Workbook Method for estimating HIV prevalence in low level or concentrated epidemics

Joint United Nations Programme on HIV/AIDS

World Health Organization

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Background

• Estimation and projections of HIV/AIDS are increasingly important for planning and evaluation of national programs.

• We need to know where the epidemic is concentrated to direct prevention efforts.

• Need estimates on future burden and impact to anticipate prevention and care needs and plan for impact mitigation.
• A few definitions
  Prevalence and Point prevalence
  Generalized Epidemic
  Concentrated Epidemic
Prevalence

The number of people with a disease at a specific time, divided by the total population.
Four factors determine extent of ranges of HIV prevalence

• **HIV prevalence level:** ranges are lower as HIV prevalence is higher.
Four factors determine extent of ranges of HIV prevalence

- **Quality of data**: countries with better quality data have smaller ranges than countries with poorer quality data.

- **Number of steps or assumptions used to arrive at an estimate**: The more steps and assumptions, the wider the uncertainty range is likely to be (since each step introduces additional uncertainties).
Four factors determine extent of ranges of HIV prevalence

• **Type of epidemic**—Ranges tend to be wider in countries with low-level or concentrated epidemics than in countries with generalized epidemics
Generalized Epidemic

- HIV firmly established in the general pop.
- Although sub pop with higher risk may continue to contribute disproportionately to the spread of HIV, sexual networking in the general population is sufficient to sustain an epidemic independent of sub-pop at high risk of infection.
- HIV infection is consistently over 1 percent in pregnant women.
Observations on Generalized Epidemics

- Prevalence on pregnant women is usually a fair indicator of prevalence in the adult pop.
- Rural prevalence is usually lower than urban.
- Therefore, most countries with generalized epidemics can be modeled on two distinct sub-pop: urban and rural
Concentrated Epidemic

- HIV has spread rapidly in at least one defined sub-pop, but not well established in general pop.
- Most often more than one sub-pop at high risk is affected.
- HIV prevalence is consistently over 5% in at least one defined sub-pop.
- HIV prevalence is below 1% in pregnant women in urban areas.
Observations on Concentrated Epidemics

- Epidemic concentrated in specific sub-pop.
- Pregnant women not a good indicator
- Therefore, the epidemic on countries with concentrated epidemics are modeled combining prevalence of different sub-pop (IDU, sex workers, MSM).
Combining different epidemics

• National HIV epidemics are usually composed of multiple epidemics in different populations and in different geographic areas.

• Epidemic curves developed separately and then combine to form one national epidemic curve.
Approach to concentrated epidemics

• Develop estimates for populations who are most exposed to HIV/AIDS and then,

• combine those estimates to produce an overall estimate of adult prevalence.
Sources of DATA

• Sentinel Surveillance.

• Case reports

• Surveys
Sentinel Surveillance

• Method for data collection and analysis of individual patient related information.
• Useful for documenting trends.
• Surveillance is limited to few selected hospitals or laboratories in an area.
• SS of at risk groups can lead to overestimation of HIV prevalence in these groups.
Case reports

- Reported to the health system.
- Can substantially underestimate the number of people living with HIV/AIDS.
- Data is focused on specific at risk groups, often missing other important groups.
- Unlikely to capture people that are recently infected.
Surveys

• Are very expensive.
• More in depth data compared with surveillance
• More accurate estimate of incidence and prevalence.
• Rare in Caribbean countries.
HIV prevalence rate in adults 15–49 years of age for 2003
the Caribbean epidemic: a quick overview
HIV/AIDS in the Caribbean

- The second highest HIV prevalence rate in the world after sub-Saharan Africa.
- ¾ of the 250 000 people leaving with HIV/AIDS live in Hispanola.
- National adult HIV prevalence is high throughout the region: 2%–4% in the Bahamas, Haiti and Trinidad and Tobago.
- 1%–2% in Barbados, Dominican Republic and Jamaica.
- Cuba, with prevalence below 0.1%, is the exception.
HIV/AIDS in the Caribbean

• 27,000 (20,000-41000) new infections in 2006

• 19,000 (14,000-25000) people died of AIDS in 2006.

• Several countries have scaled up their efforts to give access to ART
HIV/AIDS in the Caribbean

• Largely an heterosexual epidemic

• **Sex between men** accounts for about one tenth of reported HIV cases in the region
HIV/AIDS in the Caribbean

• Declining trends are most likely related to some positive behaviour changes that have become evident.

• HIV incidence had already begun declining around 1990, before the behaviour changes were observed.
Status of the HIV epidemic in the Caribbean

- Overall the epidemic continues at a relatively high rate with potential for increased spread
- There are encouraging signs of decreases in HIV in some countries with more advanced epidemics
- However, HIV rates are very high among those most at risk in many countries
- Much remains to be done in order to control the HIV epidemic in the Caribbean
Responding to the HIV/AIDS Epidemic in the Caribbean

• An effective response to the HIV/AIDS epidemic depends primarily on the commitment, capacity and leadership at the national level.

• The Regional response needs to ensure a favourable policy and legislative environment, adequate resources, good coordination, technical assistance and support for the countries.

• Unfortunately, the Regional response has generally failed to achieve these goals.

Peter Figueroa
Overview for concentrated epidemics

- Surveillance data and size estimates for high risk groups and low risk populations
- Workbook or EPP
- Adult HIV prevalence
- UN Population Division’s population estimates
- Epidemiology assumptions
- Spectrum
  - PLWHA
  - New infections
  - AIDS deaths
  - Treatment needs
the Workbook Method
What is workbook?

• It is a software that exists as an Excel file with several spreadsheets and it is available in English, French, Spanish, Russian, and Chinese.

• That will produce point prevalence estimates and a curve fitting historical prevalence estimates.

• Available at: http://www.unaids.org/en/HIV_data/Epidemiology/episofware.asp
What will workbook do

- You will enter information collected in your country, then the Workbook provides an estimate of HIV prevalence.
- Remember that the reliability of the Workbook estimates is only as good as your input data.
Use Workbook to:

• Make estimates of various regions

• Generate an epidemic curve

• Generate estimates for adult prevalence that can be imported into spectrum
What will you get?

• Your total estimate of prevalence calculated in Workbook will be the sum of the number of adults living with HIV/AIDS in:

  – Higher risk behaviour groups, such as injecting drug users (IDU), men who have sex with men (MSM), female sex workers (FSWs)
  – Lower risk behaviour groups
Why we use workbook?

To develop estimates for populations which are most exposed to HIV and then combined to produce an overall estimate of adult prevalence in a country.
Overview of Workbook

- Purpose of Workbook
- Required elements
- Strengths of Workbook
- Limitations of Workbook
- Output
Purpose of Workbook

• **Estimate National HIV prevalence**
  – Concentrated Epidemics
    • High risk populations
    • Populations at lower risk
      – Partners of IDUs, FSW, etc
      – General population

• **Develop Epidemic Curve**
  – Logistic curve
  – Double logistic curve

• **Output for Spectrum**
Overview of talk

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Required Elements Planning

- **Structure of Epidemic**
  - Define geographic regions
  - Define your risk groups

- **Data Points**
  - High risk groups/Lower risk groups
    - Determine size of high and low risk group
      - MSM, IDU, FSW, Clients of FSW
    - HIV prevalence within risk groups

- **Epidemic Curve Estimation**
  - Prevalence by year
  - *Solver™* installed
Geographical regions

- Disparate country, you may want an HIV prevalence estimate for each region.
- In a smaller country, you may also have an estimate for each region or province
- For each region, you will be asked to enter in Workbook the regional population (age 15-49 years) and the percent of the population that lives in urban areas.
- Some countries don’t divide into regions, so you may consider the whole country as one region.
High Risk Groups and potential sources of prevalence

- IDUs
- MSM
- FSW
- Clients of FSW
- Capture-recapture studies
- High Risk group Surveillance
- Census studies
Populations at lower risk and potential sources of prevalence

- Sex Partners of IDUs
- Sex Partners of MSM
- FSW
- Sex Partners of Clients of FSW
- Published estimates calculated with assumptions
  - DHS
  - Census surveys
  - STI
Assumptions on spread of HIV infection within lower-risk behaviour populations

• Transmission, if it occurs, is through sexual partners from the higher-risk population

• There is little or no spread of HIV infection
  • within lower-risk behaviour populations
  • from unsafe blood transfusion or
  • from unsafe medical injection practices
Assumptions on spread of HIV infection within lower-risk behaviour populations

• Early in the epidemic, the number of people who are HIV positive lower-risk groups will be very small because there has not been enough time for spread from their higher risk sexual partners. The best way to identify this group may be through behavioural studies.

• Over time, the number of people with HIV/AIDS in these groups at lower risk for exposure to HIV/AIDS can be much larger. If the epidemic in your country is considered to be long-standing, use prevalence in other low risk populations, such as in pregnant women, as the basis for the estimate of the rate of sexual transmission.
Missing data on Risk Groups

- The two most important types of missing data are:
  - Missing estimates of higher-risk population size: if there is no reliable local estimate of the size of higher-risk population, you may estimate it by borrowing values from neighboring or similar countries where data does exist.
Population Size
Example on proxy

• East Texas and North Kansas are countries that are similar culturally, ethnically, economically:
  – If the size (% of population) of the East Texas IDU population is unknown and
  – If North Kansas has a reasonable estimate of the size of the North Kansas IDU population,
  – Consider using the North Kansas IDU size (% of population) for East Texas IDU.
HIV prevalence

- Do not borrow prevalence values from any other sources
- If you have no surveillance data, use whatever appropriate or applicable data you have and clearly document your decisions.
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The Workbook

- Planning
  - Set up sheet
  - Regional sheets
  - National Estimate
  - Consistency checks
  - National projections
Plan your structure

• Develop a structure for your Wordbook according to:

  • Geographical regions
  • High and low risk groups and estimates
  • Data sources (DHS, ANC, case reports, etc…)
  • Regional data (name, pop, % urban, early or long standing epidemic and missing data)
The Workbook

- Planning
- **Set up sheet**
- Regional sheets
- National Estimate
- Consistency checks
- National projections
Setup Sheet

- Country name and year
- Region names, population sizes (UN), percent urban
- Additional risk group categories
- Data sources
- HIV Case reports and AIDS case reports
- A quality assessment of your surveillance system
The Workbook

- Planning
- Set up sheet
- **Regional sheets**
- National Estimate
- Consistency checks
- National projections
Regional Sheets

- There are 6 regional tabs.

- Each area (region, province, state, county or other area) will have its own regional sheet. You will use each regional sheet to record detailed HIV/AIDS information in that region.

- You may unhide additional sheets to calculate national prevalence for up to 10 regions (6 are visible, 4 are hidden).
High Risk Groups

- IDUs
- MSM
- FSW
- Clients of FSW
Populations at lower risk

- Sex Partners of IDUs
- Sex Partners of MSM
- Sex Partners FSW
- Sex Partners of Clients of FSW
Estimation of PLR
Method A

• For estimating lower-risk population prevalence you need to:
  estimate the number of sexual partners of people with higher-risk behaviours in the region then apply HIV prevalence in this lower-risk group.
Estimation of PLR
Method A

• To estimate of the number of sexual partners, you need behavioural information about the higher-risk groups, such as the percentage of men who have sex with men who are married or have regular female sex partners. Prevalence of HIV infection in these groups is often not readily available. You may have to make a reasonable estimate of prevalence in these sexual partners.

• For some situations, you can estimate prevalence by assuming a frequency of sex and multiplying that by a reasonable probability of transmission during heterosexual sex.
Example
Estimating Prevalence

• Assume that sex occurs once a week (and there are 52 weeks in a year) and the transmission probability (male to female) is 0.2% per act (which is a standard number substantiated elsewhere), then $52 \times 0.2\% = \text{approximately} \ 10\% \text{ rate of infection}$
Method B

• For Method B, use HIV prevalence data from pregnant women as your lower-risk behaviour prevalence.

• From your national population numbers, the spreadsheet will use the number of women in reproductive age (15-49) minus women in the populations with higher-risk behaviour, shown in regional sheet.
Method A or B

• Both methods are good for estimating the number of lower-risk behaviour adults infected in the population.
The Workbook

- Planning
- Set up sheet
- Regional sheets
- **National Estimate**
- Consistency checks
- National projections
National Estimate

• The National estimate is the sum of the estimates in each region.
The Workbook

- Set up sheet
- Regional sheets
- National Estimate
- Consistency checks
- National Projections
Consistency checks

• Compare the values seen in your national estimate to those in other countries with low-level or concentrated epidemics.

• Average population sizes of groups at higher-risk and estimates of prevalence are compared
The Workbook

- Set up sheet
- Regional sheets
- National Estimate
- Consistency checks
- National Projections
National Projections Epidemic Curves

• You will use the Epidemic Curve sheets for three purposes:
  – to fit an epidemic curve to the data points so that you can assess the trend over time.
  – to determine doubling time of the epidemic, rate of growth of the epidemic and the current prevalence level.
  – to develop prevalence data that can be exported to Spectrum, a program used to estimate the impact of HIV prevalence on incidence, mortality, orphanhood and other variables.
Sum of Squares (SS)

• The Sum of Squares (SS) is an additional logistic parameter and is used as a diagnostic. SS provides a measure for determining how efficient the three parameters are estimating a reasonable curve.
  – The closer SS is to 0.00, the better.
Logistic curve

- \( a \) = prevalence at which epidemic is expected to level off
- \( t \) = time at which epidemic reaches half its peak value
- \( \alpha \) = rate of increase at the start of the epidemic
Double logistic curve

- $a$ = peak prevalence
- $\beta$ = rate of decline
- $b$ = final prevalence level
- $t$ = turn-over time
- $\alpha$ = rate of increase
### When to Use Each Logistic Curve Model

<table>
<thead>
<tr>
<th>Single logistic</th>
<th>Double logistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>- The most common model</td>
<td>- Used when epidemic shows signs of decline</td>
</tr>
<tr>
<td>- Used when the epidemic is still growing or starting to stabilize</td>
<td>- Requires more than five data points (years of prevalence data). Five parameters are calculated, so you need more than five estimates.</td>
</tr>
<tr>
<td>- Requires more than three data points (years of prevalence data)</td>
<td></td>
</tr>
</tbody>
</table>

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**World Health Organization**

[Image of World Health Organization logo]

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**UNAIDS**

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Overview of talk

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Limitations of Workbook

- **Lack of data**
  - Population sizes
  - HIV prevalence within populations

- **Epidemic Curves require historical data**
  - At least 3 years for simple logistic
    - For rising or stabilizing prevalence
  - More than 5 for double logistic
    - For declining prevalence
Overview of talk

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Output

- Point Prevalence value for single year
- Epidemic Curve: Prevalence over time
- Output for Spectrum
Use the Workbook Method for this:

- HIV has spread rapidly in a defined sub-population, but is not well-established in the general population.

- This epidemic state suggests active networks of risk within the subpopulation.

- HIV prevalence is consistently over 5% in at least one defined subpopulation. HIV prevalence is below 1% in pregnant women in urban areas.
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Objectives

- Hands on experience on Workbook.
- Get the information on the set-up sheet.
- Set the information on your region.
- Look at your national estimates.
- Check data consistency
- Get an epidemic curve
- Estimate population size
### St. Lucia Excercise

<table>
<thead>
<tr>
<th></th>
<th>IDU Population Size</th>
<th>IDU HIV Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Netherlands</td>
<td>16,299,000 pop</td>
<td>81,495 (0.5%)</td>
</tr>
<tr>
<td>Mozambique</td>
<td>19,792,000</td>
<td>39,584 (0.2%)</td>
</tr>
<tr>
<td>Barbados</td>
<td>270,000</td>
<td>270 (0.1%)</td>
</tr>
</tbody>
</table>