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.[1,2] 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).[3] 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[4] 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[5]). This matrix is based on a literature review of VCT effectiveness on risk behavior[6] 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

Parameter	Baseline value (sensitivity range)	Reference
AEM fitting parameters		
Transmission probability		
Male to female (Pm_f)	0.00125 (-/+ 25%)	Fitting
Male to male (Pm_m)	0.01790 (-/+ 25%)	Fitting
Needle stick	0.03 (-/+ 25%)	Fitting
Ratio of male to female versus female to male transmission	3.80 (-/+ 25%)	Fitting
IDU network parameter (%)	80.00 (-/+ 25%)	Fitting
STI cofactor		
Female to male	16.00 (-/+ 25%)	Fitting
Male to female	20.00 (- 25%)	Fitting
Male to male	1.00 (+25%)	Fitting
Circumcision factor	2.55 (1.91-3.19)	Fitting
Epidemic start year		
IDU	2002 (1996-2004)	Fitting
Heterosexual	1989 (1985-1993)	Fitting
MSM	1992 (1988-1996)	Fitting
Population sizes (2006)		
FSWs	37,422 (24,970-47,190)	[7]
FSWs who are direct FSWs (%)	62.20 (-/+ 25%)	[7]
IDUs	9,596 (6,380-11,900)	[7]
Higher risk MSM	15,117 (14,361-15,872)	[7]
Lower risk MSM	133,220	[7]
Male sex workers	2,062	[7]
Prisoners	20,199 (15,149-25,249)	[7]
Transgender	1,769 (1,568-1,733)	[7]
Clients of FSWs	204,200 (121,009 - 287,378)	[7]
Partners of IDUs	5,829 (5,537-6,120)	[7]
Males age 15+	14,596,400	[8]
Females age 15+	14,152,600	[8]
HIV prevalence (% in 2007, used for fitting)		
Direct FSW	11.60 (-/+25%)	[3]
Indirect FSW	3.29 (-/+25%)	[3]
IDUs	42.80 (-/+25%)	[3]
MSM	2.00 (-/+25%)	[3]
General population	0.00 (0.00-3.00)	[3]
Heterosexual behavior and STIs (2007)		
Direct female sex workers		
Direct to indirect FSWs behavior movement each year (%)	1	Default value
Number of clients per day	1.7	[3]
Days worked per week	5.3	[3]
Condom use with clients (%)	62 (-/+25%)	[3]
Average duration of sex work (years)	2.5	[3]
STI prevalence (% neisseria gonorrhea)	44 (-/+25%)	[3]
Indirect female sex workers		
Number of clients per day	0.86	[3]
Days worked per week	5.5	[3]
Condom use with clients (%)	60	[3]
Average duration of sex work (years)	2.0	Local expert opinion[¥]
STI prevalence (% neisseria gonorrhea)	22 (-/+25%)	Local expert opinion
Clients of sex workers		
Males age 15-49 visiting sex workers (%)	1.7	[7]
Average duration of being a client (years)	11	Local expert opinion
Adult males circumcised (%)	87 (-/+25%)	[9]
Male and female casual sex		

Males having casual sex in last year (%)	0.3	Local expert opinion
Females having casual sex in last year (%)	0.1	Local expert opinion
Condom use in casual sex (%)	21 (-/+25%)	[3]
Average number of casual contacts in last year (male)	1	Default value
Sex with spouses or regular partners		
Number of weekly sexual contacts with spouse/regular partner	1.4	Local expert opinion
Condom use with spouses or regular partners (%)	10	Local expert opinion
Adult population with STI (%)	0.5	Local expert opinion
IDUs injecting and sexual behavior (2007)		
IDU mortality (% additional mortality per year)	1.0	Default value
IDUs sharing (%)	32 (-/+25%)	[3]
Injections shared, by those in sharing group (%)	70 (-/+25%)	[3]
Number of injections each day	0.74 (-/+25%)	[3]
Average duration of injecting (years)	8.0 (-/+25%)	[3]
Sharing to non-sharing movement in a year (%)	20 (-/+25%)	Local expert opinion
Visiting FSWs (%)	41 (-/+25%)	[3]
Condom use with direct FSW (%)	54 (-/+25%)	[3]
Condom use with indirect FSW (%)	54 (-/+25%)	[3]
Condom use with spouse or regular partner (%)	34 (-/+25%)	[3]
Number of contacts with regular partners (per week)	1 (-/+25%)	Default value
Injecting sex workers (ISW) (2007)[Ω]		
Injecting behaviors - higher frequency injecting SWs		
Percentage of higher frequency sex workers who inject	0.1	[3]
Percentage of higher frequency ISW in high risk networks	0	Default value
Percentage of higher frequency ISW sharing	0	Default value
Percentage of all injections shared (sharing higher frequency SW)	0	Default value
Number of daily injections for higher frequency ISW	0.7	[3]
Average duration of injecting for higher frequency ISW (years)	2.5	[3]
Percentage condom use with clients (higher frequency ISWs)	62	[3]
Injecting behaviors - lower frequency injecting SWs		
Percentage of lower frequency sex workers who inject	0.1	[3]
Percentage of lower frequency ISW in high risk networks	0	Default value
Percentage of lower frequency ISW sharing	0	Default value
Percentage of all injections shared (sharing low frequency SW)	0	Default value
Number of daily injections for lower frequency ISW	0.7	[3]
Average duration of injecting for lower frequency ISW (years)	2.5	[3]
Percentage condom use with clients (low frequency ISWs)	60	[3]
MSM sexual behavior (2007)[§]		
Higher risk MSM (Hi MSM) sexual behavior		
Reporting anal sex last year (%)	93	Local expert opinion
Number anal sex contacts last week	0.5	Local expert opinion
Average duration of same-sex behavior (years)	12.7	Local expert opinion
Shift from Hi MSM to Lo MSM	25	Default value
MSM having sex with other female partners (%)	34	[3]
Condom use in last anal sex (%)	45 (-/+25%)	[3]
Prevalence Hi MSM with anal STI (%)	21	[3]
Lower risk MSM (Lo MSM) sexual behavior		
Percentage of Lo MSM reporting anal sex in last year	53	Local expert opinion
Number anal sex contacts last week (for MSM w/anal sex)	0.1	Local expert opinion
Average duration of same-sex behavior (years)	18.1	Local expert opinion
Percentage of Lo MSM with other female partners	20	Local expert opinion
Percentage condom use in anal sex with other Lo MSM	48	Local expert opinion
Percentage Lo MSM with anal STI	5.4	Local expert opinion
MSM sexual behavior with commercial partners		

Percentage of Hi MSM visiting male sex workers	13	Local expert opinion
Percentage of Lo MSM visiting male sex workers	2	Local expert opinion
Ratio of frequency of visiting MSW (Lo MSM/Hi MSM)	0.1	Default value
Percentage of Hi MSM visiting female sex workers	6	Local expert opinion
Percentage of Lo MSM visiting female sex workers	0	Local expert opinion
Condom use in anal sex with male sex worker (%)	50	Local expert opinion
Condom use direct FSW (%)	62	[3]
Condom use indirect FSW (%)	60	[3]
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)	[6]
Distribution delivery settings		
Current practice (base-case)		
Hospitals (%)	60 (-/+25%)	[10]
Community health centers (%)	10 (-/+25%)	[10]
Private health centers (%)	20 (-/+25%)	[10]
Prison (%)	10 (-/+25%)	[10]
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%)	[11]
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

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 AIDSIna

[Ω] 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

1. Brown T, Peerapatanapokin W. The Asian Epidemic Model: a process model for exploring HIV policy and programme alternatives in Asia. Sexual Transmitted Infections 2004;80 (Suppl 1):S19-24.
2. Saidel T, Des Jarlais D, Peerapatanapokin W, Dorabjee J, Singh SB, T Potential impact of HIV among IDUs on heterosexual transmission in Asian settings: scenarios from the Asian Epidemic Model. International Journal of Drug Policy 2003;**14**:63-74.
3. IBBS. *Integrated Biological-Behavioral Surveillance among Most-at-Risk Groups (MARG) in Indonesia*. Jakarta, Indonesia, 2007. http://www.aidsindonesia.or.id/surveilans-terpadu-biologis-perilaku-integrated-biological-behavioral-surveillance.html (accessed 4 July 2012).
4. Constella Futures - The Futures Group. Resource needs for HIV/AIDS: model for estimating resource needs for prevention, care, and mitigation. Version INA 1.0 – September 2007. Original model was adapted for Indonesian context by Nalinee Sangrujee, Constella Futures, 2007. Original model available at: http://futuresgroup.com/resources/software_models/resource_needs_model (accessed 4 Jul 2012).
5. The Futures Group International. Goals model for estimating the effects of resource allocation decisions on the achievement of the goals of the HIV/AIDS strategic plan. Manual, 2003. http://futuresgroup.com/files/softwaremodels/goals.pdf (accessed 4 Jul 2012).
6. Bollinger L. How can we calculate the "E" in "CEA"? AIDS 2008**;22 (Suppl 1):**S51-57.
7. National AIDS Commission (NAC), Jakarta. Estimation of risk population sizes per province, 2006.
8. Badan Pusat Statistik (BPS), Central Bureau Statistics Indonesia. http://www.bps.go.id (accessed 4 Jul 2012).
9. Indonesia Demographic and Health Survey (IDHS) 2007. http://www.motorcycleoutreach.org/FR218_April_09_2009.pdf (accessed 4 Jul 2012).

10. Ministry of Health West Java. Presentation: Sustainable services for PLWHA at the level of basic services. Bandung, Indonesia, 2010.
11. Ministry of Health. Workshop on Resource Needs Model in Bogor. Jakarta, Indonesia, 2007.