HIV EPIDEMIOLOGY: A REVIEW OF RECENT TRENDS AND LESSONS

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Introduction

Our understanding of HIV epidemiology continues to grow. We have a far better understanding of the global diversity of HIV, HIV transmission dynamics in different contexts and effective prevention responses. HIV prevalence is declining in an increasingly impressive number of sites. This review summarizes recent lessons and trends in the global HIV epidemic.

What are we learning from improved surveillance?

Our investments in improved surveillance have yielded important results and insights. In the last five years, approximately 20 countries, including Botswana, Burkina Faso, Burundi, Cameroon, Ethiopia, Ghana, Guinea, Kenya, Lesotho, Mali, Rwanda, Senegal, South Africa, Tanzania and Zambia in Africa, the DR and Peru in Latin America and Cambodia in Asia have conducted national population-based, household HIV surveys. A major population-based HIV survey is now underway in India. These surveys have enabled us to refine previous HIV estimates derived from antenatal HIV surveys and have given us more accurate global HIV prevalence estimates. The results of antenatal and population-based HIV surveillance for all countries that have completed national population-based HIV surveys appear below in Figure 1.

Figure 1. Antenatal and population-based HIV estimates

As the figure shows, population-based estimates are lower in almost all cases (except Uganda) and significantly lower in many cases. The differences are particularly pronounced in parts of East Africa (notably Rwanda and Ethiopia) and much of West Africa (including Sierra Leone, Burkina Faso and Ghana), where population-based estimates are two- to fivefold lower than antenatal estimates. Cambodia’s population-based HIV prevalence of 0.6% is also far lower than its antenatal estimate of 2.6%.

As the ensuing section shows, improved surveillance has given us greater insight into the heterogeneity of HIV globally.
The heterogeneity of HIV

HIV in Africa is far more heterogeneous than previously recognized, as Figure 2 illustrates.

*Figure 2. The heterogeneity of HIV in Africa*

Africa’s HIV epidemic may be divided into four distinct clusters. Southern Africa is characterized by highly generalized epidemics, with HIV prevalence ranging from 15-35%. East Africa’s epidemics, for many years grouped with Southern Africa’s, are far lower, ranging from 2-7%. Prevalence in West Africa, Africa’s most populous region, ranges from 1-5%. In North Africa, HIV prevalence seldom exceeds 0.1%.

To an even greater extent than previously believed, Southern Africa is the epicentre of the global HIV epidemic. The hyper-epidemics of Southern Africa are a continental - and a global - exception, which are unlikely to occur elsewhere. HIV epidemics elsewhere in Africa are less generalized than previously believed.

If Africa’s HIV epidemic is so diverse, it is hardly surprising that the global HIV epidemic is even more diverse, as Figure 3 shows.
The fundamental distinction between concentrated and generalized HIV epidemics

Historically, we have said that HIV epidemics are concentrated if HIV prevalence in the general population is below 1% and generalized if HIV prevalence in the general population exceeds 1%. However, population-based surveys cited above show that HIV infection in the general population has been overestimated in many cases. Recent data from Cambodia underscores this point. Whereas earlier estimates suggested that 2.6% of adults were HIV-positive, recent preliminary population-based estimates suggest that well below 1% of adults may have HIV. The historical definition is flawed in several respects. First, as noted, it is often combined with overestimated prevalence to classify countries as generalized. Second, it does not accommodate contexts in which vulnerable groups form a large enough proportion of the adult population to produce overall HIV prevalence estimates above 1%, without significant transmission in the general population. Finally, and most seriously, it is not a transmission-based definition – indeed, it tends to classify countries arbitrarily as concentrated or generalized, limiting further analysis of underlying transmission dynamics. An alternative transmission-based definition is required, which encourages greater analysis of transmission dynamics and critical intervention priorities and points. We propose the following definition: An HIV epidemic is concentrated if HIV transmission is primarily attributable to HIV-vulnerable groups and if protecting HIV-vulnerable groups would protect the wider population. In contrast, an HIV epidemic is generalized if the converse is true – HIV transmission is not primarily attributable to HIV-vulnerable groups and protecting HIV-vulnerable groups would not in itself protect the wider population.

If this definition is used, there may be no generalized epidemics outside parts of Africa and the Caribbean (whose epidemics are in any case poorly understood). Moreover, within Africa, there may be considerably more concentrated epidemics than previously
recognized. Also within Africa, there may be more mixed epidemics, displaying significantly transmission both within and beyond HIV-vulnerable groups than previous analyses and typologies could readily accommodate. The following analysis of HIV prevalence and transmission patterns in three African countries in Western, Eastern and Southern Africa may shed further light on this submission.

First, consider HIV in Accra, Ghana, West Africa, where HIV prevalence in the general population is 2%, HIV prevalence in sex workers approaches 80% and a recent study by Cote et al (2005) estimated that 76% of new HIV infections among adult males of aged 15-49 was attributable to sex work. These data, shown in Figure 4 below, depict a highly concentrated epidemic.

*Figure 4. HIV transmission dynamics in Accra, Ghana*

Consider the following data (Figure 5) from Nairobi, Kenya, East Africa, where HIV prevalence in the general population approaches 10%, HIV prevalence among sex workers is approximately 60% and a study by Pisani et al (2003) estimated that approximately half of infections could be attributed to sex work. This pattern suggests mixed epidemic, with HIV infections arising almost equally from vulnerable groups and the general population.

*Figure 5. HIV transmission dynamics in Nairobi, Kenya*

Finally, consider the following analysis from Zambia, Southern Africa. In a context where adult HIV prevalence is approximately 15% and sex worker HIV prevalence is approximately 50%, Shields (2005) estimates that less than 5% of HIV infection may be attributed to sex workers, their clients and other male bridge populations, including
soldiers and truckers. The remaining infections occur outside recognizable HIV-vulnerable groups (Figure 6).

*Figure 6. HIV transmission dynamics in Zambia*

These three analyses from West, Eastern and Southern Africa depict three very different epidemics. Accra, Ghana, in West Africa, represents a concentrated epidemic, with most transmission attributable to sex work, in which programs to protect sex workers and their partners are a clear priority. Nairobi, Kenya, in East Africa, represents a mixed epidemic, with transmission among both HIV-vulnerable groups and the general population, in which interventions for both vulnerable groups and the general population are required, in equal measure. In contrast, Zambia in Southern Africa represents a highly generalized epidemic, in which most transmission is in the general population.

**What are the core distinctions between concentrated and generalized epidemics?**

What, then, are the core distinctions between concentrated and generalized epidemics? These distinctions are summarized in Table 1 below.

*Table 1. Concentrated and Generalized epidemics*

<table>
<thead>
<tr>
<th>Concentrated epidemics</th>
<th>Generalized epidemics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driven by sexual and injecting practices, especially among HIV-vulnerable groups, including sex workers, men-having-sex-with-men</td>
<td>Driven primarily by sexual behavior in the general population</td>
</tr>
<tr>
<td>Require large-scale to protect HIV-vulnerable groups</td>
<td>Require large-scale, fundamental changes in community norms and sexual values and practices</td>
</tr>
<tr>
<td>Expanding coverage of proven interventions vital</td>
<td>Social and community change processes critical</td>
</tr>
</tbody>
</table>

As elaborated below, we have a far clearer conception of how to address concentrated epidemics, through large-scale interventions for vulnerable communities. Our understanding of how to approach generalized epidemics is growing, but remains less confident.
Basing investments and interventions on the type of HIV epidemic

To what extent are we basing investments and interventions on the extent to which an HIV epidemic is concentrated or generalized? There are limited data, but the existing data prompt concern. Consider two striking examples, the first from a concentrated epidemic in Accra, Ghana, West Africa, the second from a generalized epidemic in Swaziland, Southern Africa.

In Ghana, where estimates cited above suggest that 76% of HIV infections among adult males of sexually active age could be attributed to sex work, the World Bank estimated that 0.8% of its MAP program support to Ghana was identifiably invested in programs for sex workers and their clients. This disjuncture between epidemiology and programs is illustrated in Figure 7 below.

Figure 7. HIV transmission dynamics and investments in Ghana

This striking disjuncture between HIV transmission dynamics and interventions is reproduced, albeit in the opposite direction, in some generalized epidemics. In Swaziland, major HIV prevention programs focused on HIV-vulnerable populations at borders and major highways. Yet, enumerations revealed very low numbers of sex workers, as Table 2 below shows.
Table 2. HIV-vulnerable groups at borders in Swaziland

<table>
<thead>
<tr>
<th>Group/Site</th>
<th>Lomahasha</th>
<th>Namaacha</th>
<th>Oshoek</th>
<th>Ngwenya</th>
<th>Lavumisa</th>
<th>Golela</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex Workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local</td>
<td>0</td>
<td>30</td>
<td>10</td>
<td>10</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Visiting</td>
<td>0</td>
<td>20</td>
<td>10</td>
<td>10</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>Truckers</td>
<td>Crossing</td>
<td>10</td>
<td>10</td>
<td>25</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Sleeping</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Traders</td>
<td>Crossing</td>
<td>120</td>
<td>120</td>
<td>20</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Sleeping</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Subsequent behavioral surveys confirmed that casual sex was far more common than commercial sex in Swaziland, as Figure 8 below shows.

Figure 8. Casual and commercial sex in Swaziland

Swaziland’s trends are also observed in nearby Lesotho, as shown in Figure 9 below.
From epidemiology to interventions – what is working?

What evidence is there that interventions may be working?

The UNAIDS 2006 Report on the Global HIV Epidemic notes that several countries in Africa reported reduced HIV prevalence rates by 2005. These declines are due to the following factors:

- Improved HIV surveillance and thus reduced estimates in some cases
- HIV-related deaths, which reduce the number of people living with HIV
- Behavior change, probably partly spontaneous and partly as a result of formal HIV prevention programs

In some countries, notably Uganda, Kenya and Zimbabwe in Africa and Thailand, Cambodia and South India in Asia, there is considerable evidence that, in addition to improved surveillance and death, behavior change has helped to slow the epidemic. This is encouraging, as HIV prevention through behavior change is the only way we can turn the tide against HIV. Despite increased access to AIDS treatment, HIV prevention remains the cornerstone of the global HIV response. While behavior change has many causes and cannot be attributed to any single program, we have some insights from one country with a generalized epidemic – Uganda – and two countries with concentrated epidemic – Thailand and Cambodia - into the overall program elements that contributed to reduced HIV transmission.
HIV prevalence and incidence

In order to understand reductions in HIV prevalence, it is important to distinguish between HIV prevalence and HIV incidence. HIV prevalence includes all HIV infections, new and old. HIV incidence is limited to new HIV infections, acquired in the last year. Because of the long duration between HIV infection and death, HIV prevalence trends lag HIV incidence trends by several years, as shown below:

**Figure 10. Illustrative HIV incidence and prevalence curves**

Recent US Bureau of the Census models suggest that HIV incidence began to fall in several countries in Eastern and Southern Africa in the late 1980s and early 1990s, as shown below:

**Figure 11. Modeled HIV incidence trends in Africa**

**Reduced HIV prevalence**

Globally, we were slow to spot declines in HIV incidence, because surveillance systems focus on HIV prevalence not incidence and HIV prevalence trends lag several years behind HIV incidence trends. However, as the UNAIDS 2006 Report on the Global HIV Epidemic notes, HIV prevalence is now declining in both generalized and concentrated epidemics.

**Generalized epidemics**

HIV is declining among pregnant women in several countries, including Uganda, Kenya, Zimbabwe, Rwanda, Ethiopia, Burundi and Burkina Faso. However, HIV declines in Ethiopia and Burkina Faso are largely limited to capital cities.

This analysis focuses on reduced HIV prevalence in three countries – Uganda, Kenya, Zimbabwe, where the evidence is strongest. The note first summarizes the evidence for HIV prevalence declines. It then examines the behavior changes that contributed to reduced HIV prevalence. It discusses some of the programmatic elements that may
have contributed to Uganda’s declining HIV prevalence. However, HIV prevalence declines cannot be attributed to any single program. Behavior change is due to many factors – spontaneous change in response to information and HIV deaths, local community responses, innumerable informal initiatives and myriad national and international initiatives – which cannot be disentangled.

Uganda

Reduced HIV Prevalence

HIV prevalence declines have been reported in many groups in Uganda, including urban and rural antenatal women both young and old, military recruits, the general population and youth in Masaka and Rakai districts.

Figure 12. HIV prevalence among 15-19 year old pregnant women in Uganda

Behavior change

Population based surveys conducted by WHO in Uganda from 1989 to 1995 present impressive evidence of behaviour change, with partner reduction among adults – particularly highly sexually active men - playing a major role, supported by deferred sexual inception among youth and increased condom use.

Figure 13a and b. Behavior change in Uganda from 1989 to 1995
Programmatic Elements

The following programmatic elements appear to have contributed to reduced HIV prevalence in Uganda:

- It focused on behaviour change – and specifically partner reduction - as the key to HIV prevention
- It was characterized by political commitment and engagement at all levels
- It was also characterized by a willingness to provide clear, unambiguous information and warnings, which pierced denial and helped to overcome stigma and discrimination
- It was multi-sectoral, involving government, community and religious leaders at all tiers
- It was based on the premise that communities can be mobilized to prevent HIV and that communities have within themselves the resources and capital to reverse this epidemic
- It relied upon social communication channels and networks to educate people about HIV
- It created a context in which people perceived high personal risk of HIV infection and a personal proximity to the epidemic (measured, for example, by the extent to which we know people have died of AIDS) that many communities and countries with equally high HIV infection levels have not yet attained

Kenya

Reduced HIV prevalence

HIV prevalence among pregnant women in Kenya has fallen from a peak of 13.4% in 2001 to 6.7% in 2004.
Behavior Change

Analysis of behaviour change in the 1998 and 2003 Kenya Demographic and Health Surveys yields similar conclusions. Partner reduction among adults played a major role, supported by deferred sexual inception among youth and increased condom use.

Figure 15a and b. Behavior change in Kenya
Zimbabwe

Reduced HIV prevalence

HIV prevalence has fallen from 33% in 1996 to 24% in 2004 (and early reports suggest 21% in 2005). While the trend is encouraging, 24% remains exceptionally high.

*Figure 16. HIV prevalence among pregnant women in Zimbabwe*

Behavior change

Surveys conducted by Imperial College in Manicaland, Zimbabwe also show significant behaviour change. Partner reduction among adults played a major role, supported by deferred sexual inception among youth.

*Figures 17a and b. Behavior Change in Manicaland, Zimbabwe*
Concentrated epidemics

In addition, we have seen HIV decline in several concentrated epidemics, most notably Thailand, Cambodia and South India.

Thailand

Reduced HIV prevalence and behavior change

As shown below in Figure 18, HIV prevalence fell among sex workers in Thailand, as condom use rose to extremely high levels in commercial sex and the proportion of Thai men visiting sex workers fell steeply.

Figure 18. HIV prevalence and behavior change in Thailand

As Figure 19 below shows, the decline in unprotected commercial sex in Thailand was associated with an 89% decline in STI rates.
Thus, the Thai data suggest a rapid and steep decline in STI and HIV transmission, attributable to behavior change, including a marked reduction in unprotected sex and a steep decline in the proportion of men visiting sex workers.

Cambodia

Reduced HIV prevalence and behavior change

As in Thailand, an analysis of Cambodia’s HIV epidemic (Figure 20) shows reduced HIV prevalence among sex workers (and pregnant women), associated with a steep decrease in unprotected sex and in the proportion of men visiting sex workers.

Figures 20a and b. HIV prevalence and behavior change in Cambodia
India

Reduced HIV prevalence

Recent data from India, presented below in Figures 21a and b, also show encouraging indications of reduced HIV prevalence among young antenatal clients and STI patients in South India, where HIV rates are highest.

*Figures 21a and b. HIV prevalence in India*

Sources: Kumar et al, 2006

"South" "North"
Conclusions

• Concentrated and generalized epidemics are fundamentally different and require discrete approaches. Globally – and even in Africa – there are far fewer generalized epidemics initially realized. Generalized epidemics should be approached as a tragic global exception – not as the most common epidemic pattern. Concentrated epidemics require concerted focus on HIV-vulnerable groups and high coverage of proven, evidence-based approaches. Generalized epidemics require fundamental changes in social and community processes and norms.

• Significant behavior change has taken place and has contributed to reduced HIV prevalence in a growing number of countries. Behavior change has myriad causes and cannot be attributed to any single program, reflecting a complex range of spontaneous and planned, formal and informal, local, national and international initiatives. With this caveat, concentrated epidemics may be reversed primarily through increased condom use, supported by reductions in the proportion of men visiting sex workers. Generalized epidemics may be reversed primarily by normative change and partner reduction in the general population, reinforced by condom use, particularly among individuals with rapid rates of partner change.

• Prevention remains our first weapon against this epidemic. Our prevention programs are improving and if sustained and intensified, can truly turn the tide against HIV. Reductions in HIV incidence and prevalence give us confidence that HIV prevention is working. Moreover, our understanding of what drives HIV transmission and how to address these drivers is growing, giving us a solid basis for even more effective HIV prevention responses. Despite increased access to AIDS treatment, HIV prevention remains our major weapon against this epidemic and must be sustained and intensified. In short, HIV prevention is working and can work even better in future. We stand at a crossroad – redoubled HIV prevention efforts can turn the tide of this epidemic.

• Much of Southern Africa remains a tragic exception - the absolute epi-centre of the global epidemic with continued high HIV transmission. It requires special analysis and approaches – business as usual will not suffice in Southern Africa.