APPENDIX. Description of AEM and RNM models and data sources used

Asian Epidemic Model (AEM)

The AEM is a dynamic, deterministic compartment model designed for macro simulation of populations and key processes driving HIV transmission; it is described in detail elsewhere. The AEM considers HIV transmission within a population aged ≥15 years and divides the population in nine compartments: 1) clients of FSW; 2) males who are not clients of FSW; 3) lower risk, general population females; 4) direct FSWs; 5) indirect FSWs; 6) IDUs in higher risk sharing networks; 7) IDUs in a lower risk or not sharing network; 8) male sex workers; and 9) MSM who are not sex workers. Each compartment is divided into those infected with HIV and not infected. Movement between compartments is determined by the average duration of sex work, or death, or infection with HIV. The AEM includes data on factors such as demography, population size, injecting, sexual behavior, and epidemiology for the years 1975-2030. The most important model output data are the number of new HIV infections, AIDS cases, deaths, and routes of transmission per year between 1975 and 2030. The number of new infections is calculated based on the prevalence in the partner population, the frequency of sex acts or injections, and the probability of HIV transmission. Corrections are made for increased HIV transmission due to the presence of other sexually transmitted infections (STIs) or the lack of male circumcision by adding co-factors that increase the effective transmission probability by a fixed amount. Finally, a correction is made for protective behaviors such as condom use. To fit the model, the AEM fitting parameters (e.g. probabilities of transmission, Table A) are adjusted in order to obtain a reasonable match between the prevalence reported and the prevalence calculated by the AEM.

We used the West-Java baseline model as defined by local leading experts from AIDSina (Portal for Indonesia AIDS community) and the East-West Center (EWC), and as is compatible with data used by the MoH. This model is based on the National Indonesian AEM and adapted with local data for West-Java and assumptions made by EWC and AIDSina, who consulted experts in MoH and AIDS commissions. Data sources were retrieved to verify the data used in the model and only minor adaptations were made. Table A presents an overview of the model parameters, and their baseline
values and references. The AEM uses these data to project HIV prevalence for most-at-risk-populations. We adjusted AEM fitting parameters so that projected HIV prevalence fits the observed HIV prevalence among IDUs, FSWs, and MSM from surveillance studies in West-Java. HIV prevalence among the general population was not used for model fitting. Data on population sizes, and on epidemiological and behavior variables were sourced from government monitoring and evaluation systems and the International Biological Behavior Surveillance System (IBBS); no change in behavior parameters was assumed after 2007 (last year data of IBBS). The AEM was used, first, to reflect current practice of VCT delivery (base case) and second, to reflect the impact of increased condom use among most-at-risk populations caused by scaling up VCT. This increase in condom use was estimated by the RNM, described below, and altered in the AEM. As the AEM does not represent transgenders, prisoners, and partners of IDUs, these groups were excluded in our effectiveness analysis because we expected these groups to have minor impact on the spread of the epidemic.

Resource Needs Model

The RNM was used primarily to estimate the resources needed for both the base case and the strategy of scaling up VCT, by combining population sizes, coverage of VCT, and unit costs. The RNM also calculated the impact of VCT on risk behavior, based on the RNM impact matrix (originally part of GOALS model). This matrix is based on a literature review of VCT effectiveness on risk behavior and differentiates the impact of VCT on the reduction in non-condom use for low-, middle-, and high-risk populations. We assumed that all populations targeted by VCT in the scaling up strategy are high-risk populations and used a baseline VCT impact value of 44% reduction in non-condom use.
Table A. Baseline values, sensitivity ranges and references of parameters used in Asian Epidemic Model adapted for West-Java Province

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Baseline value (sensitivity range)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AEM fitting parameters</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmission probability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male to female ($P_{m_f}$)</td>
<td>0.00125 (-/+/25%)</td>
<td>Fitting</td>
</tr>
<tr>
<td>Male to male ($P_{m_m}$)</td>
<td>0.01790 (-/+/25%)</td>
<td>Fitting</td>
</tr>
<tr>
<td>Needle stick</td>
<td>0.03 (-/+/25%)</td>
<td>Fitting</td>
</tr>
<tr>
<td>Ratio of male to female versus female to male transmission</td>
<td>3.80 (-/+/25%)</td>
<td>Fitting</td>
</tr>
<tr>
<td>IDU network parameter (%)</td>
<td>80.00 (-/+/25%)</td>
<td>Fitting</td>
</tr>
<tr>
<td>STI cofactor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female to male</td>
<td>16.00 (-/+/25%)</td>
<td>Fitting</td>
</tr>
<tr>
<td>Male to female</td>
<td>20.00 (- 25%)</td>
<td>Fitting</td>
</tr>
<tr>
<td>Male to male</td>
<td>1.00 (25%)</td>
<td>Fitting</td>
</tr>
<tr>
<td>Circumcision factor</td>
<td>2.55 (1.91-3.19)</td>
<td>Fitting</td>
</tr>
<tr>
<td>Epidemic start year</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Population sizes (2006)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSWs</td>
<td>37,422 (24,970-47,190)</td>
<td>7</td>
</tr>
<tr>
<td>FSWs who are direct FSWs (%)</td>
<td>62.20 (-/+/25%)</td>
<td>7</td>
</tr>
<tr>
<td>IDUs</td>
<td>9,596 (6,380-11,900)</td>
<td>7</td>
</tr>
<tr>
<td>Higher risk MSM</td>
<td>15,117 (14,361-15,872)</td>
<td>7</td>
</tr>
<tr>
<td>Lower risk MSM</td>
<td>133,220</td>
<td>7</td>
</tr>
<tr>
<td>Male sex workers</td>
<td>2,062</td>
<td>7</td>
</tr>
<tr>
<td>Prisoners</td>
<td>20,199 (15,149-25,249)</td>
<td>7</td>
</tr>
<tr>
<td>Transgender</td>
<td>1,769 (1,568-1,733)</td>
<td>7</td>
</tr>
<tr>
<td>Clients of FSWs</td>
<td>204,200 (121,009 - 287,378)</td>
<td>7</td>
</tr>
<tr>
<td>Partners of IDUs</td>
<td>5,829 (5,537-6,120)</td>
<td>7</td>
</tr>
<tr>
<td>Males age 15+</td>
<td>14,596,400</td>
<td>8</td>
</tr>
<tr>
<td>Females age 15+</td>
<td>14,152,600</td>
<td>8</td>
</tr>
<tr>
<td><strong>HIV prevalence</strong> (% in 2007, used for fitting)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct FSW</td>
<td>11.60 (-/+/25%)</td>
<td>3</td>
</tr>
<tr>
<td>Indirect FSW</td>
<td>3.29 (-/+/25%)</td>
<td>3</td>
</tr>
<tr>
<td>IDUs</td>
<td>42.80 (-/+/25%)</td>
<td>3</td>
</tr>
<tr>
<td>MSM</td>
<td>2.00 (-/+/25%)</td>
<td>3</td>
</tr>
<tr>
<td>General population</td>
<td>0.00 (0.00-3.00)</td>
<td>3</td>
</tr>
<tr>
<td><strong>Heterosexual behavior and STIs</strong> (2007)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct female sex workers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct to indirect FSWs behavior movement each year (%)</td>
<td>1</td>
<td>Default value</td>
</tr>
<tr>
<td>Number of clients per day</td>
<td>1.7</td>
<td>3</td>
</tr>
<tr>
<td>Days worked per week</td>
<td>5.3</td>
<td>3</td>
</tr>
<tr>
<td>Condom use with clients (%)</td>
<td>62 (-/+/25%)</td>
<td>3</td>
</tr>
<tr>
<td>Average duration of sex work (years)</td>
<td>2.5</td>
<td>3</td>
</tr>
<tr>
<td>STI prevalence (% neisseria gonorrhea)</td>
<td>44 (-/+/25%)</td>
<td>3</td>
</tr>
<tr>
<td>Indirect female sex workers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of clients per day</td>
<td>0.86</td>
<td>3</td>
</tr>
<tr>
<td>Days worked per week</td>
<td>5.5</td>
<td>3</td>
</tr>
<tr>
<td>Condom use with clients (%)</td>
<td>60</td>
<td>3</td>
</tr>
<tr>
<td>Average duration of sex work (years)</td>
<td>2.0</td>
<td>Local expert opinion1</td>
</tr>
<tr>
<td>STI prevalence (% neisseria gonorrhea)</td>
<td>22 (-/+/25%)</td>
<td>3</td>
</tr>
<tr>
<td>Clients of sex workers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males age 15-49 visiting sex workers (%)</td>
<td>1.7</td>
<td>7</td>
</tr>
<tr>
<td>Average duration of being a client (years)</td>
<td>11</td>
<td>Local expert opinion4</td>
</tr>
<tr>
<td>Adult males circumcised (%)</td>
<td>87 (-/+/25%)</td>
<td>9</td>
</tr>
<tr>
<td>Male and female casual sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Value</td>
<td>Source</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------</td>
<td>------------------</td>
</tr>
<tr>
<td>Males having casual sex in last year (%)</td>
<td>0.3</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Females having casual sex in last year (%)</td>
<td>0.1</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Condom use in casual sex (%)</td>
<td>21 (±25%)</td>
<td>3</td>
</tr>
<tr>
<td>Average number of casual contacts in last year (male)</td>
<td>1</td>
<td>Default value</td>
</tr>
</tbody>
</table>

### Sex with spouses or regular partners

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of weekly sexual contacts with spouse/regular partner</td>
<td>1.4</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Condom use with spouses or regular partners (%)</td>
<td>10</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Adult population with STI (%)</td>
<td>0.5</td>
<td>Local expert opinion</td>
</tr>
</tbody>
</table>

### IDUs injecting and sexual behavior (2007)

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDU mortality (% additional mortality per year)</td>
<td>1.0</td>
<td>Default value</td>
</tr>
<tr>
<td>IDUs sharing (%)</td>
<td>32 (±25%)</td>
<td>3</td>
</tr>
<tr>
<td>Injections shared, by those in sharing group (%)</td>
<td>70 (±25%)</td>
<td>3</td>
</tr>
<tr>
<td>Number of injections each day</td>
<td>0.74 (±25%)</td>
<td>3</td>
</tr>
<tr>
<td>Average duration of injecting (years)</td>
<td>8.0 (±25%)</td>
<td>3</td>
</tr>
<tr>
<td>Sharing to non-sharing movement in a year (%)</td>
<td>20 (±25%)</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Visiting FSWs (%)</td>
<td>41 (±25%)</td>
<td>3</td>
</tr>
<tr>
<td>Condom use with direct FSW (%)</td>
<td>54 (±25%)</td>
<td>3</td>
</tr>
<tr>
<td>Condom use with indirect FSW (%)</td>
<td>54 (±25%)</td>
<td>3</td>
</tr>
<tr>
<td>Condom use with spouse or regular partner (%)</td>
<td>34 (±25%)</td>
<td>3</td>
</tr>
<tr>
<td>Number of contacts with regular partners (per week)</td>
<td>1 (±25%)</td>
<td>Default value</td>
</tr>
</tbody>
</table>

### Injecting sex workers (ISW) (2007)

#### Injecting behaviors - higher frequency injecting SWs

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of higher frequency sex workers who inject</td>
<td>0.1</td>
<td>3</td>
</tr>
<tr>
<td>Percentage of higher frequency ISW in high risk networks</td>
<td>0</td>
<td>Default value</td>
</tr>
<tr>
<td>Percentage of higher frequency ISW sharing</td>
<td>0</td>
<td>Default value</td>
</tr>
<tr>
<td>Percentage of all injections shared (sharing higher frequency SW)</td>
<td>0</td>
<td>Default value</td>
</tr>
<tr>
<td>Number of daily injections for higher frequency ISW</td>
<td>0.7</td>
<td>3</td>
</tr>
<tr>
<td>Average duration of injecting for higher frequency ISW (years)</td>
<td>2.5</td>
<td>3</td>
</tr>
<tr>
<td>Percentage condom use with clients (higher frequency ISWs)</td>
<td>62</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Injecting behaviors - lower frequency injecting SWs

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of lower frequency sex workers who inject</td>
<td>0.1</td>
<td>3</td>
</tr>
<tr>
<td>Percentage of lower frequency ISW in high risk networks</td>
<td>0</td>
<td>Default value</td>
</tr>
<tr>
<td>Percentage of lower frequency ISW sharing</td>
<td>0</td>
<td>Default value</td>
</tr>
<tr>
<td>Percentage of all injections shared (sharing low frequency SW)</td>
<td>0</td>
<td>Default value</td>
</tr>
<tr>
<td>Number of daily injections for lower frequency ISW</td>
<td>0.7</td>
<td>3</td>
</tr>
<tr>
<td>Average duration of injecting for lower frequency ISW (years)</td>
<td>2.5</td>
<td>3</td>
</tr>
<tr>
<td>Percentage condom use with clients (low frequency ISWs)</td>
<td>60</td>
<td>3</td>
</tr>
</tbody>
</table>

### MSM sexual behavior (2007)

#### Higher risk MSM (Hi MSM) sexual behavior

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reporting anal sex last year (%)</td>
<td>93</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Number anal sex contacts last week</td>
<td>0.5</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Average duration of same-sex behavior (years)</td>
<td>12.7</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Shift from Hi MSM to Lo MSM</td>
<td>25</td>
<td>Default value</td>
</tr>
<tr>
<td>MSM having sex with other female partners (%)</td>
<td>34</td>
<td>3</td>
</tr>
<tr>
<td>Condom use in last anal sex (%)</td>
<td>45 (±25%)</td>
<td>3</td>
</tr>
<tr>
<td>Prevalence Hi MSM with anal STI (%)</td>
<td>21</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Lower risk MSM (Lo MSM) sexual behavior

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of Lo MSM reporting anal sex in last year</td>
<td>53</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Number anal sex contacts last week (for MSM w/anal sex)</td>
<td>0.1</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Average duration of same-sex behavior (years)</td>
<td>18.1</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Percentage of Lo MSM with other female partners</td>
<td>20</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Percentage condom use in anal sex with other Lo MSM</td>
<td>48</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Percentage Lo MSM with anal STI</td>
<td>5.4</td>
<td>Local expert opinion</td>
</tr>
</tbody>
</table>

### MSM sexual behavior with commercial partners

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of Hi MSM visiting male sex workers</td>
<td>13</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Percentage of Lo MSM visiting male sex workers</td>
<td>2</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Ratio of frequency of visiting MSW (Lo MSM/Hi MSM)</td>
<td>0.1</td>
<td>Default value</td>
</tr>
<tr>
<td>Percentage of Hi MSM visiting female sex workers</td>
<td>6</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Percentage of Lo MSM visiting female sex workers</td>
<td>0</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Condom use in anal sex with male sex worker (%)</td>
<td>50</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Condom use direct FSW (%)</td>
<td>62</td>
<td>Local expert opinion</td>
</tr>
<tr>
<td>Condom use indirect FSW (%)</td>
<td>60</td>
<td>Local expert opinion</td>
</tr>
</tbody>
</table>

**Male sex workers (MSW)**

**MSW size and duration**
- Average duration of male sex work (years) 6.3 Local expert opinion
- Shifts from Hi MSM to MSW (%) 1 Default value
- Shifts from Lo MSM to MSW (%) 1 Default value

**Sexual behaviors and STI with clients**
- Percentage of MSW reporting anal sex with clients in last year 93 Local expert opinion
- Number anal sex contacts last week 1.0 Local expert opinion
- Percentage MSW with anal STI 23 Local expert opinion

**Female partners of MSW**
- Percentage MSW visiting female sex workers in last year 9 Local expert opinion
- Percentage MSW with other female partners in last year 43 Local expert opinion

**Intervention characteristics (2010 onwards)**
- Impact of VCT on reduction in non-condom use (%) 44 (6-93)
- Distribution delivery settings
  - Current practice (base-case)
    - Hospitals (%) 60 (-/+25%)
    - Community health centers (%) 10 (-/+25%)
    - Private health centers (%) 20 (-/+25%)
    - Prison (%) 10 (-/+25%)
  - Scaling up VCT
    - Hospitals (%) 0 (-/+25%) Assumption
    - Community health centers (%) 85.4 (-/+25%) Assumption
    - Private health centers (%) 3.2 (-/+25%) Assumption
    - Prison (%) 11.4 (-/+25%) Assumption
  - Clinic capacity, number of VCT per year
    - Hospitals 421 (-/+25%) Current practice
    - Community health centers 300 (-/+25%) Current practice
    - Private health centers 784 (-/+25%) Current practice
    - Prison 574 (-/+25%) Current practice
  - Projection period (years) 2010-2030 (2010-2020) Assumption

**Disability adjusted life years**
- Discount rate 0.3 (0) Assumption
- Age weighting 0 (1) Assumption

**Notes:**
- IDUs = injecting drug users, FSWs = female sex workers, MSM = men having sex with men, STI = sexual transmitted infections
- Local expert opinion was given by researchers from East West Center and AIDSlna
- The parameter values for injecting sex workers are copied from both FSW and IDU parameter values.
- The IBBS 2007 report does not discriminate between higher risk MSM, lower risk MSM and MSW, but the raw IBBS data were used by local experts for parameter estimates.
- Note: order and categorization of parameters are in line with presentation in Asian Epidemic Model.
REFERENCES


