

UNAIDS/WHO Working Group
on Global HIV/AIDS and STI Surveillance

Guidelines for second generation HIV surveillance: an update: Know your epidemic



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WHO Library Cataloguing-in-Publication Data

Guidelines for second generation HIV surveillance: an update: know your epidemic.

1.HIV infections – epidemiology. 2.Acquired immunodeficiency syndrome – epidemiology. 3.Disease outbreaks. 4.Epidemiologic methods. 5.Guideline. I.World Health Organization. II.UNAIDS.

ISBN 978 92 4 150582 6

(NLM classification: WC 503.4)

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Printed in Switzerland.

Design & layout: L'IV Com Sàrl, Le Mont-sur-Lausanne, Switzerland.

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Acknowledgements

Global surveillance of human immunodeficiency virus (HIV) and sexually transmitted infections (STI) is a joint effort of the World Health Organization (WHO) and the Joint United Nations Programme on HIV/AIDS (UNAIDS). The UNAIDS/WHO Working Group on Global HIV/AIDS and STI Surveillance, initiated in November 1996, is the main coordination and implementation mechanism for UNAIDS and WHO to compile the best information available and to improve the quality of data needed for informed decision-making and planning at the national, regional and global levels.

WHO and UNAIDS would like to thank the individuals who contributed to this document, including Virginia Loo, Tobi Saidel and Carolyn Smith for preparing this document and Bandana Malhotra for editing.

WHO and UNAIDS would like to thank Keith Sabin, Lori Newman, Jean M. Tassie and Jesus M. Garcia Calleja, WHO; Peter Ghys, Mary Mahy, Karen Stanecki, Paloma Cuchi, UNAIDS headquarters; members of the UNAIDS/WHO Working Group on HIV and STI Surveillance; Christopher Murrill and other members of the US PEPFAR Surveillance and Surveys Technical Working Group,

Significant contributions were also received from Rand Stoneburner, UNAIDS headquarters; Renu Garg, Monica Alonso and Abdil Kareem Alisalad, WHO Regional Offices.

The concepts and material presented in this publication were informed by many workshops and second generation surveillance projects conducted worldwide over a period of ten years, from 2000 to 2010. WHO and UNAIDS would like to acknowledge the contributions of the participants of these meetings, including staff of national AIDS programmes and experts in various fields related to HIV epidemiology.

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1. Introduction

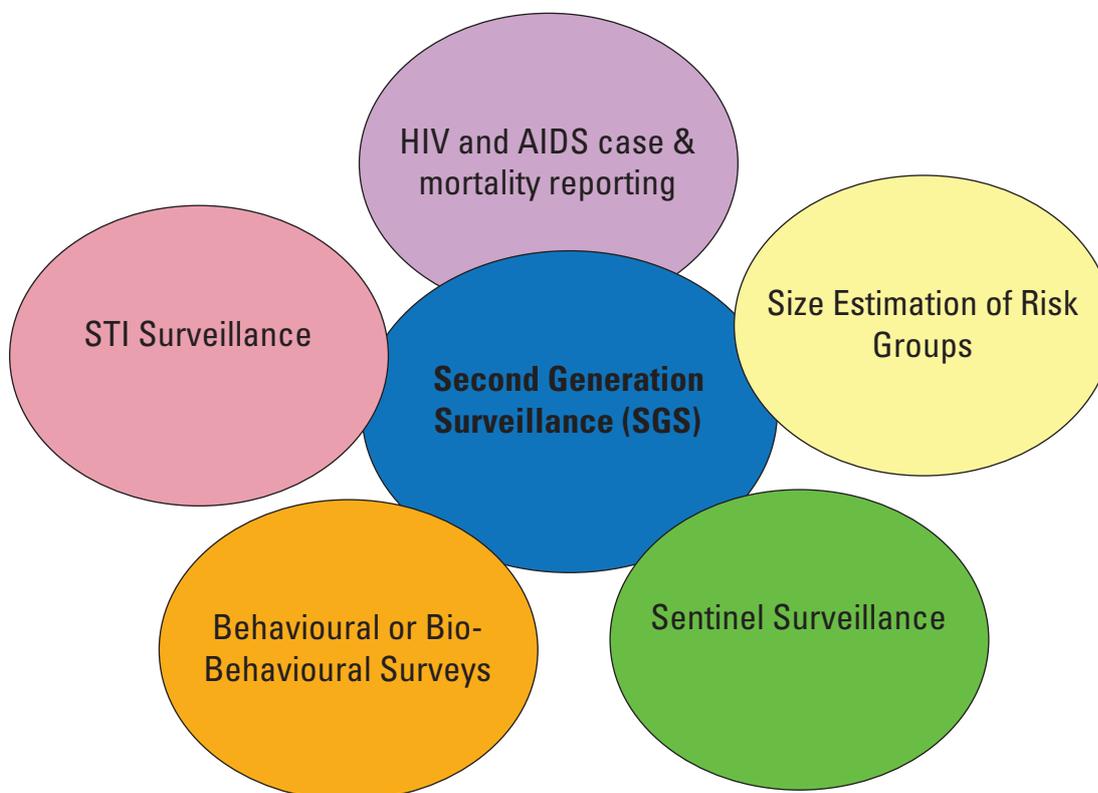
1.1. What is second generation surveillance?

First generation surveillance relied solely on data on AIDS cases and some sentinel studies on HIV prevalence. In 2000, a new strategy named second generation surveillance (SGS) was promoted to tailor surveillance systems to the epidemic state of a country (1). More specifically, the strategy proposed the following:

- to concentrate strategic information resources where they would yield information that is useful in reducing the spread of HIV and in providing care for those affected;
- to concentrate data collection in key populations at higher risk of HIV exposure, such as populations with high levels of risk behaviour that places them at increased risk or young people at the start of their sexual lives;
- to compare information on HIV prevalence and on the behaviours that spread the infection to build up an informative picture of changes in the epidemic over time;
- to make the best use of other sources of information, such as communicable disease surveillance and reproductive health surveys, to increase understanding of the HIV epidemic and the behaviours that spread it.

The components of HIV second general surveillance remain similar as presented in figure 1.

Figure 1: Components of HIV second generation surveillance



1.2. Purpose of this document

This document describes a process that would enable countries to respond more effectively to their respective HIV epidemics. Using this process, they will be able:

- to review and analyse surveillance efforts already undertaken in the country
- to describe the trends of the epidemic
- to provide recommendations to policy-makers, and
- to design methods for additional data collection to strengthen ongoing surveillance systems.

1.3. Background

Since 2000, countries have focused resources and attention on implementing HIV second generation surveillance. Increasingly, the critical information needed for countries to stay ahead of their epidemics is being gathered, collected, interpreted and applied.

An update was needed to the 2000 guidelines to incorporate the experiences of countries implementing second generation surveillance over the past 10 years. Field experience and new challenges, including important changes in survey methodology and laboratory diagnostics, have been presented at two global conferences on HIV surveillance methods and tools (2,3,4).

Countries have gained experience in when and how data collection activities for surveillance and monitoring and evaluation (M&E) can be designed so that they are complementary (5). These data collection activities have some overlaps.

- The main objective of surveillance is to track how the epidemic in a country is changing.
- The main objective of M&E is to track how effectively programmes are responding to the epidemic, and whether the outcomes and outputs correspond to the activities planned.

When conducting surveillance activities, universal ethical principles should be taken into consideration. Ethical issues are complex and require discussion and agreement. The following paragraph highlights only some of the issues that should be considered when implementing surveillance activities.

Ethical considerations

The collection and use of HIV-related data raise many critical ethical issues. One must address these issues in the design and implementation of surveillance activities. Given below are some of the key ethical concerns to think about:

- Obtain true informed consent when collecting data that are not routine or primarily for the benefit of patient management or evaluation of services.
- Be cautious with the reporting of data on the size and location of persons who engage in HIV-related risk behaviours, such as sexual practices that put them at higher risk for HIV exposure or illicit substance use. Avoid their unwarranted harassment or detention by local authorities.
- Protect confidentiality of data on HIV testing and status. Avoid reporting results of surveillance data from small geographical units or small populations.
- Avoid stigmatizing surveillance subjects with sexually transmitted infections (STIs) such as syphilis, gonorrhoea, chlamydia and HIV.
- Provide participants in HIV prevalence surveys with access to test results and referrals for services or treatment, especially those individuals who are HIV-positive.
- Use the results of surveillance for policy-making and improving the response to the HIV epidemic.

Surveillance protocols for any method, whether case reporting, surveys or sentinel surveillance, must address the relevant ethical issues. More detailed guidance is provided in *Ethical principles when conducting HIV surveillance activities for second generation surveillance* (6).

1.4. What this update includes

This update:

- re-emphasizes the key approaches to conducting HIV surveillance;
- highlights new methods, tools and thinking to make second generation surveillance more critical and relevant to a country's response to the HIV epidemic;
- gives guidance on using and interpreting surveillance data more effectively.

Since the *Guidelines on second generation surveillance* were published in 2000 (1), a number of other detailed technical guidelines have been developed on specific surveillance topics. These are listed in Appendix B and should be referred to for more detailed information on specific issues related to surveillance. Throughout this update, references are given to technical documents that expand the application of surveillance methods.

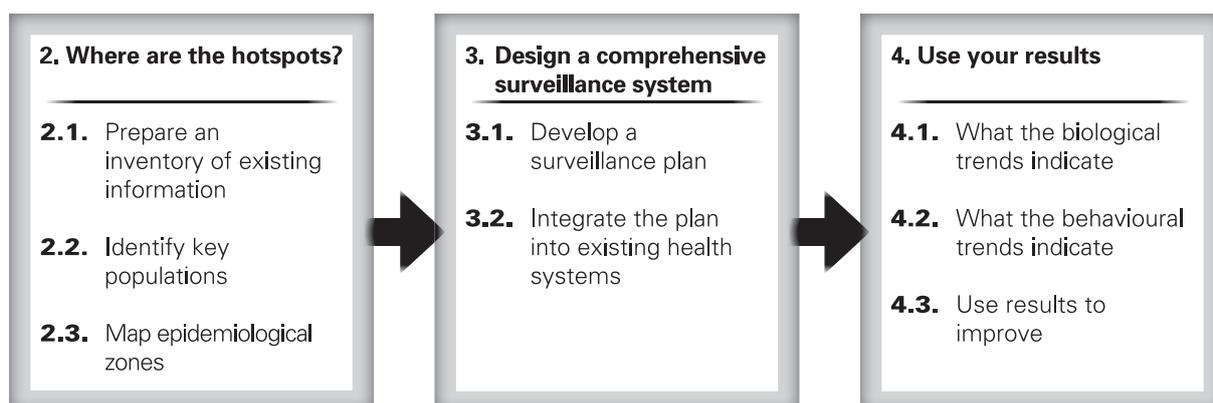
1.5. Process (→ “From start to finish: the process of HIV surveillance”?)

To address any epidemic, one must first *Know your epidemic* (4), then use the results of the analysis to provide services to areas and groups that require them the most. This document provides guidance on how to use second generation surveillance techniques to learn where most new HIV infections arise and to assess the direction of the epidemic.

Figure 1.1 shows a general process for conducting HIV surveillance activities. It is important to remember that because most countries have already developed HIV surveillance activities, all countries have some data from past surveillance activities.

Figure 1.1. Process for implementing enhanced second generation surveillance techniques

The numbers in the process below refer to the sections and subsections of this document.



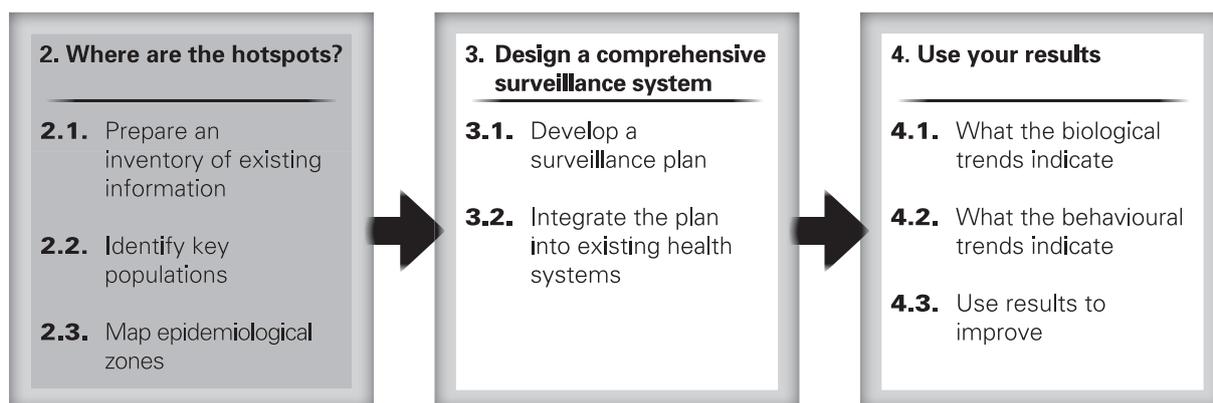
The remainder of this document discusses the process shown in Figure 1.1.

2. Where are the epidemic hotspots in your country?

This section shows how to describe a country's epidemic using the available reports and information. The work that has been done in a country will give insights into the epidemic hotspots. A hotspot is defined as a geographical area or location with evidence of high prevalence of HIV, STIs or behaviours that put people at risk for acquiring HIV infection.

Most countries already have HIV data from antenatal clinics (ANC) or surveys among specific populations, but information may not be available for all populations. There may be a need to identify areas where there is not enough information. One should not make the mistake of thinking *no information means no epidemic potential*.

Figure 2.1. How to collect existing data to create a detailed map and inventory



2.1. Prepare an inventory of existing information

2.1.1. Identify sources of data

Where are cases of new or advanced HIV infection cases coming from in your country? Are programme resources being used where they are needed to respond to the country's epidemic?

To find answers, one should begin by collecting existing information within the country. Some sources may be past national surveys. Other data may be focused in big cities or other subnational areas. Some surveys may include HIV testing of respondents. Some will not.

Here are some possible data sources:

- Sentinel surveillance of ANC attendees
- Sentinel surveillance of key populations at higher risk
- Probability surveys of the general population
- HIV and HIV advanced infection or AIDS case reporting
- STI case reporting
- Geographical mapping of HIV-positive cases or populations at increased risk for HIV

- Data from interventions or programmatic data
- Secondary data sources (from non-health sector).

No one source of surveillance data will answer all questions. One must pull data together, then triangulate (or synthesize) the data and interpret the results (7).

2.1.2. Know your epidemic

As recent national and regional/local information is reviewed, the information needed to *know your epidemic* will begin to emerge (1). Knowing a country's epidemic consists of identifying the important epidemiological regions where new infections are coming from and understanding how the epidemic is changing, either due to natural causes or as a result of interventions.

To provide information for data-driven planning for HIV programmes, one needs:

- to identify parts of the country where the epidemic appears to be the most severe;
- to describe the different factors that seem to be promoting new infections in different parts of the country;
- to list areas where there are few infections and possibly little transmission;
- to distinguish between areas with few infections and areas where there is *no information*;
- to describe which systems are already in place to detect areas with emerging epidemics and assess how sensitive these systems are.

2.1.3. Learn where most new infections come from in your country

There are two dimensions one must know in order to understand where most new infections are occurring. These are the geography of the country and the various behaviours that put people at increased risk for HIV infection. It is important to know the context in which HIV transmission occurs.

The geography → First dimension: the geography

Most countries have diverse regions with varying socioeconomic conditions and populations. An effective surveillance system must describe what is happening in every geographical region across the country or at least where the majority of the people live. In this way, one can provide information to planners of intervention programmes.

Behaviours at increased risk → Second dimension: behaviours at increased risk

Some behaviours are likely to result in more infections in some parts of a country and among some people. A country must identify the key populations with behaviours that increase their risk for acquiring or transmitting HIV. Some behaviours that increase a person's risk to HIV are:

- heterosexual sex with multiple and overlapping partners
- selling of sex
- injection drug use
- anal sex.

Identify data sources that provide information on these risk behaviours from surveys or programme records, from police records or other possible data sources. Alternatively, identify sources of data on populations that often engage in these behaviours such as truck drivers or prisoners. Risk behaviours and their context are discussed further in section 2.2.

2.1.4. Develop a surveillance inventory

A surveillance inventory is a summary of the data sources that are available for the key populations in each geographical unit of a country. A surveillance inventory provides surveillance managers with an overview of where data may be insufficient to "know your epidemic".

Choose geographical units

The units should reflect how data are collected and how the response is organized. At this early stage, one can use administrative divisions like districts, for example, aligned with the boundaries used for routine health information data collection, programme budgets or management structures. One way to organize the information currently available for each geographical unit is to create an inventory of surveillance activities. Begin the inventory by listing each geographical unit as, for instance, in Table 2.1, left column. Later, one can add what data sources are available for each key population at higher risk, as given in section 2.2.

Table 2.1. Sample: Begin a surveillance inventory by entering geographical units in the left column

Province/district	General population	Sex worker	Men who have sex with men	Persons who inject drugs	Other group
Province A					
District A1 (capital)					
District A2					
District A3					
Province B					
District B1					
District B2					
District B3					

2.2. Identify key populations at increased risk for HIV

As the surveillance inventory is developed and the data studied, areas where there is more HIV infection (HIV prevalence is high and risk behaviours are prevalent) will begin to emerge.

Follow these four steps to identify key populations at increased risk (each will be described in detail in this section):

- Step 1: In each geographical unit, decide which groups are important to track.
- Step 2: In a concentrated epidemic, estimate the size of populations at increased risk, if needed.
- Step 3: For the most affected groups, assess the level of risk intensity, through qualitative studies done previously.
- Step 4: Assess the current level of disease among different populations.

During these steps, we will refer to the epidemic categories proposed in 2000: low level, concentrated and generalized. Keep in mind that these categories may be different for different population groups or different geographical locations within a single country. A given country or population may change from one category to another over time, although progression over time should not be implied by the usage of these terms.

Epidemic categories

Low-level epidemic

- HIV has not spread to significant levels in any subpopulation, including key populations at higher risk for HIV, such as sex workers, clients of sex workers, men who have sex with men and persons who inject drugs.
- The spread of HIV is slow and inefficient because there are infrequent and few repeated transmission contacts among persons at higher risk for HIV. HIV may have only recently been introduced or may not have entered a population network with behaviours that put them at higher risk for HIV exposure.

Concentrated epidemic

- HIV transmission has taken root in one or more key populations whose behaviour puts them at higher risk, such as sex workers, clients of sex workers, men who have sex with men and persons who inject drugs.
- HIV is rarely transmitted to people outside of these key populations at higher risk of HIV exposure or their regular sex partners.
- Unless there are behaviour changes or changes in the levels of other risk factors such as having an STI, HIV transmission will continue among these key populations. Transmission will occur most rapidly among persons who inject drugs or engage in unprotected anal sex.
- The size of key populations at higher risk for HIV and the degree of risk behaviours will determine the number of new infections. Most new infections among the general population can be linked to contact with a sex worker, men who have sex with men and persons who inject drugs.

Generalized epidemic

- HIV is established in the general population.
- A large proportion of transmission occurs outside the context of commercial sex, injecting drug use or multiple partner male-to-male sex.
- Sex with multiple partners among the general population is at high enough levels to sustain epidemic growth.
- Populations with specific behaviours that increase their risk for HIV infection may contribute to more new HIV infections, even if the number of people with those behaviours is low.

The proxy thresholds for the different categories of epidemic have been discarded because some people regarded the proxy numbers as extremely rigid and they were a source of confusion to policy-makers.

Categorization of a country or population as having a low-level epidemic should be done with caution. The low-level designation is sometimes interpreted as “no cause for concern, action or resource allocation”. The key message for low-level epidemics is the greater need for focused interventions, prioritizing geographical areas and key population groups, and vigilance in monitoring the epidemic.

2.2.1. Step 1: Decide which key populations are important to track

In each geographical unit, determine whether there are key populations with known *risk behaviours*.

In the case of concentrated epidemics, the most relevant risk behaviours and key populations are those associated with the main routes of HIV transmission, such as unprotected anal sex, unprotected vaginal sex, and/or use of non-sterile injections or materials.

However, in generalized epidemics, it may well be clients of sex workers, the general population and persons with large numbers of overlapping sex partners. In these epidemics, there is evidence that the so-called key populations may also play an important role in HIV transmission.

Four key populations are at higher risk for HIV because of their behaviour. HIV is likely to be transmitted rapidly or emerge first in the following groups:

- persons who inject drugs
- male, female or transgender sex workers
- clients of sex workers
- men who have sex with men, particularly those who have a large number of partners, such as those who find sexual partners at public cruising sites such as parks and bars.

Also at risk are people (males and females) who have multiple (non-commercial) heterosexual partners over a short period of time. They are not easily identified as a group. Identifying the subpopulations with these risk behaviours within the general population is key to tracking the epidemic.

In any population group, there will be a wide range of risk behaviours practised. HIV risk transmission is not equally distributed among populations. Try to determine how each group is defined in terms of population size, behaviours and disease prevalence measured. When subgroups of the population have distinct levels of risk behaviour, try to determine if there are clear definitions for these subgroups as well. For example, sex workers may be divided into two (or more) subgroups: street-based and brothel-based.

Why identifying key populations at higher risk is important, no matter what the epidemic category

In a generalized epidemic, identifying key populations at risk for HIV is just as important as for a concentrated or low-level epidemic. The information is used differently in the three types of epidemics.

- In a low or concentrated epidemic, the presence of populations whose behaviour puts them at increased risk is a key indication of epidemic potential in a local area, especially if the prevalence data are sparse.
- In a generalized epidemic, seroprevalence data are often more widely available. However, it is still necessary to identify the presence of populations at risk. When you know where most new infections are occurring, whether from sex work, injecting drug use, among men who have sex with men or from having multiple casual sex partners, you are able to plan intervention programmes.

Adopt proxy definitions

It is often necessary to use proxy definitions for populations whose behaviour puts them at increased risk for HIV. A *proxy definition* uses a sociodemographic characteristic of a group, such as occupation, or places where key populations at higher risk are found, such as men at beer halls, male migrants living in dormitories, youth living on the street, and so forth.

The proxy definition is not causally related to risk. For example, truckers are often used as a proxy definition for clients of sex workers, because some studies show that a larger proportion of truckers report being clients of sex workers than men in the general population. On its own, driving a truck is not a risk for acquiring HIV, of course.

A proxy definition is never perfect:

- Some people who meet the proxy definition may not engage in the risk behaviour.
- Others may not meet the proxy definition, yet still engage in the risk behaviour.

Over time, some proxy groups have been adopted widely, for example, truckers, factory workers, military personnel and so forth. These populations are chosen as proxy groups based on findings that when high-risk behaviour is common within a group in one area, the same level of risk also applies to the group in other areas. These assumptions may hold true in most cases. Where possible, test these assumptions locally to ensure that resources are not being wasted by pursuing a proxy group that is not at increased risk for HIV. Of course, if the population identified as a key population can be targeted for surveillance, it is better to target this population instead of a proxy population.

If data from proxy groups have been used to describe the epidemic, survey documents should be clear on why the proxy group was adopted. Local data which demonstrate that the proxy group represents a population with behaviours at increased risk should be included.

Commonly used proxy groups

Young people: With increasing coverage of antiretroviral therapy (ART) among the HIV-infected population and the trend to initiate antiretroviral therapy at higher CD4 count levels, measuring HIV prevalence will provide a false picture of HIV trends. With more people living longer due to antiretroviral therapy, HIV prevalence will increase. Therefore, measuring HIV prevalence among young people will provide better information for estimation of recent trends and new infections.

Persons with STIs: Looking at the incidence of acute STIs (such as urethral discharge, primary or secondary syphilis or gonococcal infection) in a given proxy group may be one way to assess that unprotected sexual intercourse is occurring. In addition, the prevalence of syphilis (assessed through syphilis screening) in a given proxy group can be an indicator of insufficient access to quality health-care services.

Migrant males and truckers: Occupation-based definitions have often been used as proxies for groups of male clients. Truckers and male migrant labourers travelling without their families are some examples. People in some occupations have larger proportions of men who buy sex due to increased means, opportunity and social isolation because they spend time away from their spouse or regular partner.

Prison populations: Conditions in prisons such as overcrowding, poor sanitation, violence and limited access to prevention services contribute to rapid transmission once disease is introduced into the population. Prison populations serve as a proxy for persons who inject drugs and, to a lesser extent, for men who have sex with men. The range of risk behaviours in prisons may vary considerably.

Antenatal clinic attendees: Unlike the other proxy groups given as examples, ANC attendees are not a proxy for a high-risk behaviour group. Instead, ANC attendee populations have been useful for assessing the extent of spread of HIV to a more general population of women. Substantial effort has gone into determining how useful ANC attendees are as a proxy for prevalence in the female general population. Many factors influence the use of ANC data as a proxy:

- the level of HIV prevalence previously estimated
- the maturity of the epidemic
- the selectivity of testing among ANC attendees
- the types of ANC facilities that participate in surveillance compared with ANC utilization patterns among pregnant women
- the extent and coverage of interventions for prevention of mother-to-child transmission (PMTCT) in the country.

The discussion about the use of ANC surveillance in countries with high coverage of PMTCT services is ongoing. New guidelines will be produced on how and on which occasions PMTCT data can be used to replace ANC surveillance data.

Keep track of multiple populations

Remember that a geographical area may contain multiple populations and subpopulations at increased risk; these should be characterized in terms of size and risk behaviours. It is not enough to characterize the main population or the most visible one. Other important populations may have the potential to worsen the HIV epidemic in a given area.

For example, in many Asian epidemics, the sex work industry is large and appears to be the source of most new infections. Persons who inject drugs and who buy sex are critical sources that account for the rise in HIV prevalence among sex workers. Both populations should be monitored carefully.

In other countries, the presence of a very visible population of persons who inject drugs should not overshadow the importance of monitoring what is occurring among the large number of sex workers in the same locations.

Describing where most infections come from is not the same as knowing which population has the largest number of new infections

The number of new infections depends on the incidence rate and the size of the population exposed to that incidence rate. Focusing on the population with the highest incidence rate can sometimes be more effective than focusing on the population with the largest number of new infections.

For example, in epidemics where sex work is fuelling the epidemic, the number of sex workers may be small even when HIV prevalence among sex workers is high.

Using epidemic models, you may find that a much larger number of new infections are estimated to occur among the partners of clients of sex workers than among the sex workers themselves. However, focusing prevention efforts on the partners of clients, solely based on the larger number of infections would be a mistake because new infections among male clients and their partners are attributed to sex work. One should recommend prioritizing sex work prevention interventions (i.e. intervening with the “source population”) as a more effective strategy for preventing new infections among sex workers, clients and the clients’ regular partners.

At this point, add what you have collected about studies of key populations at higher risk for HIV exposure to your inventory.

Table 2.2. Sample surveillance inventory: Country X

Province/district	General population	Sex worker	Men who have sex with men	Persons who inject drugs	Other group
Province A	DHS (2006, 2009); Youth BSS (2005)				
District A1 (capital)	HSS ANC (2000–2007)	Mapping (2005) HSS (2000–2008)		RSA (2004)	HSS prison (2004–2009)
District A2		Mapping (2005)			
District A3	HSS (2000–2006,2008)				
Province B	HSS ANC (2000–2007)	HSS (2004–2008) BSS (2000)			
District B1					
District B2		Mapping (2005)		RSA (2004)	HSS prison (2004–2009) HSS STI (2000–2007)
District B3	HSS ANC (2000–2007)	Mapping (2005) BSS			

DHS: demographic and health survey

BSS: behavioural surveillance surveys

HSS: HIV sentinel surveillance

RSA: rapid situation assessment

HSS ANC: sentinel surveillance with sequential samples of ANC attendees

HSS STI: sentinel surveillance with biomarkers for sexually transmitted infections

2.2.2. Step 2: Estimate the size of key populations, if relevant

In each geographical unit, estimate the size of the key populations. The size of the populations most at risk for HIV is one of the most critical determinants for:

- the likelihood of spread of HIV in an area where this population is prevalent
- the increase or decrease in the number of people with this behaviour
- how much the population contributes to new infections, particularly in low and concentrated epidemics.

For example, in a group of persons who inject drugs with a high frequency of injecting and who commonly share needles when injecting, the potential for HIV to spread in a geographical unit is limited if the group comprises only a handful of people.

In the case of sex work, the potential for spread depends both the number of sex workers and the number of men who buy sex. Even if the number of sex workers is small, sex work can fuel an epidemic if the percentage of men who buy sex is high, say more than 10% of the male population, and if sex is bought frequently enough.

In a generalized epidemic, size estimates are needed for key populations whose behaviour puts them at risk for HIV as well as for people who engage in high-risk sexual behaviour, such as having multiple partners, concurrent partners, high levels of partner exchange and infrequent condom use.

The key populations in generalized epidemics can be measured, with some limitations, using nationally representative surveys which include questions on behaviours.

Are highly precise population estimates needed?

A highly precise estimate of population size is not needed to know roughly where most new infections come from. It is more important to be able to distinguish sizes which differ by an order of magnitude or more. That is, try to determine if the subpopulation at risk in a geographical unit is less than a hundred persons or contains several thousand persons.

Knowing the relative size of key populations at higher risk in different geographical units is also helpful. Because the population within a geographical unit is likely to be variable, it can be helpful to compare the size of key populations at risk both as absolute numbers as well as a percentage of the general population.

When considering which subpopulation may be the source of more infections compared to another, consider both the size of the key populations at higher risk and intensity of risk behaviour/potential for transmission.

This will require using the same population definitions to determine the size of the population and characterizing the intensity of risk behaviours. As mentioned earlier, the impact of each subpopulation on new infections in a given geographical unit should also take into account the potential number of infections transmitted:

- to regular sexual partners of sex workers
- to clients of sex workers
- to men who have sex with men
- to persons who inject drugs.

There is no perfect method for estimating the size of populations at increased risk for HIV. Table 2.3 presents a summary of methods with a short description. A guideline for estimating hidden populations has recently been published. It provides technical details on various methods and tools (8).

Table 2.3. Summary of methods for estimating population size

Category 1: Methods based on data collected in a key population at high risk		
Method name and description	Advantages	Disadvantages
<p>Census method counts all members of the population.</p> <p>Enumeration method develops a sampling frame then counts all members of the population at a sample of places listed in the sampling frame.</p>	<p>Census method is easy to explain as it simply attempts to count all members of the population.</p> <p>Enumeration method maps and then covers just a fraction of the population.</p>	<ul style="list-style-type: none"> • Key populations at high risk are often hidden. Both methods will miss members of the population not visible to the public. • Community guides are necessary to improve access. • Census is time-consuming and expensive to conduct • Enumeration method requires a reliable sample frame of venues. • Overestimates are made if the population is mobile and double counted in the exercise, and underestimates if populations are well hidden.
<p>Capture–recapture methods calculate the total size of a population based on two independent captures (samples) of population members:</p> <ul style="list-style-type: none"> • Capture 1: “tag” and count number tagged. • Capture 2: “tag”: keep track of who is “retagged” and who is “first time tagged”. 	<ul style="list-style-type: none"> • A simple two-sample capture–recapture method is relatively easy to use. • Does not require much data • Does not require statistical expertise 	<p>Relies on assumptions that are hard to meet in normal field conditions:</p> <ul style="list-style-type: none"> • Two samples are independent and not correlated. • Each member of the population has an equal chance of selection. • Each member is correctly identified as “capture” or “recapture”. • No major in/outmigration is occurring. • Sample size is large enough to be meaningful.
<p>Multiplier methods compare two independent sources of data for key populations at high risk.</p> <ul style="list-style-type: none"> • Source 1: count/list persons who accessed a service • Source 2: proportion of population who accessed service from representative survey of population of interest 	<ul style="list-style-type: none"> • Straightforward if data sources are available • Flexible method, useful in many circumstances 	<ul style="list-style-type: none"> • The two data sources must be independent. • The data sources must define the population in the same way. • Time periods, age ranges and geographical areas from the two data sources are not always aligned. • Data collected from existing sources may be inaccurate.

Table 2.3. Summary of methods for estimating population size (continued)

Category 2: Methods based on data collected from the general population		
Method name and description	Advantages	Disadvantages
<p>Population survey methods with general population behaviour questions</p>	<ul style="list-style-type: none"> • Surveys are common and familiar. • Straightforward to analyse and easy to explain to data users 	<ul style="list-style-type: none"> • Difficult to use when the behaviours are rare or stigmatized • Only reaches people residing in households, schools or other institutions used to create the sampling frame • Respondents are unlikely to admit to high risk or stigmatized behaviours if interview is not confidential or if interviewer is not skilled at establishing trust and rapport.
<p>Network scale-up methods are based on the idea that people's social networks reflect the general population.</p> <p>Ask a random sample in the general population to estimate the number of people they know, and how many of those people have the behaviour of interest.</p>	<ul style="list-style-type: none"> • Can generate estimates from the general population rather than hard-to-reach populations • Individuals are often more likely to report on the behaviour of others instead of their own behaviour. • A single survey can be used to create a size estimate for multiple hidden populations. 	<ul style="list-style-type: none"> • Average personal network size is difficult to estimate. • Subpopulations may not associate with members of the general population. • Respondent may be unaware that someone in his/her network engages in behaviour of interest. • Respondents may be hesitant to admit to knowing individuals with the specified behaviour.

Source: Adapted from Monitoring and evaluation guidelines for HIV prevention for men who have sex with men. MERG Technical Working Group on Most at Risk Populations. December 2009 (9).

2.2.3. Step 3: Assess the levels of risk intensity among key populations at increased risk

In geographical units where large numbers of people belonging to a key population at increased risk are concentrated, assess the level of risk intensity based on:

- how frequently these populations engage in unprotected sex or inject drugs with non-sterile or contaminated needles/syringes (see Table 2.4)
- how big the networks are of persons who use non-sterile/contaminated needles or have sexual partnerships.

Table 2.4. Groups of interest and key parameters of risk intensity

Groups of interest	Key measures of risk behaviours
Persons who inject drugs	<ul style="list-style-type: none"> • Type(s) of drug(s) used • Proportion who are female • Frequency of injection • Frequency of use of non-sterile/contaminated equipment • Size and characteristics of sharing network • History of imprisonment and use of drugs in prison • Frequency of unprotected sex with men and women • Seroprevalence of syphilis
Direct and indirect sex workers (male, female or transgender)	<ul style="list-style-type: none"> • Type of sex work • Duration of sex work • Volume of clients/frequency of sex acts • Frequency of condom use • Frequency of injection drug use • Frequency of sex with persons who inject drugs • Degree of mobility • Prevalence of syphilis, gonorrhoea, chlamydia • Prevalence of urethral discharge, rectal infections in male sex workers
Clients of sex workers or proxy groups of male clients	<ul style="list-style-type: none"> • Proportion that buys sex (among proxy group) • Frequency of buying sex • Number of different sex (worker) partners • Frequency of condom use • Types and frequency of sex with non-paid partners • Degree of mobility • Prevalence of syphilis, gonorrhoea, chlamydia • Prevalence of urethral discharge, rectal infections in male clients
Men who have sex with men	<ul style="list-style-type: none"> • Sexual identity/gender • Number of male partners • Number of female partners • Frequency of anal sex with men • Frequency of condom or lubricant use • Frequency of injection drug use or sex with persons who inject drugs • Degree of mobility • Prevalence of urethral discharge, rectal infections, gonorrhoea, chlamydia, syphilis
Persons with high-risk heterosexual behaviour (non-paid sex)	<ul style="list-style-type: none"> • Number and types of sexual partners • Frequency and number of concurrent partners • Frequency of sex acts • Frequency of condom use • Prevalence of urethral discharge, rectal infections, gonorrhoea, chlamydia, syphilis

For each key population at increased risk identified in Table 2.4, it is important to recognize there is a large spectrum of risk behaviour among individuals and subpopulations. For example:

- Frequency of injecting among persons who inject drugs may vary with the type and availability of drugs.
- Brothel-based sex workers may have four or five clients a night compared with home-based sex workers who have one or two clients a week.
- Some men who have sex with men may have a single monogamous regular male partner or seek male partners only occasionally such as once every few months. Other men who have sex with men regularly visit public cruising sites and have multiple sex partners in the same night.

In generalized epidemics, distinguish those who have multiple sex partners or dense sexual networks from others in the general population.

This may be difficult to do. Past surveys may not have made a clear distinction between those at higher risk and those at moderate risk. More detailed segmentation of the key heterosexual subpopulation at high risk can be done by assessing:

- the number of partners
- the frequency of sexual activity
- the factors that affect condom use, such as drug and alcohol use
- the incidence of acute STIs (such as urethral discharge, primary or secondary syphilis or gonococcal infection)
- the amount of forced sex
- the age difference between partners.

The characteristics of social and sexual networks are another aspect to investigate and may need the use of both quantitative and qualitative methods (formative research prior to behavioural surveys).

Consider the size of the subpopulation and risk intensity together. Assessing the level of risk intensity within a subpopulation is only useful if the subpopulation is fairly large in relative terms to the general population. Further, if a subpopulation with risk behaviours is large, but only a small proportion has high-intensity risk behaviour, then their potential for epidemic spread should be considered less serious. For example, a geographical area that has 1000 bar-based sex workers who have 1–2 clients a week may be contributing less to potential transmission than 200 brothel-based sex workers who have 10–15 clients per week.

2.2.4. Step 4: Assess the current level of HIV prevalence

Among whom and where is HIV disseminated

Measure HIV prevalence among a specific population when there is evidence to suggest the presence of behaviours of increased risk or when previous measures show high levels of HIV prevalence.

If HIV prevalence is measured at a high enough level (above 2%), this confirms the existence of conditions of risk, the presence of the disease and its potential for spread.

Understanding the level of HIV prevalence across different geographical areas helps your country prioritize prevention programmes geographically. You can pinpoint the areas that should be monitored more closely during surveillance.

Your surveillance system must be dynamic enough to use other sources of information. These additional sources may suggest there might be higher HIV prevalence in some areas or some populations than others. Examples such as data from blood donation services, and voluntary HIV testing and counselling services might provide additional data. This allows programmes to further prioritize areas for prevention interventions.

HIV prevalence by age group should be considered whenever possible. The existing surveys and data might contain age-disaggregated information. Again, knowing which age groups have higher prevalence rates helps programme managers focus prevention efforts. Prevalence among young age groups who are newly exposed may be considered a proxy for incidence in the population.

Data on duration of high-risk behaviours, such as how long a person has been injecting drugs, can be used to identify newly exposed persons. When you focus on those who have newly begun injecting, this may provide an indication of incidence. See the section on measuring incidence for further information on this topic.

Assessing the current level of HIV prevalence in a generalized epidemic

A geographical area classified as having a generalized epidemic should have sufficient data to indicate that HIV has penetrated sexual networks outside of the traditional key populations at higher risk: sex workers, men who have sex with men and people who inject drugs. In these settings, combining the level of HIV prevalence and size of the different risk subpopulations may help you to determine the relative contribution of different subpopulations to the epidemic.

In some generalized epidemic settings, it might be difficult to allocate resources towards focusing surveillance and prevention interventions only on populations at higher risk for HIV instead of focusing efforts on the general population or specific age groups within the population. However, programme interventions among key populations at increased risk are still recommended and can indeed make a significant impact on a generalized epidemic.

Tracking the level of HIV prevalence among antenatal clinic attendees

In generalized epidemics, monitoring the level of HIV prevalence among the general population is as important as measuring the spread.

HIV sentinel surveillance among women attending ANC is an easy way to reach a sample of the general population (10). ANC attendees are a proxy for the general population. However, women attending ANC tend to be young (depending on the fertility patterns in the country) and are by definition not using condoms. Thus, HIV prevalence among ANC attendees may be different from HIV prevalence among the adult population. HIV prevalence among ANC clients will change if fertility levels change in the country. However, comparing HIV prevalence among ANC attendees by geographical region is useful for identifying the hotspots in a country as well as getting a sense of trends over time.

ANC prevalence together with programmatic data can be used to estimate national HIV prevalence using different tools (11,12). More information about methods and tools is available at <http://www.unaids.org/en/dataanalysis/epidemiology/>.

As services for PMTCT are scaled up and coverage reaches over 90%, countries are increasingly considering substituting data from clinics which provide testing services for mother-to-child transmission (MTCT) for data from sentinel surveillance among ANC attendees. Several research studies are under way to see how the transition from the use of ANC data to the use of MTCT data can be done. Further guidance is being developed based on the experience of some countries.

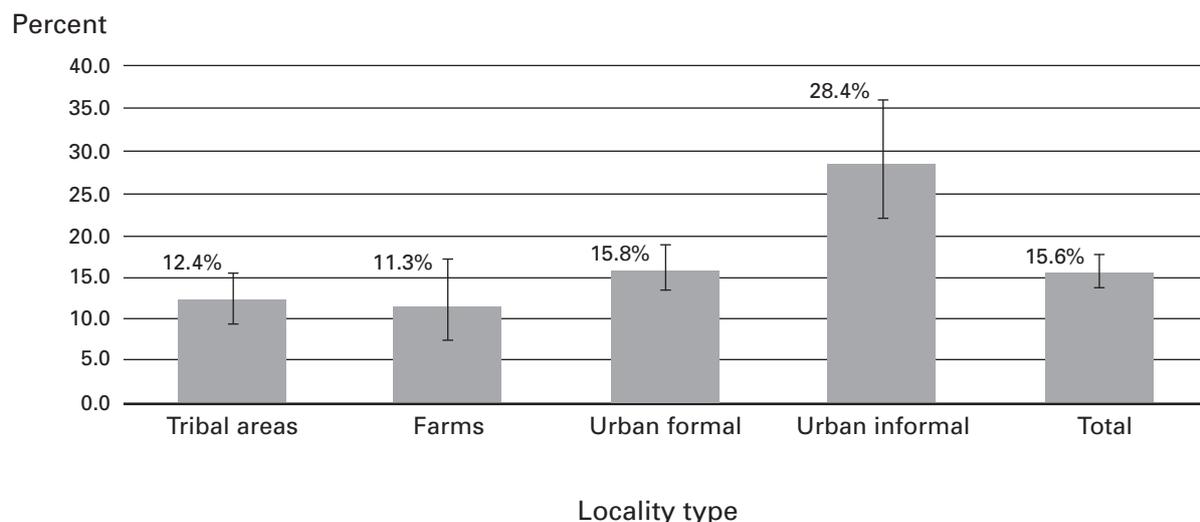
The role of national population-based surveys in tracking the level of HIV prevalence

National population-based surveys can provide the geographical distribution of risk and prevalence level by different populations. These surveys are very useful because they combine HIV prevalence information with many other indicators for each individual respondent. This allows for extensive analysis of factors that are associated with HIV infection. As shown in Figure 2.2, stratification by different regions can provide insight into the hotspots of the HIV epidemic.

This kind of survey is useful only in countries with national HIV prevalence levels above 2%. Due to the cost and complexity of such surveys, they should be implemented only every three to five years, depending on the level of the HIV epidemic and the cost involved. Technical guidance notes can be found at http://www.unaids.org/en/media/unaids/contentassets/documents/epidemiology/20101207_HIVtesting_in_surveys_WG_en.pdf.

There are a few potential biases in these surveys. First, it is important to check refusal rates. People who know their status or feel they are likely to be infected might refuse to be tested, which could potentially bias the results. Second, national population surveys focus on individuals living in households, and therefore exclude people who are in hospitals or who live on the streets. However, this is unlikely to bias the results unless the population not living in households represents more than 5% of the population.

Figure 2.2. Stratification by region (national population surveys in South Africa, Human Sciences Research Council [HSRC] 2002, 2005, 2008)



2.3. Create a national picture: map epidemiological zones

Compiling available information for each geographical unit allows the identification of areas where the epidemic appears to be well established. Areas where key populations at higher risk are present and are of substantial size also need to be identified. Finally, additional information must be used on behavioural risk and HIV prevalence among populations with high-risk behaviours to look for broad patterns that indicate the potential for new infections.

Continue to refine your map. Look for groupings of geographical units that share epidemic patterns. Put them into *epidemiological zones* linked by:

- a shared higher-risk population, such as transport corridors along which key populations with high-risk behaviours circulate;
- common higher-risk contexts, such as agricultural or industrial belts that attract migrant labour;
- sociocultural practices that can be risk factors for HIV transmission such as traditional sex work.

An epidemiological zone may be a whole country or may coincide with a sociopolitical unit, for example, a state, province or district. Alternatively, a zone may span several adjoining administrative units, for example, a coastal belt of districts, a region of northern provinces or a subarea within an administrative area, for example, a large city within a province.

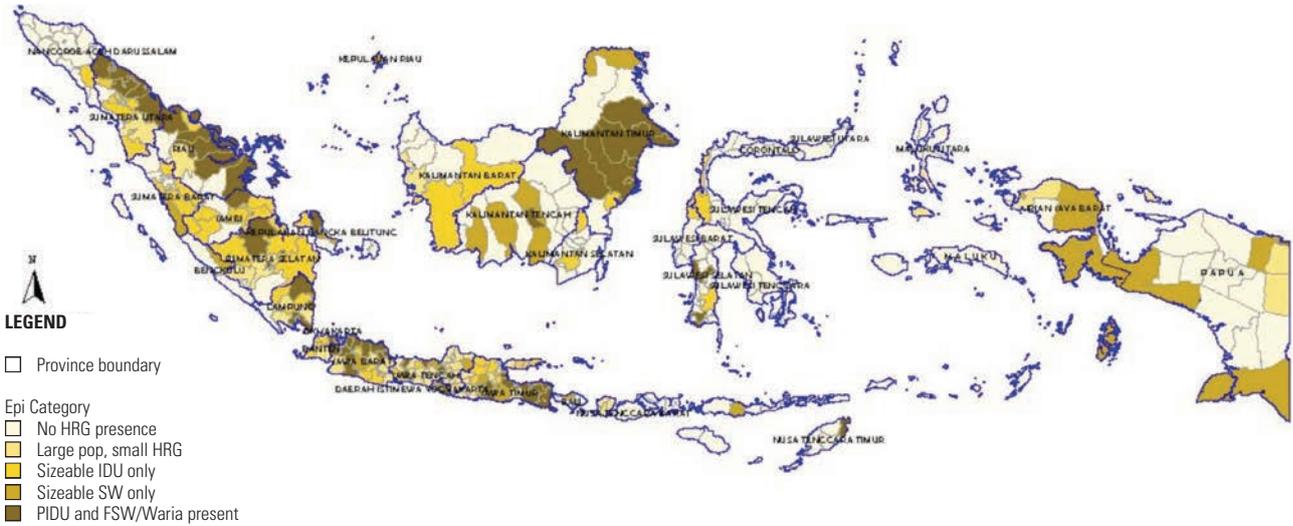
An epidemiological zone forms a corridor of transmission, where key populations with high-risk behaviours migrate from one area and transmit disease or seed epidemics among populations in another area.

Some examples from countries can be seen below.

An example from Indonesia: mapping the epidemic

Indonesia is a large country with a diverse and mobile population, spread across many islands. Evidence from a range of behavioural and biological surveys and other surveillance data suggests that the epidemic in Indonesia is a mix of low-level and concentrated local epidemics among sex workers and persons who inject drugs (Figure 2.3).

Figure 2.3. Diversity of concentrated epidemics in Indonesia



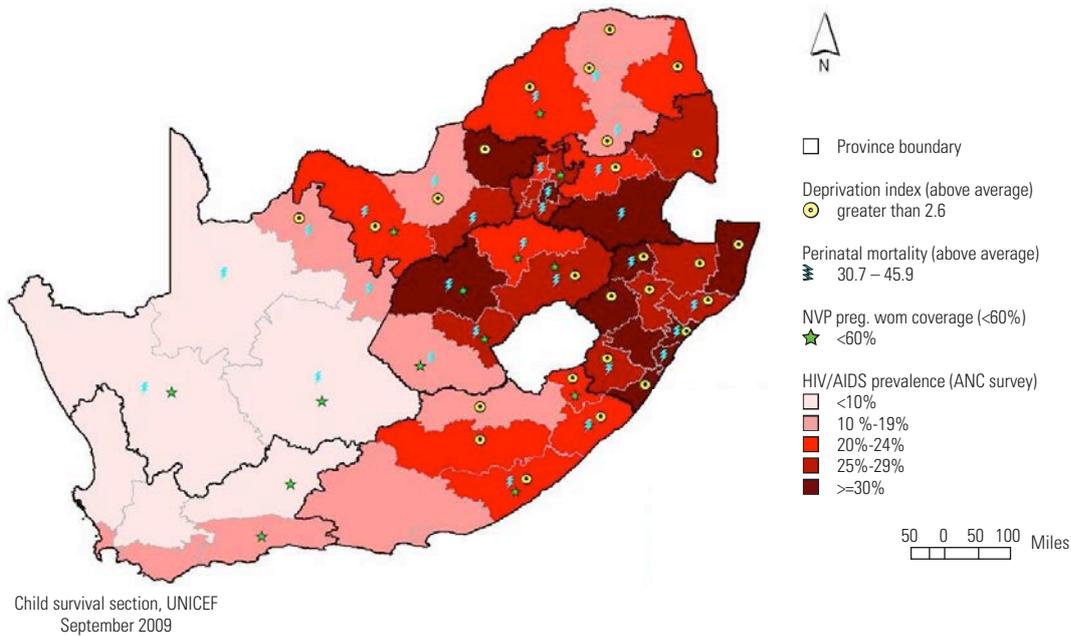
Source: Indonesia Heterogeneity Synthesis by Pandu Riono, Virginia Loo, Pandu Harimurti, David Wilson, World Bank report June 2009

Past studies have revealed the following:

- In Papua, the epidemic situation is the most serious. Large numbers of reported AIDS cases and reports of high-risk behaviours led to a series of special surveys to characterize the epidemic in this region. In a representative household survey of people aged 15–49 years conducted in 2006, HIV prevalence was 2.4%. Prevalence was higher than 1.0% in a range of areas, from accessible to inaccessible lowlands to the highlands.
- Further exploration of the key mode of transmission in Papua found that most new infections could be traced back to sex work. For this reason, the epidemic in Papua is considered to be concentrated rather than generalized.

Another example is the distribution of HIV infection in South Africa by province, based on the results of ANC surveillance data (Figure 2.4).

Figure 2.4. HIV prevalence among ANC attendees in South Africa, 2008



Past studies have revealed the following:

- In South Africa, the highest HIV prevalence is found in the eastern part of the country. Similar patterns were found in three representative household surveys of people aged 15–49 years conducted in 2002, 2005 and 2008.
- The north west of the country with the lowest HIV prevalence is also the least populated region.

2.4. What are the gaps in your country’s surveillance activities?

A detailed map of epidemiological zones and an inventory of existing information should be used to identify missing HIV surveillance information. The following example of an inventory gives an idea of how to do this.

Table 2.5. Sample inventory for a country with a concentrated epidemic: what is missing?

Province/district	General population	Sex worker	Men who have sex with men	Persons who inject drugs	Other group
Province A	DHS (2006, 2009); Youth BSS (2005)				
District A1 (capital)	HSS ANC (2000–2007)	Mapping (2005) HSS (2000–2008)		RSA (2004)	HSS prison (2004–2009)
District A2		Mapping (2005) HSS (2000–2006,2008)			
District A3	HSS ANC (2000–2007)	HSS (2004–2008) IBBSS (2000)			
Province B					
District B1		Mapping (2005)		RSA (2004)	HSS prison (2004–2009) HSS STI (2000–2007)
District B2	HSS ANC (2000–2007)	Mapping (2005) BSS			
District B3					

DHS: demographic and health survey

IBBSS: integrated biological and behavioural surveillance surveys

HSS: HIV sentinel surveillance

RSA: rapid situation assessment

HSS ANC: sentinel surveillance with sequential samples of ANC attendees

HSS STI: sentinel surveillance with biomarkers for sexually transmitted infections

What is missing in the sample inventory?

- Prison populations have been covered with extensive sentinel surveillance, while other populations with risk behaviours have not been covered. No surveys were conducted among men who have sex with men and people who inject drugs.
- There are no data from Province B or District B3.
- Behavioural surveillance is rarely conducted: have populations with behaviours that increase their risk to HIV been identified?
- In Province A, only general population studies have been done.
- Very little data have been collected on STIs.

It is important to clarify the following questions about the epidemiological zones. Are there epidemiological zones where:

- there are no data?
- there is a high incidence of STIs but no clearly identified key population at increased risk for HIV?
- there is high HIV prevalence in the absence of recent studies? This points to another question: what determined the high HIV prevalence if no recent studies have been conducted?
- many new HIV infections are suspected but no key population at higher risk has been investigated or identified as the source?

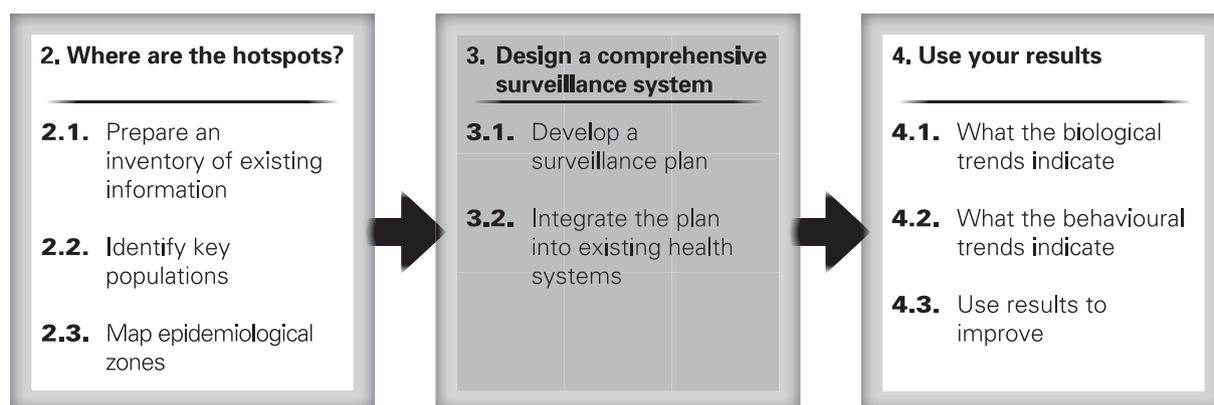
Once a clearer picture has been obtained of the existing data, the country's information gaps and of some of the trends, a comprehensive surveillance system can be developed or at least the existing HIV surveillance system can be strengthened. Future surveillance activities should be designed to collect the right information to get a clearer picture of the country's epidemic.

3. Design a comprehensive surveillance system

Designing and managing the operations of an effective surveillance system rely on two key principles:

- **Clear prioritization:** What are the most critical data and analyses needed for the epidemiological zones with the highest epidemic potential? How can financial and technical resources be deployed most efficiently?
- **Flexibility:** Do you have the ability to adjust where and when data are collected and analysed based on new information about the epidemic? Incorporating flexibility into your national surveillance plan design will help the programme be responsive and stay ahead of the epidemic.

Figure 3.1. How to design a holistic surveillance system



Recall the purposes of second generation surveillance

The surveillance system is used:

- to get a clear understanding of the current state of the epidemic
- to learn how the epidemic is changing
- to identify opportunities to control the epidemic.

The actions that your country may take to improve its second generation surveillance could include the following:

- Invest resources to improve the collection of data or analysis of existing data.
- Plan to collect additional data using a different method for data collection such as time–location sampling (TLS) or respondent-driven sampling (RDS) or population based surveys if appropriate prevalence levels are present.

3.1 Develop a surveillance plan

When developing a national strategic plan for HIV, it is important to include HIV surveillance and collection of strategic information. A strategic operational plan for conducting HIV surveillance activities for three to five years should be prepared.

A surveillance plan explains what there is to be done and should include the following:

- Which key populations at increased risk of HIV are to be identified
- What data to collect and analyse
- In which areas to conduct surveillance and within what timeframe.

Two guidance documents developed by the WHO/UNAIDS Working Group on HIV and STI Surveillance as part of this second generation surveillance series provide specific tools for the process of designing and planning a second generation surveillance system (13,14):

- *Initiating second generation HIV surveillance systems: practical guidelines* (2002)
- *The pre-surveillance assessment: guidelines for planning sero-surveillance of HIV, prevalence of sexually transmitted infections and the behavioural components* (2005)

Design a comprehensive and local surveillance system

It is common to think about surveillance as a series of separate data collection activities: mapping, sentinel surveillance, behavioural or integrated biological and behavioural surveys, HIV case reporting, and so forth. Using this approach, programmes:

- allocate a budget to each activity and a timeline for implementation
- decide how many sites can be covered with the budget for that activity
- decide which sites should be included in the next surveillance round.

This approach makes it difficult to assess the data that will be collected in local areas.

A better approach is to think geographically. As shown in Section 2, use epidemiological zones. Match surveillance activities to local epidemic needs. One should ask:

- Is the epidemic potential of this area large, small or unknown?
- Which key populations at increased risk are important?
- How up-to-date is the information on group size, disease prevalence or risk profile of the key populations?

Section 2 also showed how to develop a simple inventory. Developing an inventory helps you to identify priority surveillance activities for different areas. Use the inventory to note available data for each geographical area and each risk population within that area.

Consider all sources of data and include them in the analysis of the epidemic situation. Some information will be from activities that are formally part of the HIV surveillance system. Other information will be available from the results of special studies or projects.

Tips for developing a national surveillance plan

National surveillance plans should be developed with key stakeholders and partners involved in data collection in the country. Key stakeholders include:

- programme managers
- monitoring and evaluation officers
- members of civil society who represent the populations being studied
- development partners who might fund the activities or who could provide technical assistance on surveillance
- staff from the national statistics office or those who conduct the major household surveys and censuses.

Including these partners will ensure that the plan answers the key questions needed by programmes, is complementary to other data collection efforts, is realistic as well as sustainable, and allows knowledge sharing and use of data by partners.

After looking at the inventory and epidemiological zones map, the rationale for choosing certain surveillance activities over others should be discussed. For each surveillance activity, the surveillance plan should cover the technical guidelines to be followed as well as the prepared protocols that were approved by an ethics panel. This includes:

- the rationale and criteria used for selecting sites and populations with cost per site
- the roles and responsibilities of staff in surveillance administration, management, technical support and implementation
- a timeline showing the major surveillance milestones: preparation, implementation, analysis, data use for planning and decision-making, dissemination
- the quality assurance procedures that need to be followed
- the data collection and quality control instruments
- the standard documentation templates that will be used for collecting data
- how to address ethical conduct and data security issues
- how to standardize and yet maintain local ownership.

Think about the epidemic categories within the country

Epidemic categories are most useful when the area has a uniform epidemic pattern. The categories in your mapping describe the general patterns of transmission dynamics of your epidemic. They guide your country in planning appropriate responses.

In some countries or geographical areas, epidemic categories may not fully describe the underlying epidemic. The categories are most helpful in concentrated epidemics by drawing attention to key populations at higher risk in need of services but they are less helpful in low-level epidemics. Low-level epidemics may be interpreted as no cause for concern, action or resource allocation when, in fact, the key message should be the need to develop focused interventions, prioritizing areas and persons at higher risk, and vigilance in monitoring the epidemic.

When the categories are strictly defined by seroprevalence, some countries and regions have been wrongly classified as having generalized epidemics. This leads to inefficiencies in planning and resource allocation. An example of how this could happen:

- Some countries or areas with a general population prevalence measured at slightly more than 1% have mistakenly shifted resources towards general population prevention measures.
- However, evidence in those areas suggests that most new infections still result from behaviours of increased risk, for instance, injection drug use, buying/selling sex or anal sex between men.
- For those areas or countries, it makes more sense to consider the local epidemic to be concentrated and to enact prevention interventions covering key populations at higher risk.

If the country has identified unusual transmission dynamics or risk factors, the ways in which the surveillance system design will address these issues should be considered.

If the country has an established system or surveillance infrastructure, one may choose to continue some surveillance activities, phase out others, or adjust and add data collection activities to be more in line with these second generation surveillance guidelines. The goal is to collect the most useful data.

Countries with limited resources for surveillance may need to phase in or adjust the number of sites and frequency of collection of different types of surveillance data.

3.1.1. Recommended surveillance activities by epidemic category

The recommendations below identify surveillance activities in order of priority (from most to least useful). The goal is to use these recommendations to answer key questions about the epidemic and help the country develop effective responses. Maximum use must be made of existing data sources that may provide additional information about the HIV epidemic; for example, data on STIs. The following recommendations should serve only as a guide as need to be adapted to the context of the country.

Surveillance activities for low-level epidemics

If the country has epidemiological zones where the epidemic is believed to be at a low level, it is most important to identify the areas where new infections may emerge (Table 3.1). Surveillance resources should be allocated to update size estimates of key populations at higher risk, and regular case reporting for HIV, AIDS and STIs.

Table 3.1. Surveillance activities for areas with low-level epidemics

Surveillance activity	Scope of activity	Frequency
Size estimation of key populations at higher risk	<ul style="list-style-type: none"> • Initial assessment in all areas of the country/region • In-depth assessment where the largest numbers are found 	<ul style="list-style-type: none"> • Every 2–3 years as there is considerable mobility among such populations
Facility- or community-based HIV and STI sentinel surveillance for key populations at higher risk	In areas with programme intervention sites serving more than 1000 beneficiaries with high-risk behaviours	Annually
Biobehavioural surveys of key populations at higher risk (for example, BSS, IBSS)	In areas where there are more than 1000 persons belonging to high-risk groups in a city or town	Every 2–3 years
HIV or advanced HIV infection case reporting	All facilities conducting HIV testing and counselling	Ongoing
AIDS death reporting	All facilities providing HIV care and treatment + vital registration	Ongoing
STI reporting	All facilities diagnosing STIs by syndrome/ laboratory diagnosis	Ongoing
ANC syphilis surveillance	All ANC sites with routine syphilis testing as part of standard of care	Annually or biannually

Low-level epidemic: brief explanatory notes

- Size estimation data: Rapid situation assessments can be used to estimate the size of populations with high-risk behaviours in an area in a cost-efficient manner. More specific and precise data on size through detailed mapping should be conducted in areas where the largest numbers of persons with high-risk behaviours are found. Where resources are limited, updating size estimates should be prioritized in areas with the largest epidemic potential, usually where the largest numbers of key populations at higher risk are found.
- HIV case reporting: Case reporting data are useful for triggering further investigation into an area when sudden spikes or unusually large numbers of cases are reported. It is important to understand the underlying pattern of testing, diagnostic capability and reporting by different facilities to interpret these data appropriately.
- STI case reporting: Case reporting for STIs can be based on either syndromic (diagnosis based on symptoms) or laboratory diagnosis. Syndromic case reporting should focus on urethral discharge in men. Urethral discharge is highly suggestive of recent unprotected sexual intercourse. Where available, etiological case reporting should focus on primary and secondary syphilis and gonorrhoea, since these are acute conditions also suggestive of unprotected sexual intercourse.

Surveillance data on vaginal discharge should be interpreted with caution since non-STIs such as bacterial vaginosis or candidiasis present in a manner similar to that of STIs. Although genital ulcers can be a manifestation of acute infection with syphilis or chancroid, increasingly, herpes simplex virus (HSV) has become the major cause of genital ulcer disease in many countries (especially in countries with a high HIV prevalence).

- Facility- or community-based sentinel surveillance for HIV and STIs for key populations at higher risk: This type of surveillance is only possible when large numbers of beneficiaries regularly access services at a community site.
 - Sites where outreach staff accompany or actively recruit key populations at higher risk to the service will not provide a systematic facility-based sample that produces reliable prevalence data.
 - Small sites will not provide an adequate sample size to meet the requirements of a high-quality sentinel surveillance system.
- Biobehavioural surveys: When resources are limited, only a small number of surveys should be planned. Aim for areas where the largest numbers of key populations at higher risk are identified, such as capital cities. Do this type of surveillance activity only after other higher priority surveillance activities have been put in place. At a minimum, test routinely for syphilis. Syphilis rates among key populations at higher risk may provide an early warning of HIV transmission. Nuclei acid amplification tests (NAAT) for gonorrhoea and chlamydial infection may be incorporated into special studies.
- ANC syphilis surveillance: Increases in the prevalence of syphilis among ANC attendees can be used to identify women at increased risk for HIV, and may provide an early warning of changes in HIV transmission in the general population. Transition to PMTCT use of data should be considered in countries with generalized epidemics.

Surveillance activities for concentrated epidemics

If HIV has been detected in key populations at higher risk, it is very important to understand how the epidemic is changing and in which areas it may be expanding. In these areas, systematic tracking of HIV prevalence and risk behaviours among key populations at higher risk should remain the focus (Table 3.2).

Table 3.2. Surveillance activities for areas with concentrated epidemics (the frequency is only indicative and not prescriptive)

Surveillance activity	Scope of activity	Frequency
Size estimation of key populations at higher risk	<ul style="list-style-type: none"> Initial assessment in all areas of the country/region In-depth assessment where large numbers are found 	<ul style="list-style-type: none"> Every 2–3 years
Biobehavioural surveys of key populations at higher risk (for example, BSS, IBBS)	<ul style="list-style-type: none"> In areas where more than 500 persons belonging to population groups with high-risk behaviour in a city or town Prioritize areas where key populations with risk behaviours are present 	<ul style="list-style-type: none"> Every 2 years for high-priority sites Every 3–5 years for lower-priority sites
Facility- or community-based HIV and STI sentinel surveillance for key populations at higher risk	In areas with intervention sites serving more than 500 beneficiaries among key populations	Annually
HIV or advanced HIV infection case reporting	All facilities conducting HIV testing and counselling	Ongoing
STI case reporting	All facilities diagnosing STIs by syndrome or laboratory diagnosis	Ongoing
ANC sentinel surveillance for HIV and syphilis	<ul style="list-style-type: none"> In areas where HIV prevalence among key populations at higher risk is high (for example, more than 10%) and the size of male key populations at higher risk is large (for example, persons who inject drugs comprise more than 1% of the adult male population) Only sites where the ANC volume is larger than 150 new attendees per month 	Annually or biannually

Concentrated epidemic: brief explanatory notes

- HIV case reporting: Case reporting data are useful for triggering further investigation into an area when sudden spikes or unusually large numbers of cases are reported. It is important to understand the underlying pattern of testing, diagnostic capability and reporting by different facilities to interpret these data appropriately.
- If in previous sentinel surveillance activities the HIV prevalence was more than 5% and there are large enough key populations, then an integrated biological and behavioural surveillance or other sampling methodologies such as time–location sampling or respondent-driven sampling can be used. The threshold for when to conduct surveillance should be lowered to 500 people within the key populations.
- ANC sentinel surveillance: By definition, in a concentrated epidemic, transmission among the general population occurs infrequently, except for regular partners of populations whose behaviour puts them at high risk for HIV. ANC sentinel surveillance is a useful tool for assessing when the burden of HIV becomes large in the general population. This will help you to forecast care and treatment service needs. ANC sentinel surveillance should be conducted where:
 - HIV prevalence among key populations at higher risk is high, that is, higher than 15%
 - key populations at higher risk are large, comprising more than 1% of the population.

Antenatal clinic sentinel surveillance sites may also be important in source communities where a large proportion of the males are migrants and there are well known places for sex work. ANC sites with low regular attendance should not be included.

If most of the pregnant women are covered by PMTCT services, ANC surveillance may be not necessary. Instead, regular reporting of data from PMTCT services can be use to replace data from ANC sentinel surveillance. However, an extensive assessment of the PMTCT data is required before ANC surveillance can be stopped completely. More concrete recommendations are in the process of being developed to address the issues of quality of data, and the possible use of PMTCT data to replace that from ANC.

Surveillance activities for generalized epidemics

When the epidemic is more established and the burden of disease is widely dispersed in the population, data are needed to know:

- where and how new infections are being transmitted
- how the epidemic is changing
- the burden of disease.

The system also needs to characterize the subset of the general population that engages in increased sexual risk-taking behaviours (Table 3.3).

Table 3.3. Surveillance activities for generalized epidemics (the frequency is only indicative and not prescriptive)

Surveillance activity	Scope of activity	Frequency
ANC sentinel surveillance for HIV and STI	At least one site in each administrative unit (that includes urban and rural settings)	Annual or every two years
General population surveys (with behavioural and biological markers, including for STI)	Purposeful selection of geographical areas to represent different epidemic zones and enable meaningful national estimates	Every 5 years
HIV or advanced HIV infection case reporting	All sites where HIV testing is done	Ongoing
AIDS mortality reporting	All facilities providing HIV care and treatment + vital registration	Ongoing
STI case reporting	All facilities diagnosing STIs by syndrome or laboratory diagnosis	Ongoing
Characterization and size estimation key populations at higher risk	Initial assessment in all areas of the country/region In-depth assessment where large numbers are found	Every 2–3 years
Facility-based HIV and STI sentinel surveillance for key populations at higher risk	In areas with intervention sites serving more than 500 beneficiaries (among key populations at higher risk)	Annually
Community-based biological and behavioural surveys, (HIV and STI) of key populations at higher risk	In areas where sex workers, high-risk men who have sex with men or persons who inject drugs have been identified	Every 2 years for high-priority sites Every 3–5 years for lower-priority sites

Generalized epidemic: brief explanatory notes

- Antenatal clinic sentinel surveillance continues to be the most feasible method of measuring trends in the general population. Surveys among the general population have been useful for deciding how to calibrate ANC sentinel surveillance and use it as a proxy for prevalence trends among the general population.
ANC sentinel surveillance: In a generalized epidemic, ANC data are useful for estimating the burden of disease in the general population as well as monitoring the trends in the epidemic over time. All administrative units should have this type of surveillance. In some situations, PMTCT data may be substituted for ANC sentinel surveillance data.
- General population surveys: Probability surveys of the general population are resource-intensive. Cluster selection should be based on snapshots of biological and behavioural measures in different epidemiological zones.
 - Extrapolating data to national-level estimates on this basis may have greater utility for characterizing the local epidemic and calibrating ANC sentinel surveillance data, rather than developing a single national sampling frame.

- If prevalence in the general population is very high, that is, higher than 15%, more frequent general population surveys done at a subnational level may be more useful for tracking the epidemic than focusing on surveys or sentinel surveillance among traditional key populations at higher risk (sex workers, persons who inject drugs, men who have sex with men).
- Testing for STI in general population surveys allows for early identification of populations in need of HIV prevention interventions.

In generalized epidemics, household surveys of the general population are an important surveillance tool. The usefulness of these surveys is enhanced if they are designed to look at trends in HIV prevalence or related risk behaviours in smaller geographical areas (15).

This is particularly true in countries where overall HIV prevalence in the general population is above 1% but still in low single digits. These countries may have regions with diverse epidemic conditions. National-level estimates are not informative when you seek:

- to understand the nature of your epidemic
- to decide how to use ANC sentinel surveillance as a proxy for your general population
- help to focus intervention programmes.

Get the most information from your surveillance resources:

- Be sure that the questions in existing household surveys such as the demographic and health survey (DHS or AIS) include the information needed for surveillance.
- Include collection of biomarkers for HIV and STI often.

More recently, a number of countries have conducted multiple rounds of general population surveys. In these cases, trends are examined in different regions of the country among various subgroups, such as men and women aged 15–19 years or 20–24 years.

Do not use general population surveys in low-level epidemic areas

These types of surveys are expensive and resource-intensive to conduct so they are not recommended for low-level epidemic areas. Instead, use probability surveys of key populations at higher risk if you have a low-level epidemic.

- HIV case reporting: The use of HIV case reporting can have a different purpose in generalized epidemics. Complete HIV case reporting remains useful for measuring the number of people infected and for knowing their status. If people know their own HIV status, they may be likely to seek care and treatment services.
- Characterization of key populations at higher risk for HIV: Mapping-based size estimates for traditional key populations, such as sex workers, persons who inject drugs, men who have sex with men and clients of sex workers remain important for generalized epidemics. In addition, identifying subpopulations with large numbers of concurrent sexual partners in the general population also becomes critical. Some forms of mapping of risk venues, such as the Priorities for Local AIDS Control Efforts (PLACE) method (16), can be used for these groups. Other important methods include general population surveys that capture patterns of risk behaviour.
- STI case reporting: Data from STI case reporting in generalized epidemics can assist in explaining changing trends in HIV prevalence as well as indicate the effectiveness of prevention programmes.
- Biobehavioural surveys: Surveys for key populations at higher risk should include those designed to sample subgroups of the general population with large numbers of, or concurrent, sexual partners. If resources are limited, sites where the largest numbers are present and ANC prevalence appears highest should be selected.

3.1.2. Collect data on a regular basis from a variety of sources

As your surveillance plan is put in place, you will continue to track data from the sources you have identified. Some additional long-term sources are given below.

Track key events where the burden of disease is high

With the increase in access to PMCT and antiretroviral therapy programmes, more and more people are attending health services, either public, private or non-profit. National AIDS control programmes may benefit from tracking information collected in the health services. Some examples of key events in HIV infection are presented in Figure 3.2. These are, for instance, first HIV-positive test, care while on antiretroviral therapy, more specific CD4 counts, viral load or opportunistic infections during disease progression among those infected, and eventual death. These surveillance data sources provide valuable information for forecasting the need for care and treatment, and they may be also very useful for low and concentrated epidemics.

Use HIV case reporting for local information

In most places, experts believe that HIV case reporting severely underestimates the number of people with HIV but may roughly represent who is infected and where they live. HIV case reporting can provide useful approximate levels or the relative size of the HIV-positive population in different geographical units.

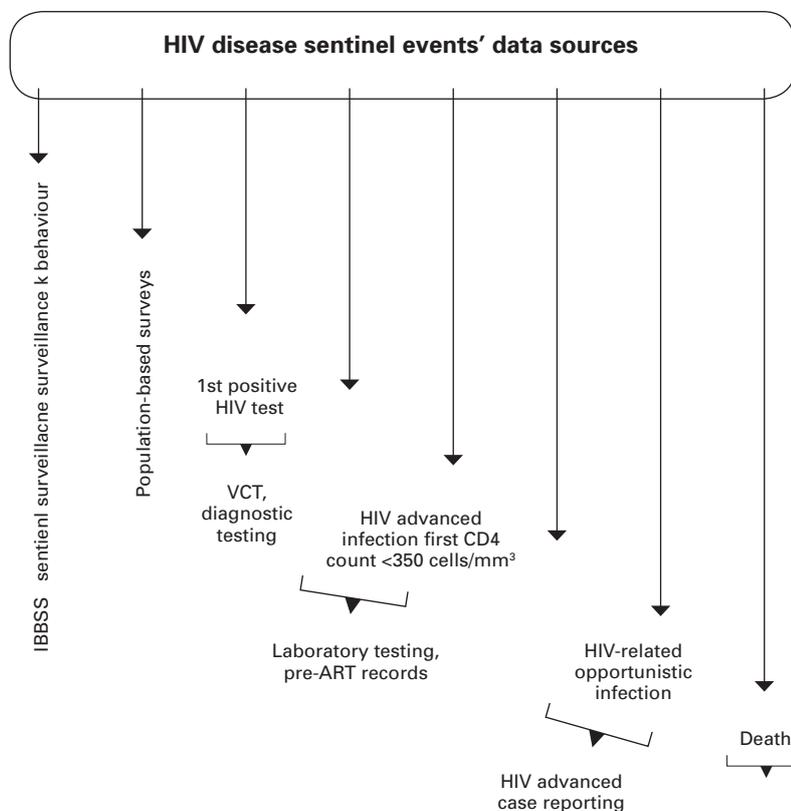
Compare case reporting information with the information provided through modelling packages such as Spectrum: HIV case reporting data can be very specific to local areas. Cases are reported from specific facilities that serve smaller areas. Spectrum yields national-level estimates, although some countries have sufficient data for subnational estimates.

Think about the effect of antiretroviral therapy on surveillance

Advanced HIV infection case definitions and the resources put into reporting have changed. This has led to uncertainty:

- How do we interpret trends in HIV or advanced HIV infection over time?
- How do we interpret how HIV or advanced HIV infection case reporting data can be translated into care and treatment needs?

Figure 3.2. Sentinel events during progression of HIV disease



Many of these changes have been related to the scaling up of antiretroviral therapy services within countries.

- As antiretroviral therapy has become more widely available, patterns in testing and diagnosis of advanced HIV infection have reflected the interest in starting treatment early to obtain better outcomes.
- People doing well on treatment no longer meet either the clinical or laboratory-based case definitions.
- At the same time, AIDS-related morbidity and mortality rates change, depending on what proportion of patients with advanced HIV disease receive treatment and how well programmes are able to support patients' adherence to get the most benefit from treatment.

3.1.3. Track paediatric cases with advanced HIV infection

Many countries make a special effort to monitor the burden of disease among specific populations to make sure they benefit equally from available treatment. One example is paediatric cases of HIV. A majority of paediatric cases are acquired through perinatal exposure to an HIV-positive mother. Tracking the burden of disease among children aged 0–14 years is important for assessing the effectiveness of prevention programmes. More specific guidance will be published in 2012.

Paediatric HIV surveillance often relies on follow up of PMTCT services (Table 3.4). Currently, paediatric HIV prevalence is often estimated based on

- the number of pregnant mothers and their HIV prevalence rate
- the coverage of PMTCT programmes.

Spectrum software can assist with making these estimates for countries with generalized epidemics. However, it is important to validate these estimates with additional data and compare them with empirical data whenever possible.

In very high-prevalence countries, it is possible to collect data on HIV prevalence from children 18 months and older in national population surveys. Such surveys have been conducted in South Africa, Botswana and Uganda. These results can be used to better understand cofactors that are associated with HIV infection, and how well treatment programmes are reaching children in need of services.

Table 3.4. Paediatric HIV surveillance

Approach	Methods	Strengths	Limitations
HIV case reporting <ul style="list-style-type: none"> • HIV-exposed • HIV-infected • Advanced HIV infection 	<ul style="list-style-type: none"> • Facility-based • Laboratory-based 	<ul style="list-style-type: none"> • National estimates possible 	<ul style="list-style-type: none"> • Logistical difficulties
	<ul style="list-style-type: none"> • PMTCT/early infant diagnosis (EID) programme data for HIV-infected and HIV-exposed infants extracted to case reporting system 	<ul style="list-style-type: none"> • No special surveys needed if programme coverage is high 	<ul style="list-style-type: none"> • Need high coverage • Logistical difficulties • Variable data quality across different sites
Mortality surveillance	<ul style="list-style-type: none"> • Verbal autopsy • Additional questions in population-based surveys • Case reporting • Vital registration systems 	<ul style="list-style-type: none"> • Can be added to existing population-based surveys 	<ul style="list-style-type: none"> • May be resource-intensive • Underreporting possible
Population-based household surveys	<ul style="list-style-type: none"> • Include risk indicators and HIV testing of youth younger than 15 years 	<ul style="list-style-type: none"> • Representative, national estimates possible 	<ul style="list-style-type: none"> • Only for high-prevalence, generalized epidemics • Ethical issues
Immunization clinic surveys	<ul style="list-style-type: none"> • Unlinked anonymous or linked testing of infants at first visit to immunization clinic 	<ul style="list-style-type: none"> • High uptake • Birth histories available 	<ul style="list-style-type: none"> • Usually only up to 2 years of age • Need high immunization rates • Only for high-prevalence, generalized epidemics
Special surveys	Paediatric inpatient surveys: Routine HIV testing of paediatric inpatients	<ul style="list-style-type: none"> • High uptake • Capture advanced HIV cases 	<ul style="list-style-type: none"> • Universal testing of paediatric inpatients may not be feasible
	School-based surveys: Consecutive sampling of youth in school usually centred around interventions	<ul style="list-style-type: none"> • Set venue 	<ul style="list-style-type: none"> • May not be feasible or allowed in some countries • Ethical consent issues
	Out-of-school youth surveys: usually snowball or respondent-driven sampling in venues other than school, e.g. street-based	<ul style="list-style-type: none"> • Capture youth with high-risk behaviours 	<ul style="list-style-type: none"> • May not be feasible due to stigma

Source: Patel SV et al. Filling a gap: HIV pediatric surveillance in resource constrained settings (17). *Journal of HIV/AIDS Surveillance and Epidemiology (Special issue)*, 2010, 2 (1):6. Available at: <http://www.ieph.org/ojs/index.php/jHASE/article/viewFile/%5BjHASE%202010%2C%202%2B1%29%3A6%5D/31> (accessed 18 October 2011).

3.1.4. Understand mortality trends in surveillance

While designing a comprehensive surveillance system, remember that understanding trends in mortality can be critical to interpreting changes in incidence. Mortality surveillance is an important indicator of survival among people who are infected and an important descriptor of the epidemic.

Mortality records among HIV-positive people come from two main sources:

- Vital registration
- Antiretroviral therapy registers.

The relative importance of each source depends on two things:

- How complete are the vital registration records are in your country?
- What proportion of people diagnosed with HIV is receiving antiretroviral therapy?

In countries with strong vital registration systems, all deaths are reported centrally including the primary cause of death. If your country has a high burden of disease, try to have algorithms for attributing and coding deaths due to AIDS morbidity incorporated into the system.

Many countries have weak vital registration systems. Listing AIDS as a cause of death is still stigmatizing. This leads to underreporting of AIDS-related deaths in the vital registration systems.

People who are registered or start antiretroviral therapy should be followed until death or till they drop out. It may be difficult for an antiretroviral therapy centre to determine why a patient has stopped coming to the centre. The patient needs to be contacted in their communities if they stop coming to the clinic and this is often logistically difficult. Individuals who have died versus individuals who have dropped out should be accounted for in the interpretation of results from this data source.

In addition to these more routine forms of AIDS death reporting, some countries have undertaken more proactive studies of mortality. Some countries have returned to households that reported a recent death to conduct a verbal autopsy to determine the cause of death. Other countries have used innovative methods for reviewing cases of death to determine what proportion of deaths in an area is AIDS-related (19).

More technical details for measuring mortality due to HIV infection are in preparation.

3.1.5. Review the design of your surveillance system regularly

A good time to review the design is before or during an annual planning cycle for the next round of surveillance. Ideally, this review and planning process should closely follow the analysis and interpretation of data from the previous round. This ensures that the field experience of collecting and analysing the data is fresh in the minds of planners and contributes to planning the next round.

New information from surveillance activities may also influence adjustments to the design of the second generation surveillance system. For example:

- mapping efforts may identify a new pocket or population with high-risk behaviours, which should be included in the next round of surveys
- an unusual spike in AIDS case reporting in an area may trigger more extensive mapping of key populations at higher risk in the next round.

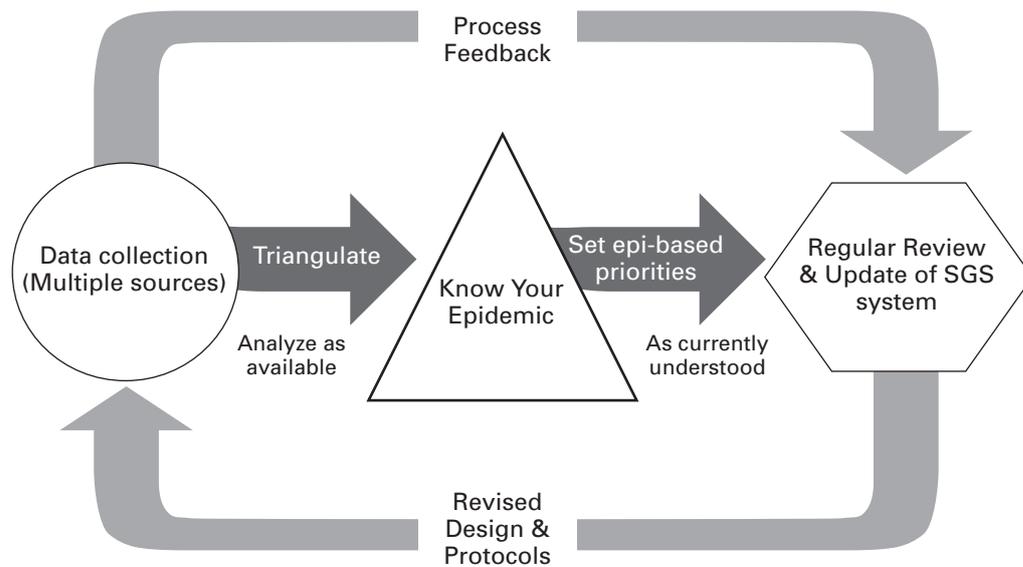
The process of review of your surveillance system may also enrich the analysis and interpretation of surveillance data as it focuses attention on the epidemic from a geographical perspective, combining multiple sources of data together (Figure 3.3).

Surveillance activities such as surveys or mapping exercises may take place in a staggered fashion over a long timeframe rather than during a discrete period. The system will benefit from the practice of spending time at the end of each round of surveillance activities:

- to review field experience
- to document problematic areas that need more resources or technical support
- to identify best practices
- to share lessons learned.

These process evaluations can inform a more comprehensive review of system design.

Figure 3.3. Review your surveillance system design



3.2. Integrate the plan into existing health systems

Where possible, surveillance activities should be integrated or made compatible with other existing surveillance, monitoring and evaluation systems, such as for STI, tuberculosis, reproductive health or antenatal care. Such integration:

- avoids duplication of systems
- reduces the workload of health-care staff
- improves the quality of patient care through regular monitoring
- improves the sustainability of surveillance activities.

Integration efforts might include the use of:

- similar electronic database platforms
- common data collection formats in routine surveillance information systems
- combined data collection instruments, e.g. the use of PMTCT programme data for ANC surveillance.

3.2.1. Develop the infrastructure to support second generation surveillance

Second generation HIV surveillance involves a wide array of data collection and analysis activities. Producing useful information requires resources for planning, coordination and implementation.

Central and local surveillance units

In large countries with strongly decentralized systems, both a central national-level surveillance unit and subnational-level units (provincial or state level) should be established within the public sector. In a two-tiered system, national-level surveillance units should fulfil the following tasks:

- Develop guidelines and protocols for surveillance activities.
- Support regional training on surveillance methods.
- Facilitate technical support for local surveillance units.
- Coordinate/manage survey activities that span multiple administrative units.
- Facilitate networking between subnational surveillance units to share best practices, engage in joint problem-solving, and address surveillance of epidemic zones or corridors that span multiple administrative areas.
- Conduct/commission national-level synthesis of data on the HIV epidemic.
- Develop the analytical capacity of the central and subnational units.

- Prepare annual reports of the epidemic situation in the country.
- Lead the review and planning process of the second generation surveillance system, including formal evaluation of second generation surveillance systems as needed.
- Feed into the national planning process based on evidence.

Subnational surveillance units often take on more direct responsibility for implementation of surveillance activities according to national minimum standards:

- Select final sites and population groups in their administrative area.
- Conduct pre-surveillance activities.
- Manage/supervise/provide quality control of data collection teams.
- Process documentation of activities.
- Enter, clean and manage data for routine surveillance activities.
- Analyse and synthesize data within their administrative area.
- Disseminate results to local stakeholders.
- Drive the process of evidence-based planning and management of programmes.
- Contribute local expertise for the development of national surveillance guidelines, protocols and system reviews.
- Report data to the central level.

The staffing of each unit will depend on the number of sites and range of activities included in the second generation surveillance system. Epidemiologists at both the national and subnational levels are useful for ensuring methodological rigour in surveillance protocols, as well as in analysis and interpretation of the data. Statistical support staff, data entry staff and statisticians are needed in units to manage, clean and analyse data such as those on AIDS case reporting and sentinel surveillance. Data management resources for surveys involving questionnaires are usually built into the operational costs of conducting the survey.

3.2.2. Strengthen laboratory systems

Due to the importance of biological data for understanding the epidemic, a strong public health laboratory infrastructure is a critical component of high-quality second generation surveillance systems. Investment in the public health laboratory system to support HIV surveillance activities can also be an opportunity to contribute to overall health systems strengthening. Ensuring that qualified staff is given adequate training and detailed protocols are key to strong second generation surveillance systems (19).

Testing conducted only for surveillance purposes may follow specific protocols and quality assurance procedures that are different from those used for diagnostic testing purposes. Whenever test results of data collected for surveillance purposes are returned to participants, the standards of confirmation and quality assurance appropriate for diagnostic testing must be used. Similarly, only those test kits that have been approved for diagnostic testing should be used for these types of surveillance activities. The diagnostic testing process should also include high-quality counselling and referral to services, as with any testing encounter (19).

In many countries, good experience with dried blood spot technology has been used to ease the logistic issues of collecting and transporting specimens from multiple field sites for either centralized testing, quality assurance or specimen banking. Use of dried blood spot specimens should be weighed against:

- the potential limitation of other types of testing that can be done (for example, syphilis testing or hepatitis B/C) with dried blood spots compared to venous blood;
- the potential additional cost of human resources to prepare dried blood spot specimens for testing or cost of test kits designed for use with dried blood spots.

The inclusion of other biological markers of acute STIs (i.e. active syphilis, gonorrhoea, chlamydial and trichomonas infections) in biobehavioural surveys is feasible in some settings due to the wider availability of rapid point-of-care tests and NAATs, which enable detection of multiple STI pathogens from urine or self-collected genital swabs. The regional STI reference laboratory network also can assist with the implementation of integrated STI, HIV and sexual behaviour surveillance systems in many countries.

3.2.3. Provide technical support

The development of a strong second generation surveillance system often requires technical support at different stages. As for most types of public health programmes, the ultimate goal is to build in-country technical capacity. Some support from international experts can be helpful for protocol development, training, data analysis or report writing. However, for issues of sustainability, it is worth investing time and other resources in training, mentoring or using other opportunities to transfer skills and knowledge to national counterparts. Familiarity with the local context as well as having an in-country presence also makes sound national expertise a more valuable resource in the long term.

There are many ways to optimize the technical resources that are available to support surveillance in-country:

- Develop rosters of resource persons with experience in specific aspects of surveillance to facilitate access between these individuals and surveillance sites. Many countries have a long history of second generation surveillance and local experts have developed the capacity to provide technical support for conducting surveillance activities. Efforts to engage local experts in formal roles to advise and support second generation surveillance is important for building a sustainable programme.
- Invest in opportunities for national resource persons to work with external consultants during in-country visits. This will make remote support more effective; national consultants can benefit from new developments in methods and approaches, while external consultants will benefit from feedback and technical perspectives that consider local contexts.
- Take advantage of courses offered through the increasing number of surveillance Knowledge Hubs such as Zagreb in Croatia (<http://www.whohub-zagreb.org/>) or Kerman in Iran (<http://www.hivhub.ir/>) to build in-country capacity (20,21).
- Ensure that reports and resource materials developed by consultants are filed electronically and are easily accessible to future consultants, especially in-country resource people. Institutional memory about decisions on site selection, protocols and analysis plans are lost as individual managers shift positions, unless special effort is made to store these centrally.

3.2.4. Use external collaborators for surveillance activities

In most cases, it is not practical for surveillance units to directly hire or reallocate staff to conduct large probability surveys such as behavioural surveillance surveys or integrated biological and behavioural surveys. This is also true for mapping studies that cover large geographical units. In these situations, a common approach is to contract the fieldwork and data analysis/report writing to a research agency or other organization with the capacity to conduct large surveys. Due to the high transaction costs of managing these types of contracts and in the interest of using standardized protocols, it is also common to engage one organization to conduct surveys across the country. National surveillance units administer the contracts centrally.

Even when external agencies are contracted to conduct surveillance activities, it is critical for government surveillance units to maintain a high level of engagement during the various stages of the process. This will ensure that the manner in which surveillance is conducted meets the national technical and ethical standards, and the data address the critical surveillance needs identified.

As much as possible, this type of engagement should include:

- input into the objectives and key indicators measured
- approval of timelines (including sequence and staggering of field work across sites)
- review of the protocols and data collection instruments developed by the contracted agency
- monitoring visits to field sites
- facilitating relationships with nongovernment organizations working with key populations at higher risk, especially marginalized groups such as sex workers, persons who inject drugs and men who have sex with men.
- review and feedback on analysis plans, preliminary analyses and final reports.

To achieve this level of engagement, organize a technical advisory group that includes in-country resource people with surveillance expertise. This group should meet periodically and review materials at different stages of the process.

The selection of an appropriate agency for conducting surveillance should consider a range of technical competence issues:

- Does the agency have experience in conducting surveys with the target population of the surveillance activity?
- Does the agency have experience of working in the country or region and does the proposed staff speak the local language?
- Does the technical staff proposed have direct experience with the specific sampling methodology to be used?
- Does the analytical approach proposed match the survey design (for example, use of specialized software appropriate for analysing this type of data)?
- Are the technical staff located in-country or does the agency have easy access to technical expertise in the relevant areas (for example, laboratory specialists, advanced statisticians, behavioural scientists, others)?

When developing the terms of reference and contracts for agencies that will conduct surveillance activities, consider these key issues in addition to technical competence:

- Are quality control measures in place (adequate supervision of field teams, caps on the maximum number of interviews conducted per day per interviewer, double data entry)?
- Are the timeframes for preparation, data collection and analysis/report writing efficient but reasonable for doing quality work? Are they adequate for meeting external timelines, for example, planning cycles?
- Is field staff adequately and fairly paid?
- Are issues regarding record maintenance, data ownership and dissemination clearly defined?
- Are there clear links to the decision-making and planning cycle?
- Has all staff agreed to abide by codes of ethical conduct and to maintain data security?

4. Use results to predict trends

This section shows how to use hotspot data (surveillance inventory and epidemiological zones map) from Section 2 of this guideline to assess the HIV epidemic trends in the country.

4.1. What the biological trends indicate

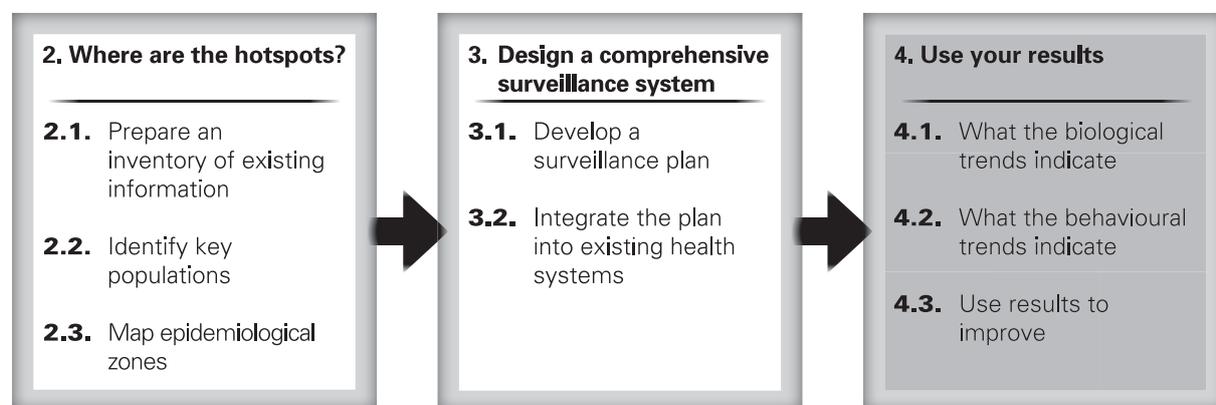
4.1.1. Make use of your HIV prevalence data

When looking at trends, there is a need for reliable measures of biological or behavioural markers over time. Reliable data are those collected:

- using a consistent, standardized method over multiple rounds or time periods
- among the same well-defined population
- among a large enough sample to obtain meaningful and precise estimates to detect changes
- taking into account the possible changes in HIV testing strategies with the passage of time.

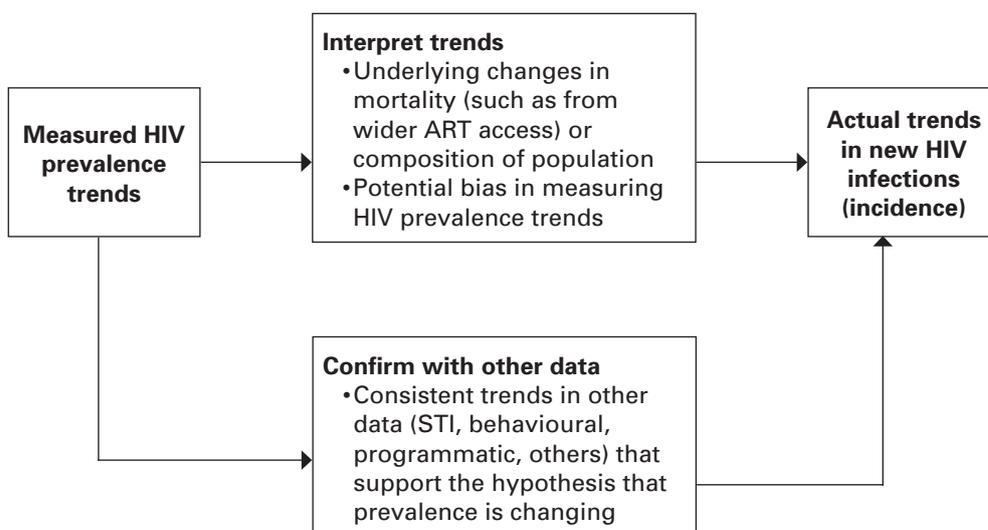
In most countries, the HIV epidemic is diverse, so trends should be followed in subnational geographical units or epidemiological zones. Collecting these types of data requires surveys that are well designed and well implemented.

Figure 4.1. What is the direction of the epidemic?



It might be difficult to examine trends in all places or among all populations. The clear priorities should be geographical areas where the epidemic potential is known to be the highest, including where key populations at increased risk are found or where evidence suggests that HIV is already established.

Until better methods are developed for measuring HIV incidence, prevalence data should be used. The country's epidemiological zone map should be used to better understand the relationship between prevalence, incidence and the direction of the epidemic (Figure 4.2).

Figure 4.2. Using HIV prevalence trends to predict trends in incidence

Follow these steps when using prevalence data to understand how the epidemic is changing (Table 4.1).

Table 4.1. Using HIV prevalence data to understand trends in incidence

Step	Action
1	Understand the relationship between prevalence and incidence.
2	Measure the prevalence, disaggregate by age groups, assess the potential selection bias.
3	Look at other sources of data for evidence to support a change in trend of the incidence.

Although the accuracy of HIV incidence tests has been the subject of considerable debate, these tests have been used widely and applied in several different ways. On an individual basis, the tests have been used to stage HIV infection clinically: how recently was the infection acquired, which treatment regimen to take, how to perform contact tracing, and whether clinical trial enrolment is appropriate. From a public health perspective, the tests have been used to estimate the proportion of new, recently acquired HIV diagnosis in a population and to epidemiologically describe these cases. A third application is the use of these tests to estimate the rate of HIV incidence in populations. A new guide on how to use the HIV test for recent infections to estimate HIV incidence at population level is available at: http://www.who.int/diagnostics_laboratory/links/hiv_incidence_assay/en/

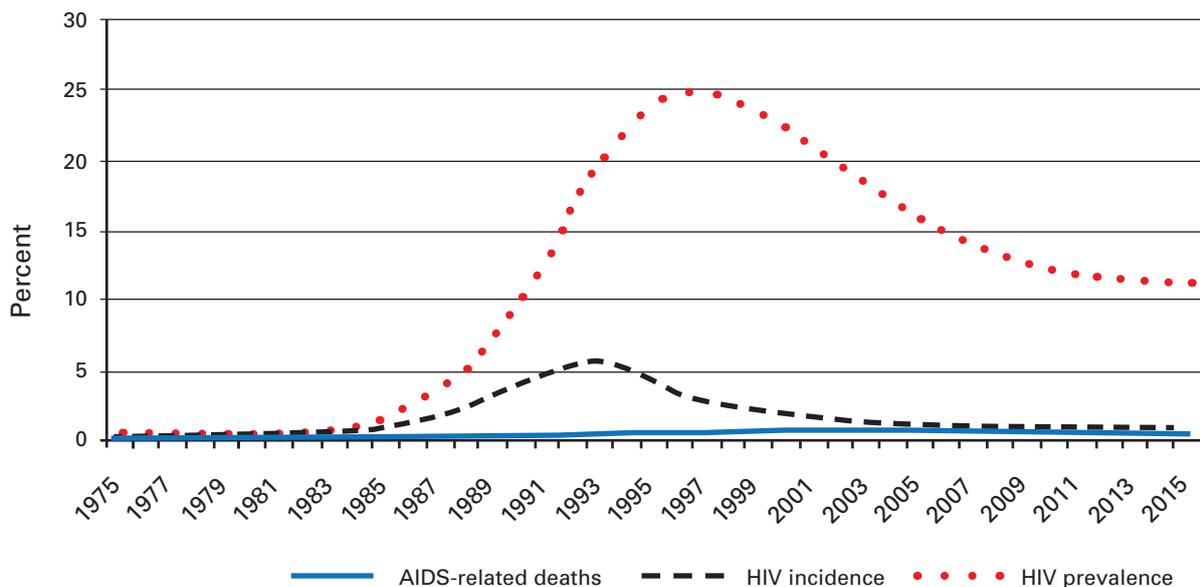
4.1.2. Step 1: Understand the relationship between prevalence trends, incidence and mortality

HIV prevalence over time is determined by:

- the number of new infections (incidence)
- the duration of infection
- the mortality rate of those infected (deaths).

The trend lines in Figure 4.3 show the natural course of an HIV epidemic. HIV prevalence does not decline until incidence declines and people with HIV begin to die.

Figure 4.3. HIV prevalence trends are driven by incidence and mortality



Source: Garnett G. Understanding the current spread of HIV. *Plenary session, XVII International AIDS Conference, Mexico, August 2008* [Abstract no. MOPL01].

The observed prevalence trend results from the underlying incidence and mortality. The prevalence trend at any time is largely built on older infections. Even if mortality is constant, changes in incidence will be hard to detect in prevalence trends unless the change is very sharp or consistent over a period of time. When looking only at prevalence, there is also a time-lag between when changes in incidence occur and when a change in prevalence is observed.

The relationship between changes in prevalence and incidence also differs at different stages of the epidemic:

- During the early years of a local epidemic, the death rate will be low. Prevalence will increase steeply.
- At 8–10 years into the epidemic, the death rate will increase if no antiretroviral therapy is available. Prevalence will naturally decline as a result, even if new infections remain constant.
- As the epidemic matures (for example, after 10 years), death rates may stabilize if antiretroviral therapy is widely available.

Consider a *closed* population, where people are not leaving or entering, and no programme or intervention affects the rate of death among people who are infected. Trends in prevalence are consistent with changes in incidence:

- An increasing prevalence means that new infections are occurring more often than the deaths of those people infected.
- A stable prevalence implies that the number of new infections is equal to the number of deaths among those who are infected.
- A declining prevalence means that new infections are occurring at a rate less than the death rate of those infected or that mortality is higher than incidence.

These basic interpretations of HIV prevalence trends are useful, but they rely on some major assumptions.

First assumption for the interpretation of HIV prevalence

The populations concerned in the HIV epidemic are rarely closed or stable. Many people (both HIV-positive and HIV-negative) may migrate in and out of the population between survey years when prevalence is measured. This may substantially change the composition of the base population among whom the trend is measured. For example:

- Individuals may migrate to urban areas for work, acquire HIV, and then return to their home or native town to receive diagnosis and care.
- The duration of time that sex workers sell sex may be for a few years only, resulting in a high turnover in the sex worker population.
- Sex workers may continuously move to different geographical units to be considered attractive to a fresh pool of clients.
- Persons who inject drugs may stop injecting for periods of time.
- Some persons who inject drugs may be targeted for drug detoxification or opioid substitution therapy, removing them from the pool of current injectors.
- Patterns of injecting can also change due to drug availability or narcotics control policies.

These scenarios are common. They will all lead to changes in who is included in the surveys used to measure biological trends, even if the surveys use the same protocol and sampling process.

Second assumption for the interpretation of HIV prevalence

HIV prevalence at any given point in time represents a combination of old and new infections. However, disease progression may change over time. That is, the length of time between when a person is infected with HIV and their death may change. What can cause this?

- Widespread use of antiretroviral therapy makes survival time longer and therefore increases prevalence.
- During the early phase of a local epidemic, HIV prevalence rises steeply but the death rate is still low (no one has yet progressed to advanced HIV). The unstable death rate must be factored in during interpretation of the prevalence trend.

Important questions for analysing trend data

Answer these questions to interpret the dynamics of the population, as they influence prevalence trends. This, in turn, has implications for interpreting changes in incidence:

- Is there likely to have been a change in the death rate during this time?
- Is the epidemic expanding or has it reached maturity?
- Is there evidence to suggest that many people have left or entered the population during this time?
- If any of these changes have occurred, have they occurred consistently over several years or have they occurred suddenly?
- Is antiretroviral therapy widely available or becoming so? Or have eligibility criteria for starting antiretroviral therapy changed over time? If so, the number of people receiving treatment will be required to help explain an increase in prevalence.

4.1.3. Step 2: Assess selection bias in surveillance trend data

It is difficult to conduct truly representative surveys of any population. It is common to have various forms of selection bias. HIV-positive individuals may not be equally likely to be captured in surveillance populations as HIV-negative individuals. When this happens, the ability to interpret trends is compromised.

Understand potential sources of bias for each survey site and time point before attempting to determine trends. You want to determine if a consistent type of bias is likely to be common across sites and over time.

Sources of bias that can affect prevalence trends can be grouped into two major categories (Figure 4.4):

- those that are *within your control*
- those that are *not within your control*.

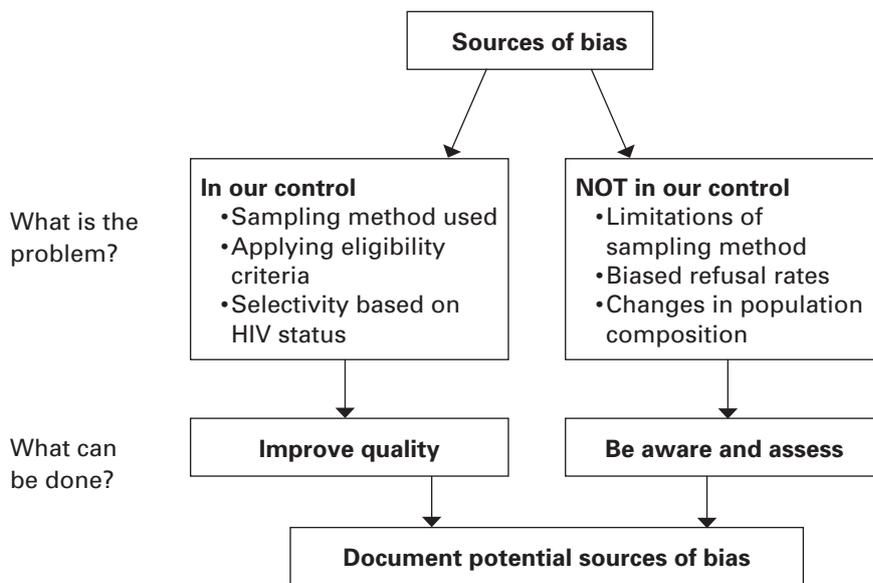
The biases within your control generally relate to:

- the rigour applied to the design and implementation of the surveillance protocol
- the quality of data collection.

The biases not within your control result from:

- instability of the population, typically the surveillance target population
- the difficulties of trying to sample them for a survey in a representative way.

Figure 4.4. Types of bias and what can be done to address each one



Assess and account for bias

Realities in the field often compromise one’s ability to follow protocols. However, the better the process of data collection is documented, the easier it is to assess and account for bias when describing what the prevalence trends indicate about new infections.

Some tips of good practice:

- Keep good notes during data collection.
- Talk to the people collecting data to see if any events may have happened which could influence participation.
- Remember that it is much easier to document what happened during data collection than trying to remember and reconstruct what happened during data analysis.

Ask these questions when assessing bias in trend data

- How was the sampling done?
- Who is represented by the sample?
- What were the inclusion criteria? Were they followed?
- If this was a known surveillance site, was observation bias a problem? Did participants avoid the site if they did not want to be included?
- Were people with known HIV status more or less likely to be included or excluded?
- Were tests with different sensitivities and specificities used over time? Might this have influenced interpretation of HIV and STI prevalence data?
- Were there important changes in the sites over time which might change the characteristics of the population captured?
- Were there problems meeting the quota: the sample size for the site? Were people who were not actually part of the population of interest included, just to increase the number of participants?
- Have new interventions or programmes been put in place in that location which could alter participation?

How accurate are your sources for HIV prevalence?

The most rigorous sources of HIV and STI prevalence data come from probability surveys of the populations of interest. The target audience includes:

- populations whose behaviour puts them most at risk for HIV (sex workers and their clients, men who have sex with men, persons who inject drugs)
- the general population
- proxy groups defined by an occupational or other sociodemographic characteristic.

Probability surveys are the most rigorous to implement. They provide the most reliable estimates of HIV prevalence, but these surveys tend to take up resources and time. Implementation may be in limited sites and infrequent (every 3–5 years). These surveys are usually reserved for areas where the HIV prevalence is higher than 2%.

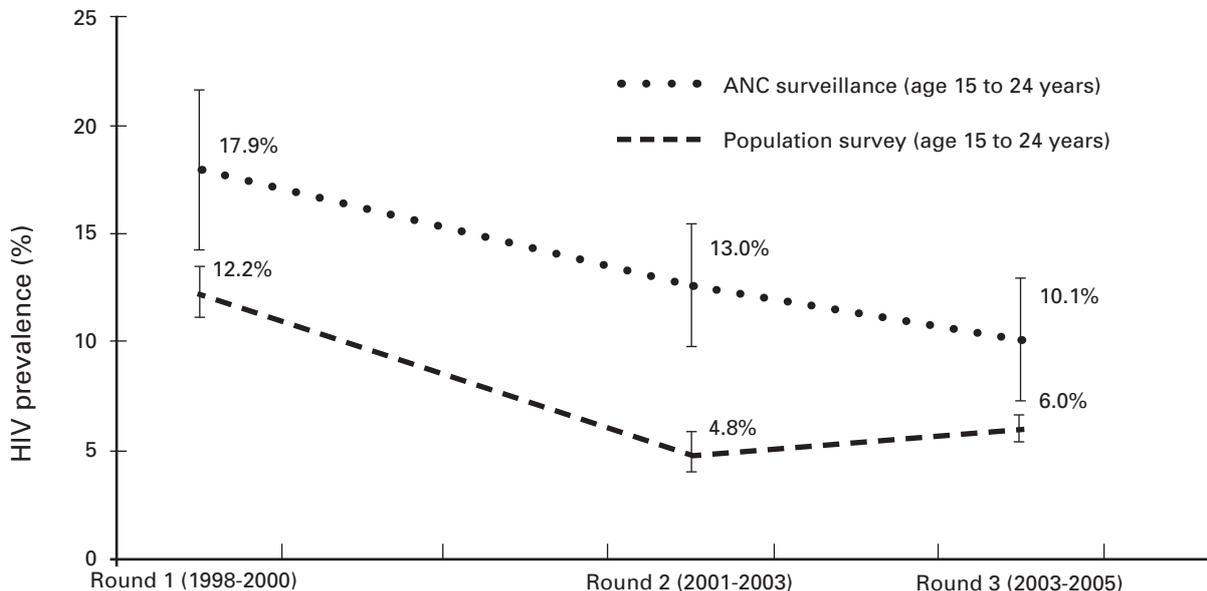
Sentinel surveillance data are another common source of seroprevalence data. These data may be from facility-based samples or from purposeful sampling in the community (sampling among key populations at increased risk). Remember that sentinel surveillance data may not be fully representative of the larger population of interest. Bias may not be easy to detect. For example, in sentinel surveillance, it may be noticed only after some analysis that data collected from a site do not seem to fit a reasonable pattern. The surveillance staff may then return to the site and probe for clues that explain the problems with the data.

Investigate all suspicious data, especially if you recognize the following situations:

- The number of recruits or participants goes up suddenly.
- The sociodemographic or socioeconomic characteristics of the population suddenly change.
- HIV-positive samples occur in clusters (sequential samples or all samples from the same day are HIV-positive).

One example of validating surveillance data comes from Manicaland, Zimbabwe (Figure 4.5). Data on biological and sexual history from young people (aged 15–24 years) were analysed. HIV prevalence data from ANC attendees were compared with three rounds of population-based surveys in the same geographical area.

Figure 4.5. Comparison of HIV prevalence trends from ANC surveillance and population surveys among youth aged 15–24 years in Manicaland, Zimbabwe, 1998 to 2005 (23)



Proportional change	Sample population survey		ANC surveillance		Trend comparison (Ho: ANC=Pop)
	%	(95% CI)	%	(95% CI)	
Round 1 to round 3	-50.7%	(-57.2, -44.3)	-43.5%	(-62.9, -24.2)	0.488
Round 1 to round 2	-60.9%	(-69.1, 52.7)	-27.4%	(-48.3, -6.5)	0.003
Round 2 to round 3	26.0%	(-0.8, 52.7)	-22.2%	(-48.8, 4.4)	0.012

Source: Marsh KA et al. Monitoring trends in HIV prevalence among young people, aged 15 to 24 years, in Manicaland, Zimbabwe. *Journal of the International AIDS Society*, 2011, 14:27.

The results suggested that the reduction in HIV prevalence among youth from the first survey (1998–2000) to the last (2003–2005) was well beyond the 25% goal set by the United Nations General Assembly Special Session (UNGASS) in 2005. However, when comparing trends between the surveillance methods, it was observed that the ANC estimates appeared to reflect the prevalence trends less accurately and reductions were significantly higher in the population surveys than the ANC surveillance estimates. Both trends were in the same direction, although of different magnitudes (22).

Avoid bias during data collection

Having consistent protocols from year to year is critical for any method of data collection used to assess trends. Follow these tips to avoid bias during sampling and data collection.

- Important preparatory step: educate the community about the reasons for conducting surveillance. Respond to concerns and questions to prevent populations at increased risk from avoiding the clinic or surveillance site during the surveillance period.
- The only way to obtain comparable samples from year to year is to use the same sampling method during each surveillance round.
- To assess the comparability of samples across rounds, record and compare key demographic variables of persons at higher risk who are included in the survey.
- If the sample is from a clinic population, assess whether the sample is representative of the normal clinic population by determining whether the clinic volume and demographic characteristics are comparable during surveillance and non-surveillance periods.
- Obtain true informed consent to ensure voluntary participation. Although informed consent may increase refusal rates, it is necessary for ethical purposes. Track the number of refusals and the reasons provided for data analysis.

4.1.4. Step 3: Look for more evidence that supports a change in trends

The previous steps looked at approaches to detect explanations for changes in prevalence which do not reflect changes in incidence. Assess the issues that surface. If biological data on HIV prevalence suggest that the incidence has changed, strengthen this conclusion by looking at other sources of data that build the case further. Many of these ideas follow basic epidemiological principles.

Ask yourself these questions when you are looking at other sources of data that indicate a change in HIV prevalence

- Does the timing of the change in HIV prevalence trend make sense, given what you know about HIV transmission? Is the change too sharp to be the result of real changes in prevalence? Does the timing of the decline in one subpopulation make sense with respect to declines in associated subpopulations? For example, do changes in sex worker patterns take place before changes are observed among clients or regular partners of clients?
- Is the change plausible, given what is known about the context of the epidemic and the history of intervention programmes? For example, are increases in prevalence seen among persons who use drugs after services are interrupted or as heroin supplies become scarce or more expensive, leading to a larger number of injectors?
- In epidemics driven by sexual transmission, are there trends in STI surveillance data that show similar patterns in a related time period? For example, are increases in HIV prevalence among men preceded by increases in case reports of male urethritis?

4.1.5. Tools for deriving incidence from HIV prevalence data

With the scale up of antiretroviral therapy programmes, HIV prevalence will increase because there are more people living with HIV and receiving antiretroviral therapy. For instance, South Africa reported an increase in HIV prevalence of 1.4% in 2008 because there were almost 500 000 people on antiretroviral therapy (24). In this case, measuring new infections or incidence became more important for measuring the HIV epidemic.

If there are sufficient data, several options exist for deriving HIV incidence trends from prevalence trends. The most direct approach is to do a true incidence measurement from a cohort study or to use biological incidence assays. However, because these measurements are still difficult to obtain, HIV incidence can be assessed using the epidemic modelling approaches described below.

Trends among young people or recent initiators (of higher risk behaviours)

HIV prevalence among young people (15–24 years) has been considered a proxy for incidence in generalized epidemics. Most young people have recently become sexually active and thus have been recently exposed to HIV. Infections among this population are likely to be relatively recent. This approach has been recommended in the guidelines for monitoring the UNGASS indicators (25). Some studies show that this is a good proxy for trends among the general population (23).

Similarly, new entrants to sex work, new users of injection drugs, or men who have recently started having anal sex are considered newly exposed to HIV and can be a proxy for HIV incidence in this population.

Strengths: In generalized epidemics with existing ANC surveillance systems, changes in HIV prevalence among young pregnant women aged 15–24 years can be easily computed from existing data. For recent initiators of risk behaviours, most surveys or data collection forms already collect information on when they started the behaviour at increased risk, allowing the calculation of this trend line.

Weaknesses: These data may not be representative of the whole country due to any of the following reasons.

- Urban settings may be overrepresented.
- PMTCT implementing programmes may introduce new biases because they are limited to women. Men are not represented.
- Pregnant HIV-infected women may “avoid” PMTCT programmes due to stigma, discrimination or other local issues when communities are small.
- The use of antiretroviral therapy may affect HIV prevalence because many women who are HIV-positive and taking antiretroviral therapy have higher fertility.
- When using data on recent initiators, the sample size may be too small to draw definite conclusions.

In a recent paper, thirty countries most affected by HIV analysed trends in HIV prevalence among young ANC attendees using sites that were consistently included in surveillance between 2000 and 2008. Regression analysis was used to fit curves to the trend data and to determine if the 2001 United Nations Declaration of Commitment goal of 25% reduction in HIV prevalence had been reached. Seven countries showed a significant decline of 25% or more in HIV prevalence among young women attending ANC by 2008, either in rural areas, urban areas or both. In all seven countries that showed a significant decline in prevalence, marked changes were also observed in either men or women for at least two of the three sexual behavioural indicators (26).

National population-based surveys

Repeated cross-sectional measures of HIV prevalence are now becoming available for general populations in many countries. Hallet et al. have developed a mathematical approach to derive and estimate HIV incidence using demographic accounting methods. This method considers the change in HIV prevalence in a cohort observed over two time periods, and calculates the number new infections after adjusting for potential mortality during the time period (27).

Strengths: Multiple surveys are available in a number of high-prevalence countries. The results can provide age-specific incidence estimates for men and women in urban and rural settings. If the sample size is large enough, the analysis can be done at a regional level.

Weaknesses: HIV testing must be included in more than one national survey. This approach to HIV surveillance should only be used in countries with generalized epidemics and only once every five years.

Spectrum computer package

This package developed by the Joint United Nations Programme on HIV/AIDS (UNAIDS) uses observed HIV prevalence points over time to fit a prevalence curve. The prevalence curve can be used to back-calculate HIV incidence using the year the epidemic started in the country, the population size, mortality and the number of people on antiretroviral therapy.

Strengths: Spectrum uses curve-fitting, which removes some of the instability of individual data points. Spectrum is used by most developing countries to estimate their national prevalence.

Weaknesses: Spectrum requires at least five data points over time to produce reasonably reliable prevalence curves and related incidence curves. The Estimations and Projections Package (EPP) can only fit curves for populations for whom there are trend data. Data requirements can be considerable. Most countries with generalized epidemics tend to have good time-series data for ANC attendees but time-series data for other populations that are important for the epidemic are generally not available.

Other incidence models

Modelling requires multiple time points of HIV prevalence and behavioural data for the different groups present in a geographical unit. Some countries or areas have more data that can be used as inputs, for example:

- HIV risk behaviour trends
- estimated sizes of populations at risk for HIV
- HIV prevalence trends
- data on the burden of STIs.

For some countries, more advanced modelling can be done, which not only provides incidence estimates but also allows countries to project the expected trajectory of HIV incidence in different populations. These are powerful planning tools. First, the UNAIDS Modes of Transmission tool is used to estimate the number of new infections currently occurring among different populations. It does not project trends or trajectory of incidence (28). In Kenya, for instance, heterosexual transmission was found to be the most prominent mode of transmission in all geographical areas from both the epidemiological analysis and modelling approach (29). Second, the Asian Epidemic Model (30) is a tool that can be used to predict trends for the types of concentrated epidemics that occur in Asia. See the example that follows, which illustrates the Asian Epidemic Model in Indonesia.

Strengths: These powerful planning tools allow countries to project forward on:

- the expected trajectory of HIV incidence
- the source of new HIV infections in different populations.

Weaknesses: Such tools require considerable amounts of data on the different populations and information about their roles in the epidemic. Models have been developed, tested and validated only for specific epidemic patterns. Also, trained staff is required to use the software.

Using the Asian Epidemic Model in Indonesia (Figure 4.6) (30)

Recall the Indonesia epidemiological zone map in Section 2 (Figure 2.3).

- The Asian Epidemic Model predicts that infections among clients of sex workers in Papua will grow steadily and result in more infections among regular partners.
- Without saturation of prevention programmes, the number of new infections per year may double by 2020.
- Outside of Papua, the dynamics of the epidemic are more complex because of the interactions among persons who inject drugs, men who have sex with men and female sex workers.
- New infections will increase sharply as the epidemic spreads beyond injection drug use and shifts towards sexual transmission.

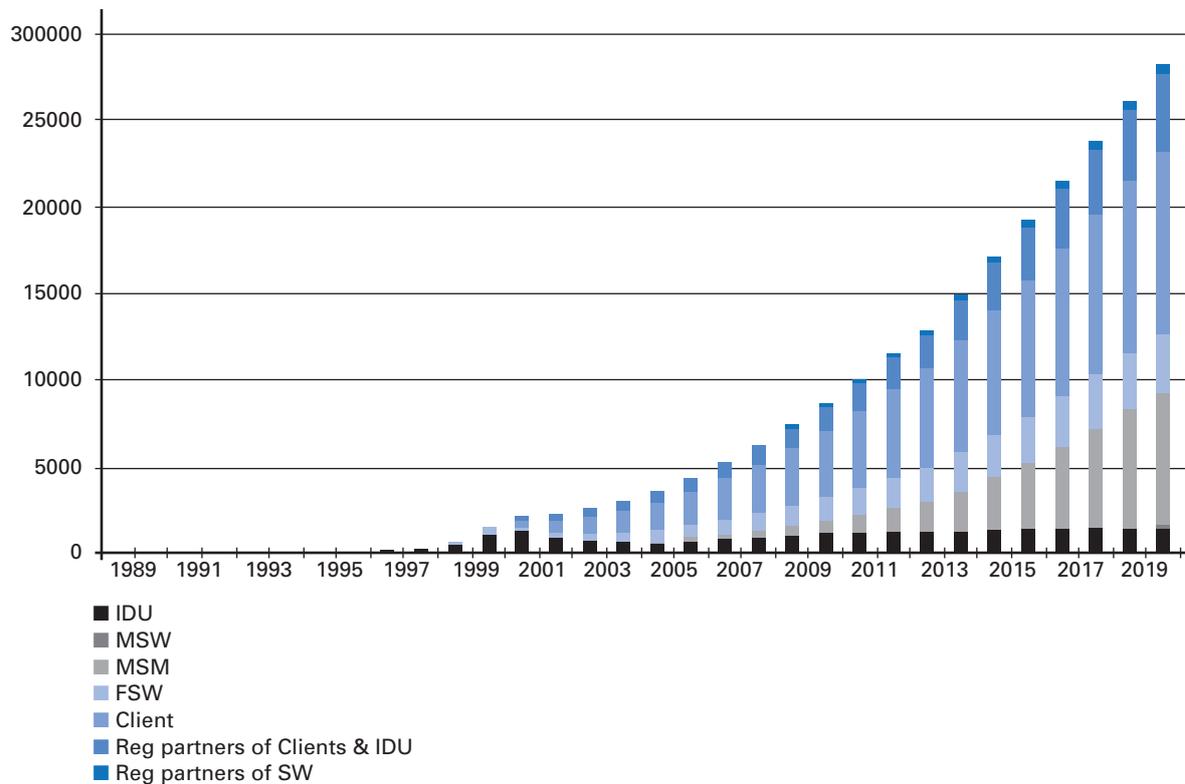
Ideally, models should not be used for monitoring trends as they are based on assumptions and are only as good as the data that are used in the model. However, most countries do not have the data to measure incidence and models are the only viable option.

HIV incidence assays

Assays and laboratory protocols for measuring HIV incidence rates directly at the population level have been under development for a number of years. They are now beginning to be used by some countries as a component of the HIV surveillance system. At present, these assays are not entirely accurate. They require correction factors and further validation for use in different settings before they can be considered as reliable surveillance tools (31,32). In the meantime, countries continue to rely heavily on tools that are well tested and known to be both sensitive and specific for measuring prevalent infections.

Figure 4.6. Asian Epidemic Model projection for Indonesia (non-Papua region)

New infections



The current assays for recent HIV infection are challenged by the variability in the immune response to HIV infection. These differences in response depend on:

- individual variation of anti-HIV antibody levels
- the rate of antibody production and maturation
- variation between the different HIV-1 clades
- the influence of antiretroviral therapy and AIDS on viral replication and anti-antibody levels
- the introduction of antiretroviral therapy: patients on antiretroviral therapy who are tested with an HIV incidence assay will appear to have recent infection when in fact the infection has been long established.

Strengths: Provides a direct measure of HIV incidence, which can be carried out retrospectively on blood samples from cross-sectional studies.

Limitations: As described above, the current assays for recent HIV infection are not accurate. Variations in the mean recency period by population, misclassification of people on antiretroviral therapy or with very late stage HIV, among other challenges, make these assays not a viable option for most countries.

A new guidance document has been published explaining how to use these assays and interpret the results (33). The most recent information is available at http://www.who.int/diagnostics_laboratory/links/hiv_incidence_assay/en/

4.2. What the behavioural trends indicate

Risk behaviours most relevant to HIV surveillance are those that directly relate to the transmission of HIV. A reduction in unprotected sex or in the use of non-sterile needles translates into a reduction in HIV transmission.

4.2.1. Use behavioural data to know your epidemic

It is well known that some sexual or drug use behaviours are risk factors for acquiring HIV. Thus, many interventions were put in place to address these behaviours either at the individual level or at the population level, or to break structural barriers to facilitate behaviour change.

Tracking risk behaviours is essential for predicting HIV trends. In many ways, tracking behavioural trends is a more timely reflection of current epidemic patterns than HIV prevalence trends, because behavioural patterns can show the potential for HIV transmission by population group and location.

4.2.2. Bias in behavioural data

In addition to selection bias, a common form of bias in behavioural data is social desirability bias. This type of bias reflects the self-reported nature of behavioural data.

Respondents in a survey describe their own levels of behaviour. Individuals may overreport safe behaviours to avoid judgement by the person interviewing them. Respondents engaged in an intervention programme know the right answers when asked:

- Do you use condoms?
- Have you used a condom during the last intercourse with a sex worker?
- Do you use sterile injecting equipment?
- How many sexual partners do you have?

It is difficult to confirm these self-reports through other sources, which complicates the interpretation of behavioural trend data. However, there are recommended methods to reduce social desirability bias in behavioural data.

Increasingly, the sources of quantitative behavioural trend data come from probability surveys. As with other surveys, there is a need to understand the representativeness and potential selection biases of the data before being able to interpret results. Different methodologies (self-administered questionnaires, interviews, use of computers) can produce different results.

Methods to reduce social desirability bias in behavioural data

- Minimize the association between the survey and intervention programmes.
- Ensure that interviewers are of the same sex as the respondent.
- Assure individuals in the programme that their responses are confidential, not shared and their answers will not affect their access to services.
- Consider avoiding face-to-face interview methods for collecting behavioural data. Alternatives include:
 - audio- or computer-assisted interviewing methods
 - polling booth interviews for selected questions.

Include multiple questions on a similar topic

- Assess the consistency of responses or use composite measures of risk behaviour to assess trends.
- Ask questions that are unlikely to change as a result of the intervention programme. For example, ask about the number of casual sex partners or condom use with regular partners.
- See if high levels of behavioural indicators have changed and are also evaluated.

When to use rapid situation assessment and when to use behavioural surveillance survey

It is not always necessary to have highly precise behavioural data. Rapid situation assessments (RSA) may be a cost-effective alternative if you do not have enough resources to conduct formal biobehavioural surveillance surveys. Well-implemented rapid situation assessments may provide evidence suggesting that high-risk acts such as the use of non-sterile injections and unprotected sex happen frequently among a large proportion of the population being characterized. More information can be found at http://www.who.int/hiv/pub/prev_care/tgrar/en/.

If you want to use rapid situation assessment to collect risk intensity data, it is important to use standardized methods and measures of monitoring or quality control. This will ensure that the basis of comparison is fair. An absence of data due to a rapid situation assessment done too quickly or poorly should not be taken as evidence for an absence of risk.

More precise risk behaviour data than that available through rapid situation assessment are needed if the goal is to monitor trends over time or to assess whether changes in behaviour coincide with increasing coverage of the intervention programme.

4.2.3. The role of integrated biological and behavioural surveys

An important innovation since 2000 with the availability of the new rapid tests is the development of methods to collect data on behavioural and biological trends in the same survey. If your country has been conducting surveys, use behavioural trends at a population level to confirm or challenge how biological trends are interpreted. It is important that the populations surveyed are similar over time to be able to construct trends.

Strengths: The measurements of biological and behavioural markers are from the same population.

Weaknesses: This method is not a cure for untangling the complex relationship between trends in HIV prevalence and trends in risk behaviours. Time is an issue; it is still not possible to correlate current behaviours with current biological outcomes among individuals in the same population.

We know that the HIV infection status of an individual at the time of the survey does not necessarily represent his or her recent behaviour over the past year or so. The person may have been infected long ago. The relationship between recent behaviour and HIV status may not seem to make sense.

Behavioural trends at the population level will eventually be reflected in changes in prevalence at the population level, but these trends will take time to become visible. They cannot be explained by results from a single point in time, either at the individual level or at the population level.

Information on acute STIs provides additional data that confirm recent high-risk behaviours with the potential for HIV infection. To assess the impact of HIV prevention programmes on sexual behaviours, you can test for treatable acute infections such as primary or secondary syphilis or gonorrhoea to identify recent, unprotected sexual behaviour.

4.2.4. Other sources of data

Programme interventions are present

The presence of programme interventions signals that risk groups are present in large enough numbers for services to be established. Talk to staff who work at the programmes to learn more details about the types of populations who are at increased risk for infection. These data sources are very useful because they come from specific geographical units. This type of data can help you to distinguish areas with high epidemic potential from those with low potential.

HIV testing sites or STI service providers are present

In areas with new prevention programme interventions, geographical mapping or rapid situation assessments may not be available. Instead, HIV testing sites (for example, voluntary counselling and testing) or providers of services for STIs may be a source of information to identify and describe newly diagnosed cases. Review the data from the testing sites to both confirm whether these clients are from traditional risk populations or whether they represent other populations that can be used as a proxy.

Data from people living with HIV

In some countries, extensive sociodemographic or risk profile data are available on people living with HIV (PLHIV) from pre-antiretroviral therapy registers or AIDS case reports. You will need to maintain patient confidentiality strictly if you review these records. These can be rich sources of information on who is infected and the mode of transmission. Data of this type are particularly useful when HIV cases are small in numbers and the populations at increased risk are hard to profile in a particular area. Interpret data from pre-antiretroviral therapy registers or AIDS case reports as longer-standing infections. These may not accurately reflect recent patterns of new infections.

Other administrative or survey data

Another source of information on key populations at increased risk in a local area is administrative or survey data collected by agencies outside of the HIV arena. For example:

- The Ministry of Health, Department of Labour or Central Statistical Office may keep data on migrant workers or centres of manufacturing, mines or agriculture.
- Ministries of Justice, Police or Narcotics Control may have data on drug trafficking or drug-related crimes and arrests.
- In some countries, the Ministry of Tourism or Health may regulate entertainment establishments or other venues related to sex work.

If there is an increasing or a consistently high number of cases. This should trigger further investigation into a geographical unit. It would be preferable to focus on newly infected cases, but HIV is asymptomatic in such cases. Most cases will be diagnosed only after individuals have developed advanced HIV, years after they are infected. By looking at risk characteristics collected on recently identified cases, the source(s) of infections locally can be identified broadly. When a pattern of risk is identified among newly diagnosed cases, further investigation is needed as to whether transmission is local or infection has been acquired in other places.

4.3. Use your results to improve programmes

Often, data are collected by surveillance officers but are not used to improve programmes or influence the understanding of the HIV epidemic in a country. Routine dissemination activities should be planned to ensure that the results of the surveillance are shared and used by programme managers.

Prevention programmes should focus on the risk behaviours that fuel the epidemic. Among populations in which HIV prevalence is found to be high, interventions can be justified as a good investment. Care and treatment programmes should also be focused on populations at higher risk for HIV. Alternatively, if the data do not support continuing a programme, changes may be needed.

4.3.1. Inform policy-makers' plans or programme reviews

Countries have a greater need to track infected populations more closely and conduct surveillance for both HIV morbidity and HIV mortality.

Countries must mobilize resources to provide adequate care and treatment for the population. They will need to develop reasonable estimates of the number of people infected with HIV who will require care and treatment services in the future. This relies heavily on some form of modelling.

In Section 3, several options for modelling incidence were described. The modelling package promoted by UNAIDS/World Health Organization (WHO) is called Spectrum (www.futuresinstitute.org). Spectrum estimates:

- the number of people (adults and children) currently living with HIV
- the number of new HIV infections
- the number of adults and children in need of antiretroviral therapy
- the number of women in need of prophylaxis to prevent mother-to-child transmission of HIV
- The number of AIDS-related deaths.

Countries with generalized epidemics may find it easier to use this software. Disease is more easily measured and is likely to receive greater attention from the government and the health-care system. This makes it more likely that good surveillance and programme data are available to feed into the models to develop reasonable results.

Countries with concentrated or low-level epidemics may have greater difficulty in estimating the burden of disease. It is difficult to locate small geographical pockets of people living with HIV and to collate sufficient surveillance data that reflect the diversity of the epidemic.

The Indonesia example shows how to plan programmes using data. Having a map of epidemiological zones could also be used to update or improve programmes by accurately targeting needs.

Using data to plan programmes in Indonesia (Figure 4.7)

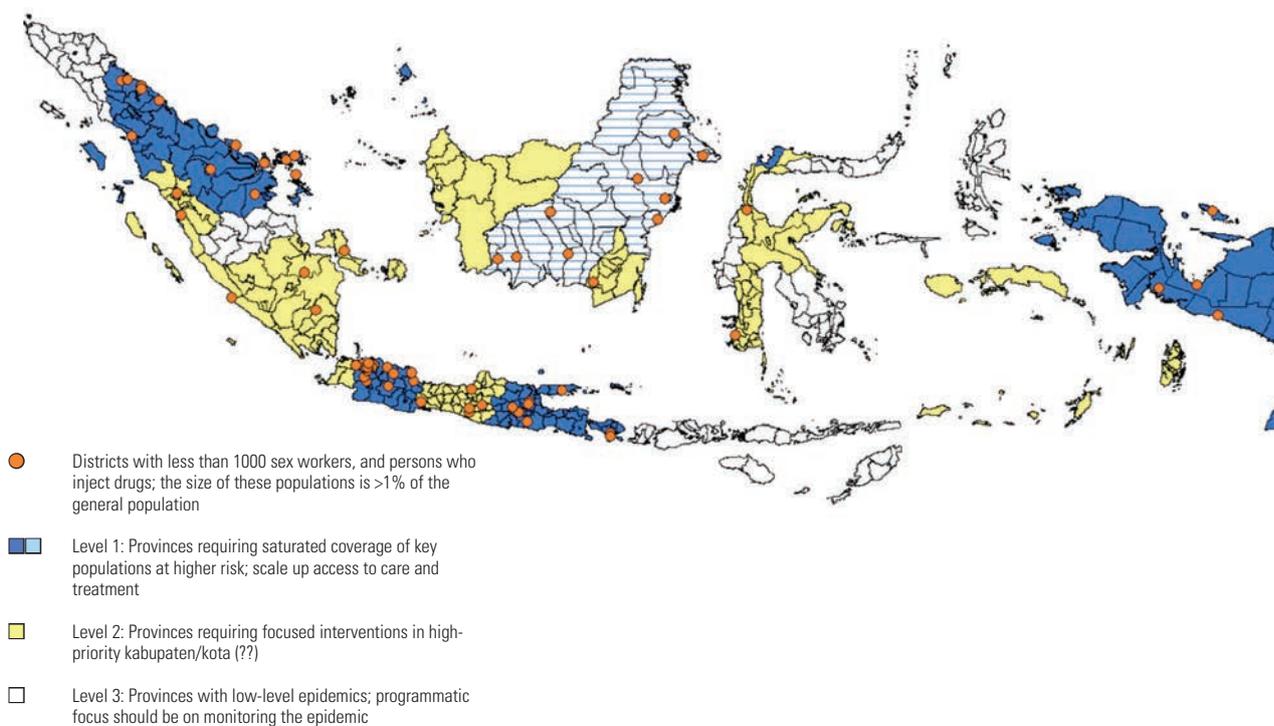
- Indonesia used several criteria to identify high epidemic priority areas:
 - large concentrations of persons whose behaviour put them at high risk were estimated to comprise more than 1% of the general population
 - large number AIDS case reports
 - high levels of HIV seroprevalence.
- Using these criteria, 71 districts (71 of 440, or 20% of all districts in Indonesia outside of Papua) were identified as having high epidemic potential or mature, concentrated epidemics.
 - These districts contain 80% of the cumulative AIDS cases that have been reported so far.
 - These priority districts also cover approximately 60% of the estimated populations of sex workers and persons who inject drugs.
- Provinces were grouped into three categories according to the number of high-priority districts in their jurisdiction.

4.3.2. Amend maps, plans and trend predictions as needed

A second generation surveillance system is an ongoing process of planning, collecting, analysing, interpreting and using data for planning, decision-making and dissemination. The system must continually update the understanding of the HIV epidemic.

- Some data are collected and analysed according to a periodic schedule, such as annual sentinel surveillance or integrated biological and behavioural surveys.
- Other data from ad hoc studies are analysed and incorporated when they become available. Such studies may be conducted during sudden increases in STIs, HIV prevalence or HIV advanced case reports, availability of new rapid situation assessment data or other sources of information.

Figure 4.7. Using data to plan programmes in Indonesia



Source: Indonesia Heterogeneity Synthesis by Pandu Riono, Virginia Loo, Pandu Harimurti, David Wilson, World Bank report June 2009

Programmes may need to be updated based on new information about the epidemic. As you process feedback (findings/data) from the last round of surveillance activities, your data priorities may need to shift.

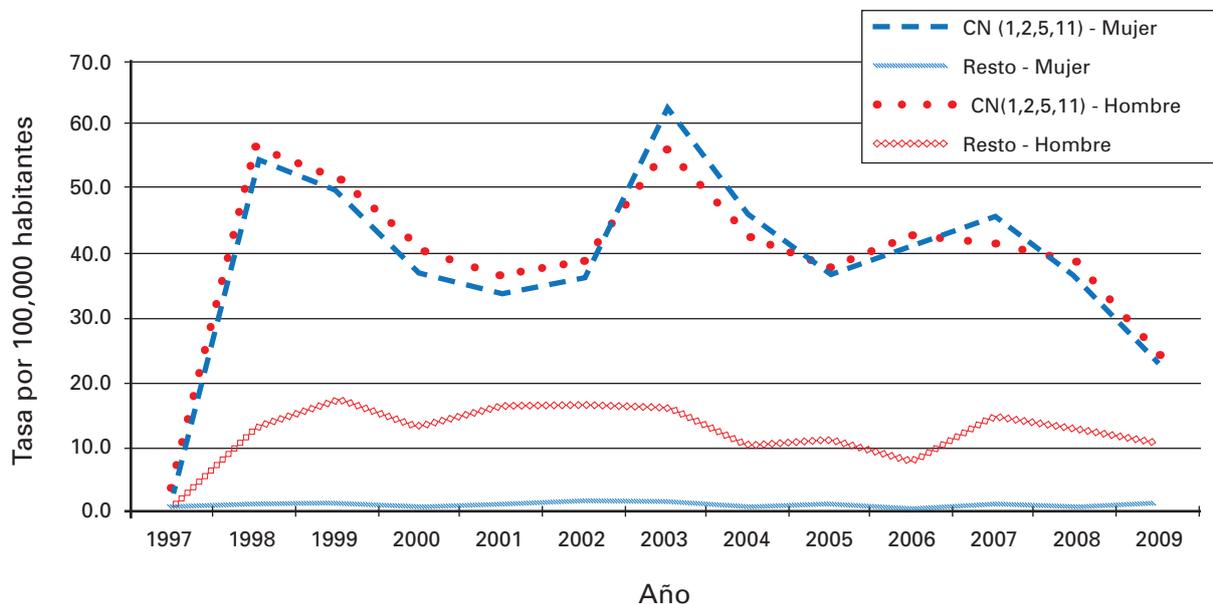
An example can be provided by data analysis of the Honduras HIV epidemic (Figure 4.8). The HIV notification rates per 100 000 population are higher in the coastal regions compared with the rest of the country. At the same time, the male-to-female (M:F) ratio of people infected with HIV in the north is close to 1, whereas in the rest of the country the M:F ratio is 3:1. This characteristic has been constant over time, which implies that two different epidemics are evolving in the country.

4.3.3. Identify where new infections are occurring

Epidemiological information can contribute to identifying where new infections are coming from. For instance, this information is key to using the UNAIDS Modes of Transmission model (MOT). It uses national prevalence and behavioural data to model the distribution of incidence in key populations at increased risk. It is therefore an important tool in supporting country programmes to “Know the HIV Epidemic” and therefore modify programmes. The epidemiological synthesis preceding the modelling exercise is a key requirement for developing a clear explanation of the dynamics of HIV infection, assessing the degree of alignment between programme and resource efforts, and the priority areas identified through the modelling exercise. By developing an understanding of the national epidemic and context (gaps, risks, service coverage and resources), the country is able to make better decisions on prioritization and definition of goals and targets for effective scale up of the national response.

As an example, Figure 4.9 presents the results of the Modes of Transmission study in selected African countries and where it was evident that key populations at higher risk played a major role in transmission of new HIV infections.

Figure 4.8. Taux de cas d’infection à VIH notifiés pour 100 000 habitants, stratifiés par situation géographique et par sexe, Honduras, 1997–2009

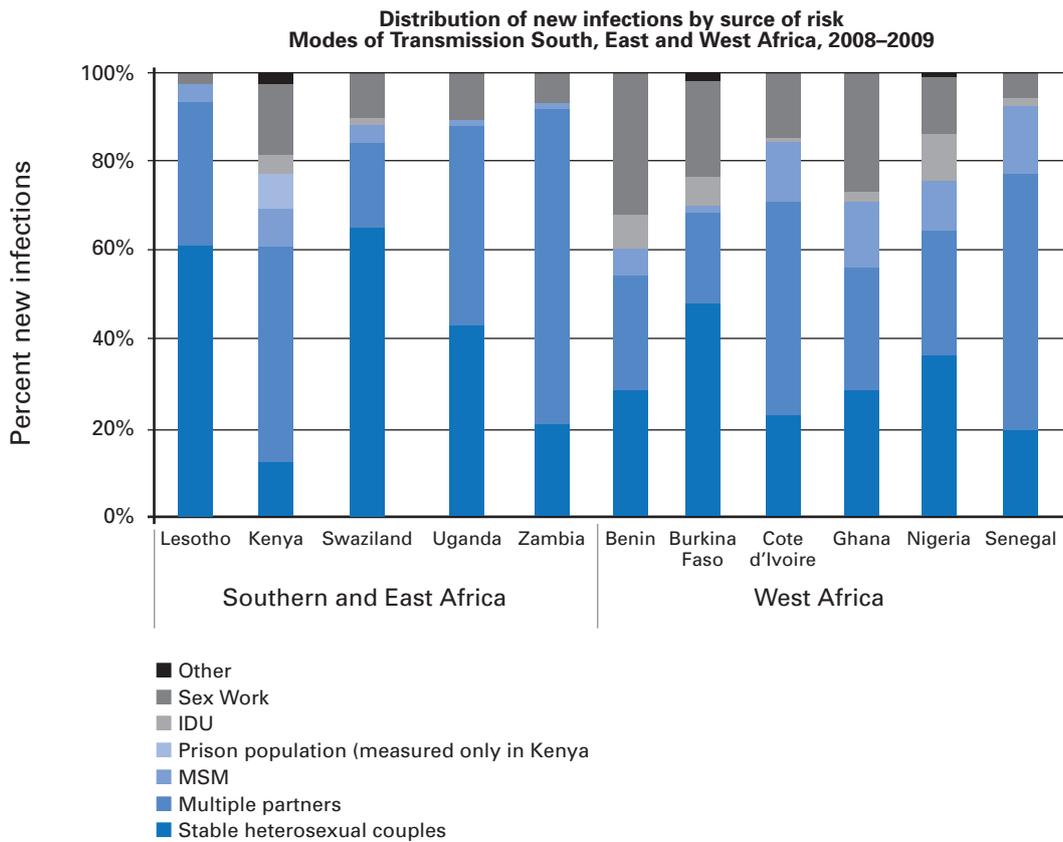


CN: North Coast H: men and M: women

Resto: rest of the country, mujer: women, hombre: men

Source : Honduras National AIDS Programme: triangulation of national data, 2011.

Figure 4.9. Results from Modes of Transmission in selected countries of sub-Saharan Africa



The results of these studies were the basis for undertaking several new prevention programmes that addressed key populations.

Appendix A: Interpret prevalence trends across multiple sites

You will commonly find two problems related to analysing data from multiple sites when interpreting data on biological or behavioural trends:

- improper aggregation – combining small samples improperly
- inconsistent survey sites.

Improper aggregation

When looking at trend data, it is tempting to pool data from multiple sites to obtain a larger sample size. The larger sample sizes are convenient because you are trying to detect statistically significant trends over time, but this is not the best solution.

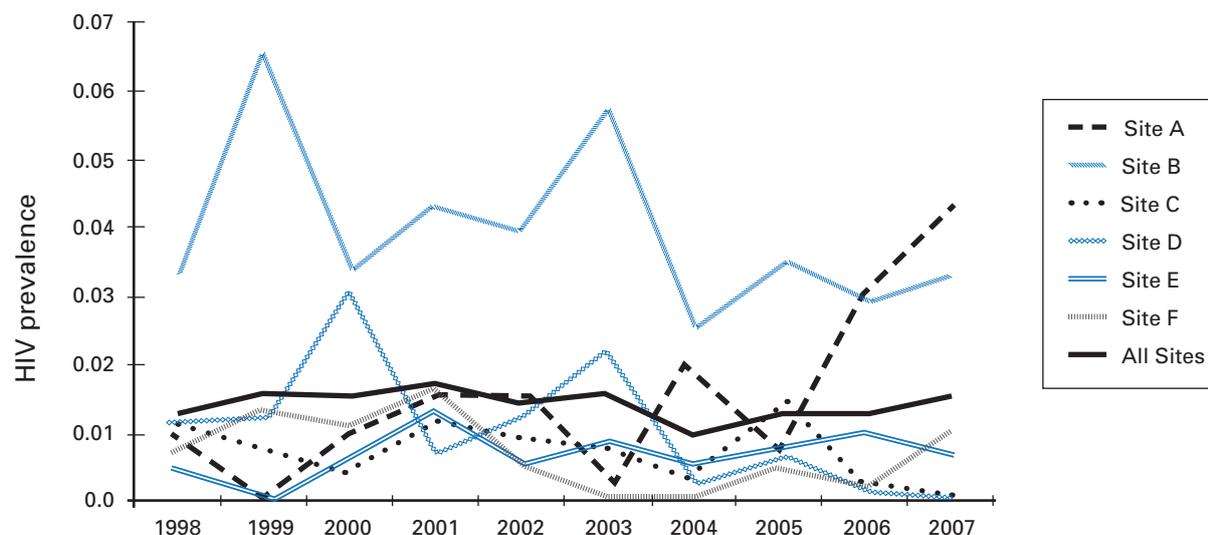
What are the issues?

The disadvantage of pooling or aggregating data across sites is that the differences between the sites are obscured. Your result may not be meaningful and may even be misleading.

What is gained in sample size by aggregating data may be lost in the inability to see potentially important local patterns. Figure A.1 illustrates how the conclusions drawn from a combined trend line for all sites is different from those of the individual sites.

- The combined-sites trend line misses the rising prevalence in site A and the overall higher prevalence in site B.
- It also misses the decline in prevalence in site D.
- Some of the fluctuations in the individual trend lines, such as at site F, are likely to be the result of small sample sizes. Those effects are smoothed out when the data are aggregated.

Figure A.1. Comparing the trend lines of all sites pooled versus individual sites



How to deal with data aggregation issues

- Consider the question that this type of analysis intends to answer. Is a prevalence estimate for a larger geographical unit required? Or is it of greater interest to understand how the epidemic in a particular area or key population is changing? Consider how to extrapolate HIV prevalence from areas represented by sentinel or survey sites to areas where direct measures of HIV prevalence are not available. For example, you may decide to assign prevalence from a site located within an epidemiological zone to the total population in that zone.
- Can prevalence be weighted according to the size of the population in the different geographical units that are part of a larger geographical unit? Simply pooling the data from multiple sites, either by crude or weighted averages, will probably not be adequate for estimating the prevalence of a large geographical unit. Even if one looks at trend data, it may not be sufficient to pool data from consistent sites if the trend is attributed to an epidemic in a large geographical unit. If there are multiple epidemiological zones in the large geographical unit, describing an overall trend may not be meaningful if the epidemic is expanding in one zone but is stable in other zones.

Inconsistent surveillance sites

Most countries start their HIV surveillance systems in areas where the epidemic is most visible, where:

- the epidemic is most mature
- HIV prevalence levels are highest.

Over time, the number of surveillance sites expands to cover the country more uniformly. Newer sites often are located where there are less severe epidemics.

What are the issues?

When you are aggregating data to develop a trend, you will need to decide whether to include:

- only sites that have data for all years, or
- all sites, regardless of when surveillance was started.

When you combine data from new sites to the trend analysis, you are likely to dilute the overall prevalence compared to the old sites that have been in the surveillance system longest. This may indicate a decline when actually there is no decline.

Also, sentinel sites may be removed or added into surveillance rounds from year to year. These changes may be caused by:

- inconsistent availability of resources
- changes in persons in charge of surveillance who may make different decisions about surveillance priorities.

The effect of this scenario on trend is less clear.

How to deal with issues of inconsistent surveillance sites

There are two methods for dealing with inconsistent surveillance sites:

- look at trends for older and newer sites separately within the same epidemiological zone, or
- consider the pattern of consistent trends across different sites or epidemiological zones (do not pool results). This may be more informative and better summarize the trajectory of the epidemic in a large geographical unit.

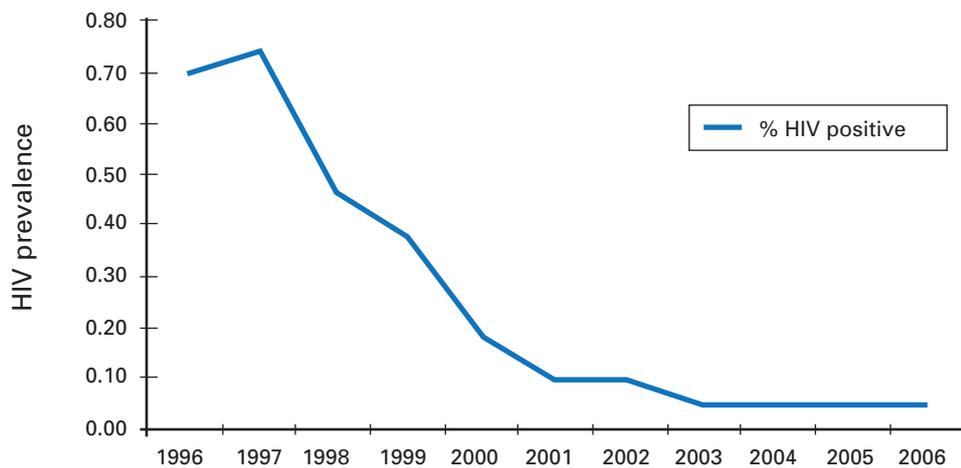
Consistency in the trends observed when you break up the data in different ways suggests real changes in the epidemic.

Think about why trends appear the way they do

When you are interpreting HIV prevalence trends, ask yourself the possible reasons why the trends appear the way they do. Two examples of explanations for trends observed in real data are given in Figures A.2 and A.3 below.

Figure A.2 provides trend data for a rapid decline in prevalence observed among a population of persons who inject drugs between 1998 and 2007. It is not unusual to see trends like this from surveillance data among persons who inject drugs. Among them, HIV prevalence may rapidly rise or fall in a short period of time. Yet, even with greatly reduced transmission, it is unlikely that HIV prevalence could drop this quickly. When you see a trend like this, you have to consider the natural and unnatural factors that affect prevalence trends, as discussed below.

Figure A.2. Dramatic decline in HIV prevalence among persons who inject drugs, 1997 to 2007



Possible explanations for trend in Figure A.2

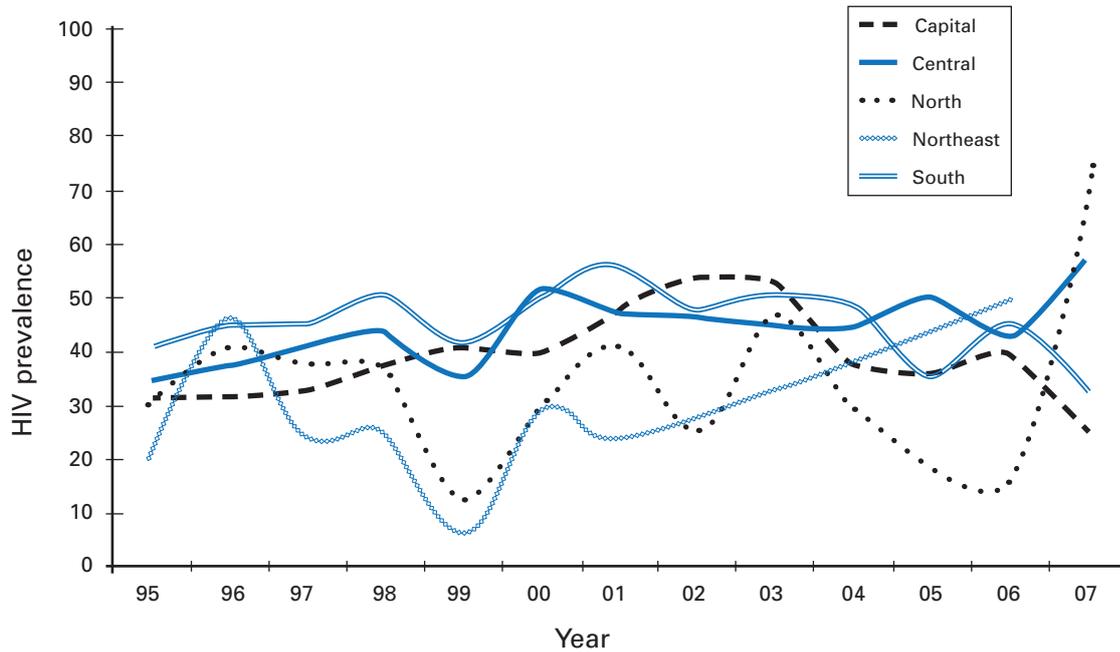
Natural causes

- Dramatic drop in HIV incidence
- Saturation of the population with HIV infection and no new susceptible persons
- Mortality among HIV-infected persons who inject drugs
- A combination of these factors might explain part of the decline, but they could not explain all of it.

Unnatural causes

- Excluding people who tested positive in the previous round of surveillance (common source of error)
- Change in the site (for example, from facility-based persons who inject drugs to community-based persons who inject drugs)
- Large influx of HIV-negative persons who inject drugs.

In Figure A.3, sentinel surveillance data for persons who inject drugs in several regions of the country are given. In one region, HIV prevalence appears to have decreased steadily for a number of years, but reversed and increased dramatically in the last round of surveillance. Could this recent increase reflect an explosive epidemic among persons who inject drugs in this region?

Figure A.3. HIV sentinel surveillance trends for persons who inject drugs, 1995–2007**Possible explanations for trends in Figure A.3****Natural causes**

There could be a continued high incidence with a high death rate among persons who inject drugs.

Unnatural causes

There could be a higher rate of testing for HIV-positive persons who inject drugs than HIV-negative persons who inject drugs. Such a situation could occur if:

- surveillance takes place in drug treatment centres
- the size of the population of persons who inject drugs shrinks because of shifting patterns of drug use (for example, trend toward methamphetamine use)
- the remaining injectors are likely to be older injectors who became infected a long time ago.

Diminishing sample sizes and inability to meet the sample size quota for persons who inject drugs at sentinel sites would be a possible indication that this dynamic might be at play.

Appendix B: Technical guidance documents

Title	Year	Topic
<i>Evaluation guidelines for HIV second generation surveillance system</i>	2011	How to assess and evaluate HIV surveillance systems and adapt them to the needs of countries (forthcoming)
Ethical guidance in HIV surveillance	2011	Ethical principles to be followed when conducting HIV surveillance activities (forthcoming)
Guidelines on estimating the size of populations most at risk to HIV	2010	Update on methodologies for estimating the size of key populations at higher risk for HIV exposure http://www.globalhealthsciences.ucsf.edu/PPHG/surveillance/who_trainings.html
<i>HIV surveillance in hard-to-reach populations</i>	2010	Update on methodologies for conducting HIV surveillance among key populations at higher risk for HIV exposure http://www.who.int/hiv/pub/surveillance/most_at_risk/en/index.html
<i>Guidelines for using testing technologies in surveillance: selection, evaluation, and implementation: 2009 update</i>	2009	An update in guidance on selecting and utilizing appropriate HIV tests for surveillance purposes http://www.who.int/hiv/pub/surveillance/hiv_testing_technologies/en/index.html
<i>Sampling strategies and design tool</i>	2009	A useful tool for determining the most appropriate sampling tool, developed at the Centers for Disease Control and Prevention (CDC), hosted at http://globalhealthsciences.ucsf.edu/PPHG/surveillance/CDC-MARPs/sampling_selection.htm
<i>HIV triangulation guide: synthesis of results from multiple data sources for evaluation and decision-making</i>	2009	Guidelines on conducting triangulation, users' manual developed with examples based on experiences in Africa http://www.who.int/hiv/pub/surveillance/hiv_triangulation_guide.pdf
<i>The pre-surveillance assessment: guidelines for planning serosurveillance of HIV, prevalence of sexually transmitted infections and the behavioural components of second generation surveillance of HIV</i>	2005	Tools for preparing to implement second generation surveillance including defining and selecting risk groups, sites and feasibility of methods http://www.who.int/hiv/pub/surveillance/sti/en/index.html
<i>Guidelines for measuring national HIV prevalence in population-based surveys</i>	2005	Guidelines for national population-based surveys with HIV testing http://data.unaids.org/pub/Manual/2005/20050101_GS_GuideMeasuringPopulation_en.pdf
<i>Guidelines for HIV surveillance among TB patients</i>	2004	How to conduct HIV surveillance among TB patients http://www.who.int/hiv/pub/tb/guidelines/en/index.html
<i>Guidelines for effective use of data from HIV surveillance systems</i>	2004	Guidance on how to analyse, interpret and present surveillance data http://data.unaids.org/Publications/IRC-pub06/JC1010-UsingData_en.pdf
<i>Ethical issues to be considered for second generation surveillance</i>	2004	Ethical issues for conducting second generation surveillance (draft) http://www.who.int/hiv/pub/surveillance/sgs_ethical/en/index.html
<i>Estimating the size of populations at risk for HIV: issues and methods</i>	2003	Guidance on different methods for estimating key populations at higher risk for HIV exposure http://data.unaids.org/Publications/External-Documents/EstimatingPopSizes_en.pdf
<i>Guidelines to HIV sentinel serosurveys among pregnant women and other groups</i>	2003	Protocols for implementing ANC sentinel surveillance http://data.unaids.org/Publications/IRC-pub06/JC954-ANC-Serosurveys_Guidelines_en.pdf

<i>Initiating second generation HIV surveillance systems: practical guidelines</i>	2002	Suggested process for planning and getting consensus on design of a national second generation surveillance system http://www.who.int/hiv/pub/surveillance/en/isbn9291732192.pdf
<i>Guidelines for using testing technologies in surveillance: selection, evaluation, and implementation</i>	2001	Guidance on selecting and utilizing appropriate HIV tests for surveillance purposes http://data.unaids.org/Publications/IRC-pub02/JC602-HIVSurvGuide1_en.pdf
<i>Behavioural surveillance surveys: guidelines for repeated behavioural surveys in populations at risk of HIV</i>	2000	Detailed guidance for planning and implementing behavioural surveillance surveys (BSS) http://www.fhi.org/en/hivaids/pub/guide/bssguidelines.htm
<i>Guidelines for second generation HIV surveillance</i>	2000	Overview of principles of second generation surveillance http://www.who.int/hiv/pub/surveillance/en/cds_edc_2000_5.pdf
<i>Guidelines for sexually transmitted infections surveillance</i>	1999	Principles of STI surveillance with review of data collection methods and designs http://www.who.int/hiv/pub/sti/pubstigidelines/en/
<i>Sexually transmitted infections prevalence study methodology: guidelines for the implementation of STI prevalence surveys</i>	1999	Framework for conducting an STI prevalence study targeting population subgroups with different behavioural and risk profiles http://www.wpro.who.int/NR/rdonlyres/E6C98579-643F-485D-93B9-2AAAD1FABA9B/0/STI_Prevalence_Study_Methodology.pdf

Appendix C: Glossary and Acronyms

Accuracy	In the context of surveillance and point estimates, it refers to how close an estimate is to the true value.
Asian Epidemic Model	An epidemic modelling software package for projecting the trajectory of an HIV epidemic. The software is customized for the type of concentrated epidemics found in Asia. (Brown T, Peerapatanapokin W. The Asian Epidemic Model: a process model for exploring HIV policy and programme alternatives in Asia. <i>Sexually Transmitted Infections</i> , 2004, 80 (Suppl 1):i19–i24.)
BSS/IBBSS behavioural surveillance surveys/ integrated biological and behavioural surveys	Repeated cross-sectional probability surveys of a specified population. Both types of surveys include behavioural risk factor data. IBBSS also include biological markers of HIV or sexually transmitted infections.
Case reporting	A type of surveillance activity in which new cases of a disease or health condition are counted over a specified period of time
Concentrated epidemic	A type of HIV epidemic in which most transmission of HIV occurs in the context or because of sex work, anal sex between men, or among persons who inject drugs. There is insufficient high-risk sexual activity occurring among the general population to sustain HIV transmission on its own.
Epidemic potential	The likelihood of an epidemic to expand greatly or quickly due to the presence of large numbers of individuals with behaviours that put them at high risk for acquiring or transmitting HIV
Epidemiological zone	A geographically defined area with very similar epidemic characteristics throughout the bounded area
Expanding epidemic	An epidemic that is increasing in terms of the number of people infected with the disease or health condition
Generalized epidemic	An HIV epidemic in which most transmission of HIV is sustained among the general population through high-risk sexual behaviour, such as having multiple and concurrent sexual partners coupled with low condom use
Key populations	Populations distinguished by behaviours associated with higher levels of acquiring and transmitting HIV. Traditional high-risk groups include female sex workers and their clients, men who have sex with men and persons who inject drugs.
Hyperendemic	A type of very advanced generalized HIV epidemic with very high HIV prevalence among the general population (for example, higher than 15%)
Impact	The ability of an intervention or environmental factor to change the direction or rate of change in an epidemic cumulatively over a long period of time
Incidence	The number of new infections of a disease or health condition occurring over a specified period of time
Know your epidemic	A concept for collecting and analysing information about the HIV epidemic that enables appropriate planning and design of a response which will efficiently prevent new infections and serve those needing care and treatment. (<i>Lancet</i> , 2008, 372 (9637):423–426.)
Low-level epidemic	An HIV epidemic in which the level of HIV prevalence even among key populations at higher risk for HIV remains low (for example, less than 5%) and prevalence among the general population is even lower
Mapping (geographical, social)	A method for understanding the size or characteristics of a specific population by systematically going to and collecting data about venues/sites where the population gathers
Mature epidemic	In the context of HIV, the period in an epidemic when infections in a population have been transmitted for a long period of time (for example, more than 10 years). At this point, the natural death rate among infected persons is approximately constant.
Men who have sex with men (MSM, venue-based)	Venue-based refers to men who have sex with men who come to specific locations known to other MSM for the purpose of meeting sexual partners. These types of MSM are likely to have a large number of sexual partners over a short period of time. They are at higher risk for acquiring HIV.

Networks (social, sexual)	The set of relationships among members of a defined population over a specified period of time. The relationships can be defined in multiple ways: <ul style="list-style-type: none"> • social networks refer generally to the relationships among those who know each other through friendship or acquaintanceship • sexual networks refer to the linkages between members of a group based on who has/had a sexual relationship
Outcome	The behavioural changes among individuals or organizations/institutions related to changing the likelihood of transmitting disease or for utilizing care and treatment services
Persons who inject drugs	Those who inject drugs for recreational purposes, that is, for non-medical purposes
Precision	In the context of surveillance and estimates, refers to how close an estimate is to other estimates made using the same methodology; that is, when a method is repeated, the degree to which a result is consistent
Prevalence	The proportion of people who currently have a disease or health condition in a defined population
Probability sample	A group of methods in sampling in which the probability of a respondent being selected for the sample is known and can be used in the analysis of survey data. This results in data that are representative of the larger population.
Rapid situation analysis (RSA)	A method for characterizing groups in a geographical unit which can be conducted quickly and with limited resources. Most rapid situation analyses are used during planning for an intervention.
Risk factor	A behavioural, biological or environmental factor associated with a higher likelihood of acquiring or transmitting a disease
Saturation	When the epidemic is no longer increasing, a level of HIV prevalence is reached among a population. A majority of persons who are susceptible to infection have already been infected.
Second generation surveillance	The process of data collection and analyses used to track the course of an HIV epidemic, identifying where the most new infections are likely to be occurring and assessing the current burden of disease. Methods include size estimation of key populations at higher risk, biological and behavioural probability surveys, facility-based sentinel surveillance, case reporting and routine monitoring data.
Sex worker (SW) <ul style="list-style-type: none"> • Direct • Indirect 	Person who sells sex for money or gifts <ul style="list-style-type: none"> • Direct sex workers derive their primary income from selling sex. This group includes brothel-based and street-based sex workers. • Indirect sex workers work in establishments other than those purely meant for sex work. For example, they may work as waitresses, bartenders, dancers, masseuses and then sell sex to clients they meet through their place of work.
Surveillance group	A defined group among whom a surveillance-related data collection activity is conducted, to make an estimate about the level of disease, behaviour or other risk characteristic of that group
Targeted interventions	HIV prevention interventions that are focused on key populations at higher risk for HIV exposure. These often include a peer education strategy to deliver behaviour change communication and commodities such as condoms, lubricants and needles/syringes
Triangulation	A data analysis process in which multiple sources of data are considered together to come to a conclusion on a question related to an epidemic or intervention
Transmission dynamics	The mechanism by which a communicable disease occurs within a population. It defines the size and direction of an epidemic.
Proxy groups	A group with a large proportion of members who engage in a risk behaviour associated with acquiring or transmitting HIV. Surveillance activities may be conducted among proxy groups when it is not feasible to sample specifically defined key populations at higher risk for HIV exposure.
Reliability	The degree to which an operational method provides consistent results if repeated multiple times
Risk intensity	The degree to which a key population practises behaviours associated with a high risk of acquiring or transmitting HIV

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ISBN 978 92 4 150582 6



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