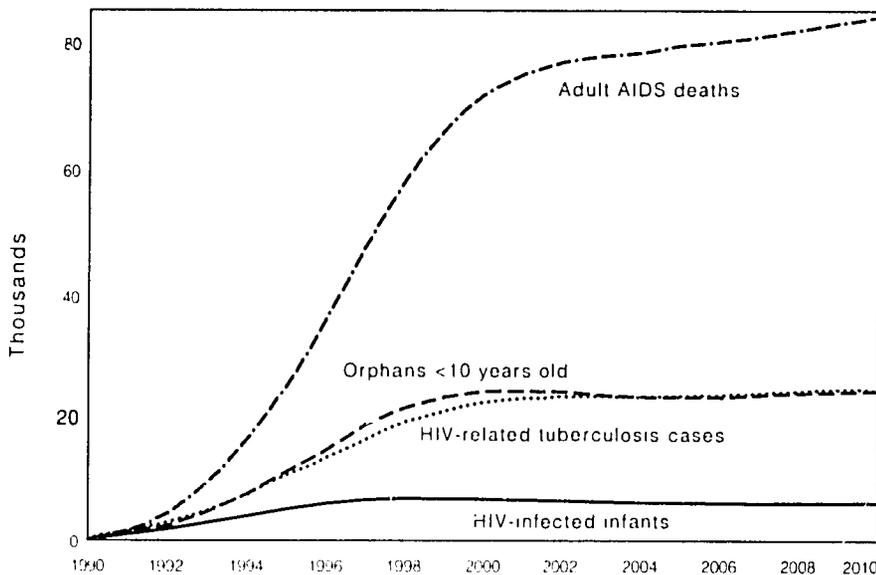


Figure 7. Annual numbers of adult AIDS deaths, adult tuberculosis cases related to HIV infections, maternal AIDS orphans under 10 years old, and HIV-infected infants estimated and projected on the basis of the moderate HIV scenario: Thailand, 1990-2010

tions grows to 2.3 million, but HIV seroprevalence decreases slightly to about 3.2 percent, given the larger total population. The low scenario results in about 50 percent fewer HIV and AIDS cases than the moderate, or conservative, scenario, and the high scenario about 25 percent more. The "Uganda" scenario yields from two to three times more cases than the moderate scenario.

Using the moderate HIV scenario for Thailand, I estimated and projected the annual numbers of AIDS deaths, HIV-related TB cases, and maternal orphans under age 10 at the time of their mothers' deaths from AIDS. During the early 1990s these annual numbers are expected to rise steadily, and all HIV-related diseases and deaths are projected to peak and then remain fairly constant at various levels after 2000 (Figure 7). In addition to the 80,000 to 90,000 annual adult AIDS deaths expected after 2000, the moderate scenario projects from 20,000 to 25,000 annual TB cases related to HIV infections, from 20,000 to 25,000 maternal AIDS orphans under 10 years of age annually, and more

than 5,000 infants who will acquire HIV infection from their infected mothers each year.

THE RELATIVE IMPACT OF AIDS IN THAILAND AND HONG KONG

Using the moderate HIV scenario, which I believe to be conservative, I estimated and projected the annual number of AIDS deaths per 1,000 adults aged 20-49 in Thailand and Hong Kong from 1993 to 2000. I selected Hong Kong for comparison with Thailand in part because its population has a low incidence of HIV. By 2000, the AIDS-specific mortality rate in Thailand is projected to be 4-5 deaths per 1,000 adults, while in Hong Kong it is projected to be only about 0.2 deaths per 1,000 adults (Figure 8). United Nations estimates of the annual mortality rate in Thailand from all causes among persons aged 20-49 have put the 1990 figure at slightly less than 3 per 1,000 (Larry Helligman, United Nations Population Division, personal communication).

Thus by the end of this decade the projected AIDS-specific mortality rate is expected to surpass the current mortality rate from all causes of death among young and middle-aged Thai adults. The United Nations Population Division has estimated the 1990 total mortality rate in Hong Kong to be less than 1 per 1,000 adults in this age group (Larry Helligman, personal communication). Although HIV prevalence is low in Hong Kong as of 1994, my projections indicate that by the year 2000 AIDS mortality will account for about 20 percent of all deaths among adults in the 20-49 age group.

CHOOSING A SCENARIO FOR POLICY PLANNING

How serious a problem will AIDS become in Asia? This question can be answered only with time. An old Arabic saying summarizes the uncertainties inherent in any forecasting: "He who predicts the future lies, even if he thinks he is telling the truth."

Short-term (less than five-year) projections of AIDS cases and deaths are the most useful for policy and program development as well as for public health and health-care planning. Such short-term projections will be fairly robust if the epidemiological data used to derive estimates of HIV prevalence and trends are reasonably accurate. This is so because 80-90 percent of AIDS cases that will occur over a four- to five-year period will develop in persons already infected. Longer-range forecasts are much less certain, regardless of the methods used.

These conservative scenarios are intended to alert policymakers and health planners to the magnitude of the increase in HIV-related diseases and deaths that can be expected during the remainder of this decade, even in the best of circumstances. Those respon-

sible for health and social-welfare programs need to mobilize resources to respond to the large case loads projected. If health-care systems cannot cope even with the conservative scenarios, there is little point in considering worst-case, or Doomsday, scenarios.

MISUSES OF HIV SCENARIOS

High- or low-HIV scenarios are plausible as long as the assumptions and the values used in making the assumptions fit within a reasonable range of estimates extrapolated from available data and observations made in other HIV epidemics. Interest groups working on behalf of HIV and AIDS patients often develop high-HIV scenarios not necessarily because they believe those scenarios to be realistic but rather to gain support for their cause. And too often, critics—on both the political left and right—who complain that HIV estimates or projections are too low or too high base their criticism not on an objective assessment of the available data but rather on whether the numbers are sufficiently high or low to affect the attitudes of policymakers and the public.

Nevertheless, the construction of unrealistic HIV scenarios lacks scientific credibility and in the long run may be counterproductive. Although numerous instances in which HIV estimates and projections have been misused can be cited, a few examples will suffice.

- I recently advised a high-ranking health official of a Pacific Rim country that his high estimate of HIV prevalence could not be supported by available data. He replied that "accuracy is not needed for AIDS advocacy."
- In 1988 New York City's commissioner of health, Dr. Stephen Joseph, enraged AIDS activists by halving the Health Department's estimate of

HIV-infected persons in the city from 400,000 to 200,000 on the basis of findings by his staff and an expert group (Joseph 1992). The activists protested his conclusion with disruptive and relentless demonstrations because they were convinced that the reduced estimate was a political ploy to justify reduced support for AIDS programs in the city.

- At an international conference on AIDS in 1991, I presented my estimate of HIV prevalence and trends in North America and Western Europe (Chia 1992), indicating that HIV incidence in these regions had peaked in the mid-1980s and projecting that the cumulative number of AIDS cases there would peak before the mid-1990s. A high-ranking health officer from a European country criticized my remarks on the grounds that making them public would be detrimental to AIDS programs. He feared my statements would cause others to draw the incorrect inference that the AIDS epi-

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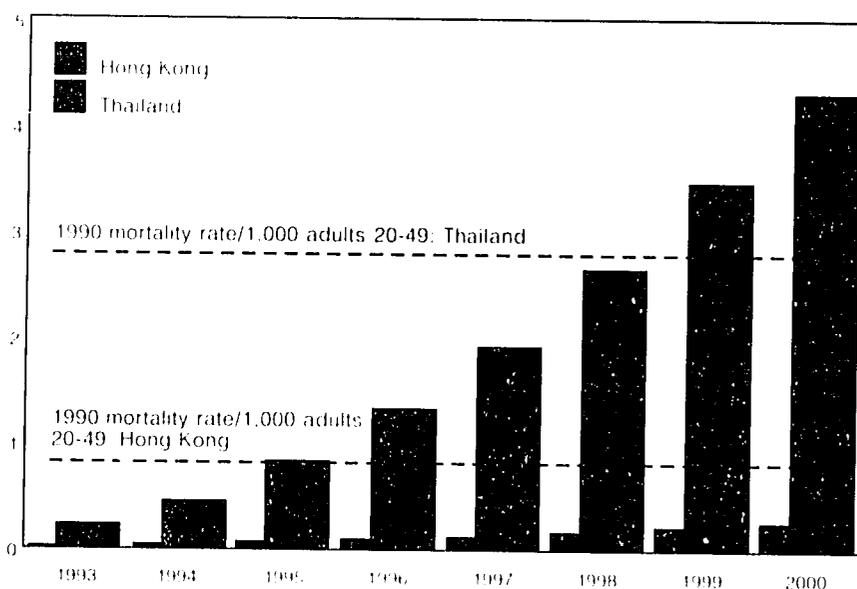


Figure 8. Annual numbers and rates of AIDS deaths estimated and projected among adults aged 20-49, based on moderate HIV scenarios: Thailand and Hong Kong, 1993-2000

Source: Adult mortality rates from all causes in 1990 from Larry Helligman, United Nations Population Division.

To maintain their credibility with policymakers and the public, epidemiologists must construct HIV scenarios as objectively as possible and be willing to make changes in response to new data.

demic was over. Although others may interpret the decreasing numbers of annual HIV infections in this light, the proper response, I believe, is to explain what the observed trends mean, not to deny the existence of those trends.

- In early 1992 the then director of the Global Programme on AIDS refused to revise WHO's official projection of 10 million cumulative cases of HIV-infected infants worldwide by the year 2000, although I advised him that the projection was unrealistically high. He took the position that WHO's credibility would suffer if the figure were to be reduced to about 3–4 million. He continued to cite the high projection; in his plenary address to the AIDS in Asia Conference in late 1992, he projected that by the year 2000 there would be about 4 million HIV-infected infants in Asia—a cumulative number that simply is not possible, even if the highest adult HIV scenarios were to prove accurate.
- The most alarming HIV scenario was presented at a U.S. Senate hearing on AIDS in 1992 by a prominent Harvard professor who stated that more than 1 billion people worldwide might be infected with HIV within two decades. This Doomsday scenario, the basis of which was unclear, would require from 25 percent to 50 percent of the world's entire adult population to be infected. An increase of this magnitude would not be difficult to detect should it occur, but this scenario is simply not plausible, given our current understanding of HIV risk behaviors and transmission, especially in developed countries.

To maintain their credibility with policymakers and the public, epidemiologists must construct HIV scenarios

as objectively as possible. They must also be ready to explain how each scenario was constructed and be willing to change any of the assumptions and values for the input parameters of a scenario when that is indicated by new data.

EVALUATING HIV SCENARIOS

Numerous individuals and groups using a variety of methods have developed HIV estimates and projections for sub-Saharan Africa, North America and Western Europe, and Asia. The following review compares my own assessment of the situation in each region with some of those estimates and projections.

A Harvard group, AIDS in the World (AIW), has published its Delphi projections for cumulative HIV infections to the year 2000 for all major regions in the world (Mann, Tarantola, and Netter 1992). AIW's high Delphi projection for cumulative HIV infections in North America and Western Europe in 2000 is close to 10.5 million. The group estimated that as of January 1994 the cumulative number of HIV infections in these regions was about 1.75 million (Daniel Tarantola, personal communication). Thus, to reach a cumulative total of 10.5 million by 2000, annual HIV incidence in these two regions will have to average close to 1.5 million. This level appears to be highly unlikely because the highest estimated annual incidence in these regions during the early 1980s was about 200,000. My conservative HIV scenario projects that the annual incidence of HIV infection over the next decade will remain low, reaching an endemic level of from 50,000 to 100,000 new infections annually. There is no doubt in my mind that AIW's high Delphi projection for these regions will have to be lowered markedly within the next couple of years.

The AIW's high Delphi projection for cumulative HIV infections in sub-Saharan Africa is more than 33 million by 2000. To reach this cumulative total, however, annual HIV incidence in the region would need to average more than 3 million. The highest annual estimate of HIV incidence in the region was about 1 million during the early 1990s, and it seems unlikely that annual HIV incidence over the next 5 to 10 years will exceed that estimate because most adults with the highest HIV-risk behaviors have already been infected. My conservative scenario projects HIV prevalence in this region to peak around the mid-1990s, with a gradual decrease to a lower endemic level by the beginning of the next century (Chin and Sato 1994).

Other scientists have published HIV modeling results that forecast an even more severe epidemic in sub-Saharan Africa (Anderson et al. 1991). Their mathematical model projects HIV prevalence continuing to increase over the next two decades and the infection of more than half of the entire adult population in a hypothetical sub-Saharan African country. Such high national HIV prevalence levels are possible but improbable, given past and current HIV data and trends in the region. They would require an annual HIV incidence averaging close to 10 million. Within the next few years it is quite possible that my conservative scenario, which would result in a cumulative total of more than 15 million HIV-infected adults in sub-Saharan Africa by 2000, may need to be revised slightly upward; but I am almost certain that the extremely high projections (of more than 120 million HIV-infected adults) will need to be revised markedly downward.

AIW's high Delphi projection for cumulative HIV infections in Southeast Asia in 2000 is more than 45 million. Their estimate for cumulative HIV in-



Commercial sex workers and their clients were among the first to be infected with the AIDS virus in Asia. Today, educational efforts promote condom use by persons at risk of contracting HIV through sexual intercourse. This poster (from Switzerland) urges those engaging in casual sex to use condoms.

fections in Southeast Asia as of January 1994 is close to 3 million. To reach a cumulative total of more than 45 million by 2000, HIV incidence in this region would have to average more than 7 million annually—which is possible but hardly likely. My conservative scenario forecasts that HIV infections in Asia will peak around the turn of the century and that the cumulative number of HIV infections in this region will then be about 12 million.

Projections of cumulative HIV infections in Thailand to 2000 range from fewer than 2 million (my own projection, made in 1992) to between 1.0 and 3.4 million, estimated by a Thai nongovernmental organization, and from 2 to 4 million, estimated by the Thai Working Group. The last-mentioned entity consisted of epidemiologists, demographers, and behavioral scientists

who developed data for an HIV model called IWGAIDS (from the Interagency Working Group on AIDS Models and Methods, or IWG, in the U.S. Department of State).

The HIV scenarios for Thailand that I have described in this report also resulted in a wide range of cumulative HIV infections by 2000. I projected about 0.75 million cumulative infections in the low scenario, compared with 1.4 million in the moderate scenario, 1.8 million in the high scenario, and close to 3 million in the "Uganda" scenario. The most recent HIV data and trends for Thailand suggest that both the "Uganda" scenario, which forecasts that HIV prevalence will reach 10 percent of the adult Thai population, and the initial IWG projection, which was as high or higher than the "Uganda" scenario, are unlikely outcomes. Great uncertainty still exists about long-term HIV projections for Thailand, but policymakers and health-care planners need to review carefully the short-term projections based on the low, moderate, and high scenarios, all of which suggest that tens of thousands of HIV-related illnesses and deaths can be expected annually by 2000, regardless of which scenario will be more accurate beyond that time.

SUMMARY AND CONCLUSIONS

Although major uncertainties remain about future HIV epidemics in Asia, one thing is certain: HIV infection will continue to spread. It is also safe to predict that the future distribution and prevalence of AIDS will vary widely among Asian countries. All the known HIV-risk behaviors and factors—commercial sex, promiscuous homosexual, bisexual, and

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heterosexual intercourse; drug abuse; and sexually-transmitted diseases—are known to be present in all Asian countries. Except for Thailand, however, scant data are available for accurately describing how these factors are distributed or for quantifying their prevalence.

The future levels of HIV and AIDS in any country will correlate closely with the current and future prevalence of other sexually transmitted diseases (STDs), such as syphilis and gonorrhea. Asian countries with low STD prevalence rates, such as China, are not expected to have high HIV rates, but countries and populations with high STD rates and low condom use are at great risk of having high rates of HIV and AIDS in the future.

It is difficult to construct HIV scenarios for Asian populations in which an HIV epidemic has not yet started or is in its very early stages. Most epidemic projections have been made for countries where HIV epidemic spread was well documented (that is, where HIV prevalence was found to be 1 percent or higher among high-risk groups such as STD patients) and where epidemic transmission had been noted for several years. Nevertheless, plausible HIV scenarios can be constructed for most Asian countries on the basis of specific epidemiological and behavioral risk factors. At this early stage of HIV spread in Asia, only a few scenarios are plausible:

- In a low scenario, HIV will continue to increase slowly in most Asian countries. Over the next 5 to 10 years, however, even the slow spread of HIV infection in Asia may result in several hundred thousand new HIV infections per year.
- In a moderate scenario, HIV epidemics will increasingly occur in more explosive forms in many of the poor and populous Asian countries. For the more developed countries and city-states (Japan, South Korea, Tai-

wan, Singapore, and Hong Kong), HIV epidemics may not be explosive, but there will probably be a slow and steady increase in HIV infections among the highest heterosexual risk-behavior groups, such as STD patients and female commercial sex workers. Throughout Asia, HIV incidence in a moderate scenario could exceed 1 million new infections per year within the next few years.

- In a high scenario, HIV epidemics will increase markedly in most Asian countries within the next few years and overall HIV incidence in Asia could rise to 3–4 million per year. Yet HIV prevalence rates will not reach the very high levels that are currently present in sub-Saharan Africa.

Although we do not know precisely how many HIV infections and AIDS cases have already occurred or are currently present in Asia, we can estimate and project numbers with varying degrees of uncertainty. All the HIV scenarios are merely scenarios, and as more data on HIV prevalence and trends are collected these scenarios may need to be revised. Nevertheless, even major revisions of HIV prevalence and trends in Asia after 1994 will not greatly affect annual AIDS projections until the late 1990s because most of the AIDS cases that will develop over the next four to five years will occur in persons who were infected during or prior to 1994.

Our ability to estimate past and current values is improving as public health surveillance systems collect more data. Although the accuracy of such estimates varies greatly depending on the quantity and quality of the surveillance data, epidemiologists can develop plausible minimum, maximum, and mid-range working estimates for the use of public health officials and health-care programs. The only certainty is that AIDS will eventually become an endemic disease that will be a major, if

not the leading cause of death among young and middle-aged adults in Asia and throughout the world. Projections of future patterns and prevalence of HIV and AIDS are needed so that governments can plan programs to respond to the increasing number of premature deaths due to AIDS in these age groups.

As of mid-1994, most Asian governments have progressed beyond the denial phase of the epidemic and have started public health programs for the prevention and control of AIDS. Even so, the current level of support given to most AIDS programs in Asia is woefully inadequate to the task of reducing the moderate HIV scenarios developed in this report. If governments continue to allocate inadequate staffing and funds to public health programs, they cannot expect the programs to be successful. Since the early 1990s Thailand and India have given high priority to the prevention and control of AIDS, but only after hundreds of thousands of HIV infections occurred.

Asian governments have become increasingly willing to begin planning for the potential impact of AIDS on all sectors of their societies. To plan effectively, they must develop their own national capabilities to assess the prevalence and distribution of HIV infection and to project future prevalence levels. Each country needs to have an expert group composed of nationally recognized leaders from public health and other disciplines who are trained to develop plausible working estimates and HIV scenarios. Their estimates and scenarios will make it possible for policymakers, health-care planners, and social-welfare agencies to prepare for the projected numbers of AIDS deaths and orphaned children.

There will never be a quick or simple solution to the global AIDS problem. Some dramatic decreases in HIV transmission have occurred among homosexual men in developed countries. It

is unrealistic, however, to believe that promiscuous sexual behavior, prostitution, and the sharing of drug-injecting equipment can be easily controlled by educational programs that merely warn the public about the risk of AIDS. Such behaviors are extremely difficult to change.

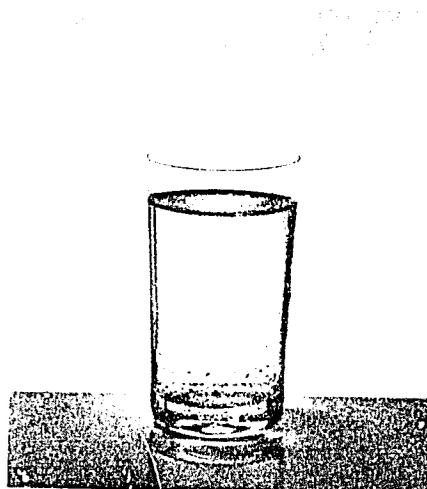
Nevertheless, these risk behaviors can be changed to eliminate or to reduce significantly the risk of HIV transmission by promoting the consistent and appropriate use of condoms for all sexual encounters outside mutually monogamous relationships among uninfected partners, and by assuring that injecting drug users do not share potentially contaminated injection equipment. Public health agencies have two strategies for preventing HIV infec-

tion in these risk-taking groups: developing understandable educational messages designed to modify or minimize high-risk behaviors, and providing condoms and sterile-injection equipment to persons who may understand the risk of HIV but continue to engage in risky behavior.

Sustained change requires far greater support and priority for prevention programs than has been forthcoming up to now in most Asian countries. Even with a massive and effective prevention program, some HIV transmission will occur among hard-core risk takers. Nevertheless, up to half of all future HIV infections might be prevented with adequately supported prevention programs. In Asia alone this could mean the prevention of several million AIDS deaths among young and middle-aged adults in their most productive years.

Policymakers throughout the world appear willing to pour what will be billions of dollars into the development of an AIDS vaccine but are not willing to allocate the same amount of money for education and behavior-modification programs that, in the long run, will be more effective. Even if an effective AIDS vaccine or treatment should become available, it will not be a "magic bullet" that eliminates AIDS as a global problem. Efforts to build public health infrastructures and to support HIV-prevention programs will have to continue because any vaccine or treatment for AIDS cannot be expected to be more than 70–80 percent effective.

Governments and societies in general still have not fully accepted the principle that an ounce of prevention is worth a pound of cure. Yet policymakers in Asia will be evaluated by how well they use the experience of other regions during the past decade to prevent further spread of this deadly virus. Will they give sufficient support to public health programs that might reduce risky



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The Program on AIDS of the Thai Red Cross Society and the Prime Minister's Office of Thailand are sponsoring a campaign to raise awareness and dispel misconceptions about AIDS. This poster's message: "Some diseases can be transmitted through sharing a glass of water, but not AIDS. AIDS can be spread only through contact with another person's blood or through sexual intercourse. Questions? Contact the Anonymous Clinic."

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behaviors, or will they continue to turn their backs on such efforts because homosexuality, bisexuality, sexual promiscuity, prostitution, and substance abuse offend their social and religious values? Will they overcome their social, cultural, and religious taboos and support AIDS programs designed to gain a better understanding of these behaviors, especially among Asian youths?

Without reliable baseline data on the prevalence and patterns of risky behavior, policymakers and AIDS program managers will not know how effective their interventions are. Until Asian societies give priority to promoting public health and supporting community programs to prevent HIV infection, they will continue to pay the huge medical and human costs that can be prevented.

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