



# Purpose

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- To understand the sources of new HIV infections and the importance of each
- To use this information for program planning

# Methods

## The spreadsheet uses

- the current prevalence of HIV infection
- numbers of individuals with particular exposures, and
- the rates of these exposures

to calculate the *expected incidence of HIV infection* over the coming year

# Major modes of transmission of HIV in adults

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- Sexual contact
  - Commercial sex
  - Casual sex
  - Marital sex
  - Men who have sex with men
- Injecting drug use
- Blood transfusions
- Medical injections

# New infections from *sexual transmission*

- New infections =  $f$  (HIV prevalence in partners, number of partners, acts per partner, transmission probability per act, STI co-factors, condom use)
- Protection = condom use

# Probability of HIV Transmission (sexual)

$$I = S [ 1 - \{ pB[1-\beta']^{\alpha(1-v)} + p(1-B)[1-\beta]^{\alpha(1-v)} + (1-p) \}^n ]$$

$S$  = Number susceptible

$p$  = HIV prevalence in partners

$B$  = prevalence of STIs in partners

$\beta$  = probability of transmission (with STI ( $\beta'$ ), without STI ( $\beta$ ))

$\alpha$  = contacts per partner

$v$  = proportion acts protected by condom use

$n$  = number of partners

# Probability of HIV Transmission (IDU)

$$I = S [ 1 - \{ p [1 - \beta ]^{\alpha(1-v)} + (1-p) \}^n ]$$

$p$  = HIV prevalence in needle sharing partners

$\beta$  = probability of transmission

$\alpha$  = contacts per partner

$v$  = use of sterile needles

$n$  = number of partners

# New infections from unsafe medical injections

- New infections = Population \*  $[1 - (1 - P_s * P_t * P_c)^n]$ 
  - $P_s$  = Prevalence (total population)
  - $P_t$  = Transmission probability
  - $P_c$  = prevalence \* % unsafe needles
  - $n$  = number of injections per year
- Protection = % unused or sterile needles



# Data needs

|                                 |  |
|---------------------------------|--|
| <b>Population sizes</b>         |  |
| <b>HIV prevalence</b>           |  |
| <b>STI prevalence</b>           |  |
| <b>Number of acts</b>           |  |
| <b>Number of partners</b>       |  |
| <b>Percent protection</b>       |  |
| <b>Transmission probability</b> |  |

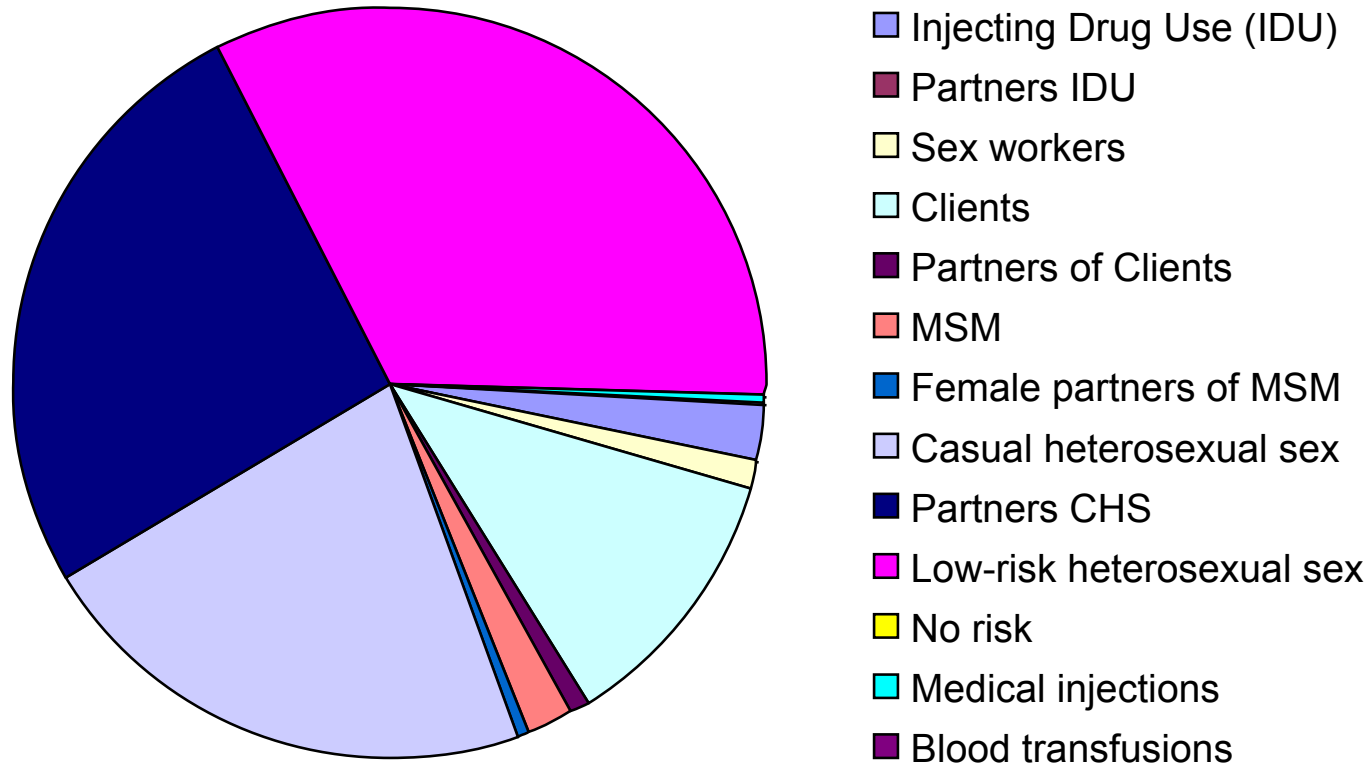
# Data needs

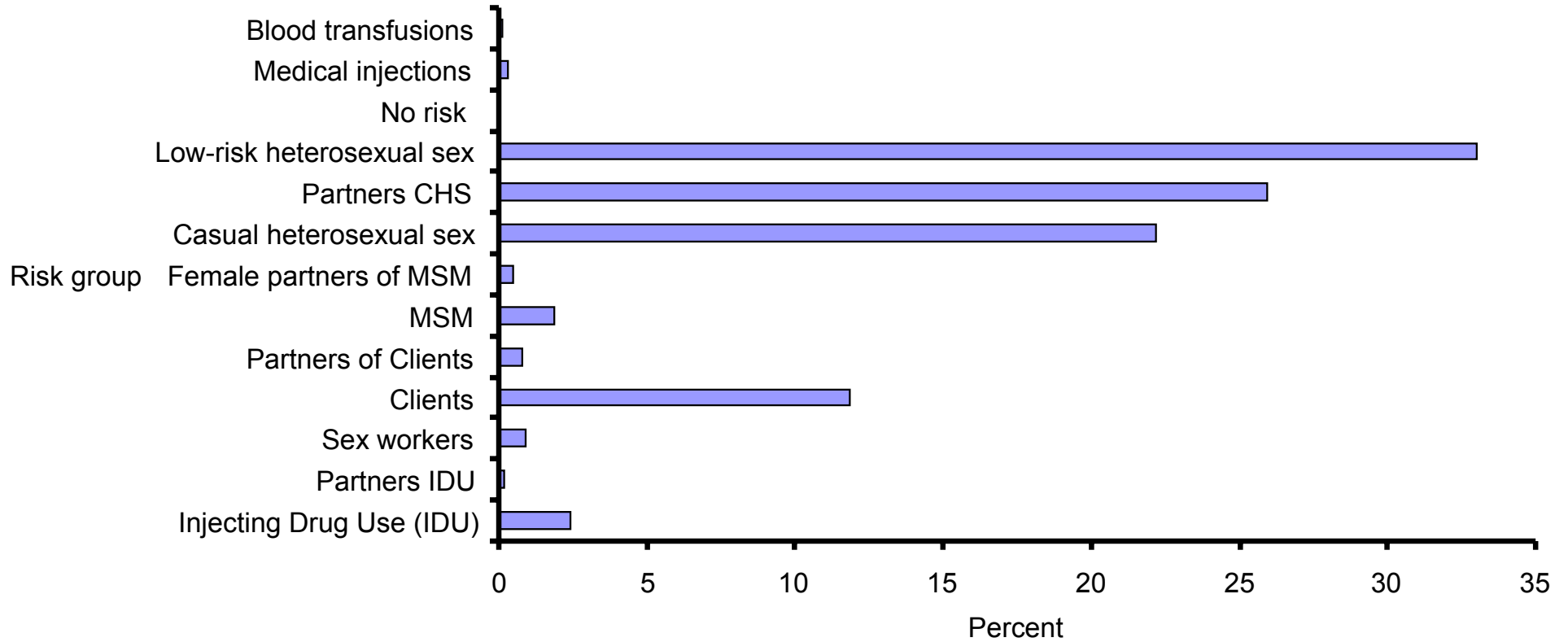
|                                 |                              |
|---------------------------------|------------------------------|
| <b>Population sizes</b>         | Surveillance, MOH statistics |
| <b>HIV prevalence</b>           | Surveillance                 |
| <b>STI prevalence</b>           | Special studies              |
| <b>Number of acts</b>           | BSS                          |
| <b>Number of partners</b>       | DHS, BSS                     |
| <b>Percent protection</b>       | DHS, BSS, service statistics |
| <b>Transmission probability</b> | Literature                   |

|    | A   | B            | C  | D    | E      | F                                | G                           | H                | I                     | J                           | K   | L                                  | M        | N      | O   | P              | Q                     |
|----|---|--------------|--|------|--------|----------------------------------|-----------------------------|------------------|-----------------------|-----------------------------|---|------------------------------------|----------|--------|---|----------------|-----------------------|
| 1  | Country:  | Example ctry |  |      |        |                                  | Blue cells: Input necessary |                  |                       |                             |   | Transmission per act               |          |        |   |                |                       |
| 2  | Adult (15-49) population size:  | 20,000,000   |  |      |        |                                  | Peach cells: Input optional |                  |                       |                             |   | Male -> female                     |          | 0.0020 |   |                |                       |
| 3  | Adult (15-49) HIV prevalence (%):   | 6.7          |  |      |        |                                  | Orange cells: Output        |                  |                       |                             |   | Female -> male                     |          | 0.0020 |   |                |                       |
| 4  |   |              |  |      |        |                                  |                             |                  |                       |                             |   | % men circumcised                  |          | 0.0%   |   |                |                       |
| 5  |   |              |  |      |        |                                  |                             |                  |                       |                             |   | STD cofactor                       |          | 3      |   |                |                       |
| 6  | Use either method 1 or 2 to determine number with risk behaviour for each group (column F).                     |              |  |      |        |                                  |                             |                  |                       |                             |   |                                    |          |        |   |                |                       |
| 7  | Method 1: Percent of population with risk behaviour (%)   |              | Method 2: Population with risk behaviour |      |        |                                  |                             |                  |                       |                             |   | probability per risky exposure act |          |        |   |                |                       |
| 8  | Adult Risk Behaviour  | Male         | Female                                   | Male | Female | Total number with risk behaviour | Prevalence of HIV (%)       | Number HIV+      | Prevalence of STI (%) | Number of partners per year | Number of acts of exposure per partner per year | Percentage of acts protected (%)   | with STI | No STI | Incidence   | % of incidence | Incidence per 100,000 |
| 9  | Injecting Drug Use (IDU)  | 0.30%        |  |      |        | 30,000                           | 20.0%                       | 6,000            | 3.5%                  | 5                           | 50  | 50%                                | NA       | 0.01   | 4,879   | 2.42           | 16,263                |
| 10 | Partners IDU  |              | 0.15%                                    |      |        | 15,000                           | 12.0%                       | 1,800            | NA                    | 1                           | 70  | 7%                                 | 0.006    | 0.002  | 341   | 0.17           | 2,275                 |
| 11 | Sex workers   |              | 0.65%                                    |      |        | 65,000                           | 40.0%                       | 26,000           | 65.0%                 | 163                         | 4   | 65%                                | 0.006    | 0.002  | 1,850   | 0.92           | 2,846                 |
| 12 | Clients   | 2.90%        |  |      |        | 290,000                          | 8.1%                        | 23,490           | 15.0%                 | 16                          | 9   | 65%                                | 0.006    | 0.002  | 23,857  | 11.82          | 8,227                 |
| 13 | Partners of Clients   |              | 1.45%                                    |      |        | 145,000                          | 9.0%                        | 13,050           | NA                    | 1                           | 70  | 7%                                 | 0.006    | 0.002  | 1,630   | 0.81           | 1,124                 |
| 14 | MSM   | 1.00%        |  |      |        | 100,000                          | 20.0%                       | 20,000           | 15.0%                 | 3                           | 10  | 35%                                | 0.030    | 0.010  | 3,800   | 1.88           | 3,800                 |
| 15 | Female partners of MSM  |              | 0.50%                                    |      |        | 50,000                           | 15.0%                       | 7,500            | NA                    | 1                           | 50  | 7%                                 | 0.006    | 0.002  | 953   | 0.47           | 1,907                 |
| 16 | Casual heterosexual sex   | 26.89%       | 12.41%                                   |      |        | 3,929,820                        | 13.1%                       | 513,971          | 7.0%                  | 2                           | 35  | 35%                                | 0.006    | 0.002  | 44,719  | 22.16          | 1,138                 |
| 17 | Partners CHS  | 9.93%        | 21.51%                                   |      |        | 3,143,856                        | 6.5%                        | 205,588          | NA                    | 1                           | 70  | 7%                                 | 0.006    | 0.002  | 52,390  | 25.96          | 1,666                 |
| 18 | Low-risk heterosexual sex   | 36.73%       | 37.53%                                   |      |        | 7,426,324                        | 7.5%                        | 556,974          | 3.5%                  | 1                           | 70  | 7%                                 | 0.006    | 0.002  | 66,596  | 33.00          | 897                   |
| 19 | No risk   | 22.25%       | 25.80%                                   |      |        | 4,805,000                        | 0.0%                        | -                | 0.0%                  | 0                           | 0   |                                    |          |        | 0   | 0.00           | 0                     |
| 20 | Medical injections  |              |  |      |        | 20,000,000                       | 6.7%                        |                  | NA                    | 2.2                         | 1   | 80%                                | NA       | 0.001  | 557   | 0.28           | 3                     |
| 21 | Blood transfusions  | 0.50%        | 0.50%                                    |      |        | 100,000                          | 6.7%                        |                  | NA                    | 1                           | 1   | 96%                                | NA       | 0.9    | 244   | 0.12           | 244                   |
| 22 | <b>TOTAL ADULT POPULATION</b>   | <b>100%</b>  | <b>100%</b>                              |      |        | <b>20,000,000</b>                | <b>6.87%</b>                | <b>1,374,374</b> |                       |                             |   |                                    |          |        | <b>Total incidence</b>                                      | <b>201,817</b> | <b>1,009</b>          |
| 23 |   |              |  |      |        |                                  |                             |                  |                       |                             |   |                                    |          |        | <b>Total incidence in partners of high-risk individuals</b> | <b>55,315</b>  | <b>1,649</b>          |
| 24 |   |              |  |      |        |                                  |                             |                  |                       |                             |   |                                    |          |        |   |                |                       |
| 25 | NB The prevalence of STD in the group with the risk behaviour is used for STD prevalence of the spillover group |              |  |      |        |                                  |                             |                  |                       |                             |   |                                    |          |        |   |                |                       |



# Distribution of infections





# Priority populations and programs

| <b>Route</b>    | <b>Population</b>               | <b>Intervention</b>               |
|-----------------|---------------------------------|-----------------------------------|
| Sex work        | SW and clients                  | Out-reach, condoms, STI Treatment |
| Casual sex      | Youth, military, truckers, etc. | Out-reach, condoms, STI           |
| Low risk        | Married couples                 | Promote testing                   |
| IDU             | IDU                             | Risk elimination, harm reduction  |
| MSM             | MSM                             | Out-reach, condoms, STI Treatment |
| Injection       | Patients                        | Sterile needles                   |
| Blood           | Transfusion recipients          | Screening                         |
| Mother-to-child | Pregnant women                  | PMTCT                             |