Technical Annexes:

Evaluation of the

epidemiological impact of

harm reduction programs on

HIV in Vietnam

2011

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Technical Annex 1: Review of data sources

This annex reviews the sources of data used for the analyses presented in this impact assessment and describes the considerations given to data quality and representativeness.

Populations of interest to the impact assessment

Evaluating the best use of different data sources for the impact assessment requires a clear definition of the population each source relates to and how this overlaps with the population considered to be both epidemiologically and programmatically relevant.

Ideal scenario: High degree of overlap between population for which data is available and data needed



The impact assessment focuses on the outcomes of Vietnam's harm reduction interventions, which are targeted toward female sex workers (FSW) and injecting drug users (IDU),. But to the extent that clients of sex workers and MSM also play an important role in transmission dynamics, these groups are also described. Some key challenges in measuring impact lies in the difficulty in both identifying and characterizing key populations at higher risk for HIV infection. These groups are generally hard to reach due to their marginalized status in country. Surveys conducted among key populations at higher risk in Vietnam also suggest they are diverse within their own groups, representing a range of risk intensity and vulnerabilities. Risk characteristics,

including frequency of injecting or numbers of clients, as well as socio-demographic variables such as age and level of income vary greatly between and within provinces. For the purpose of the impact assessment, the population definitions used for these analyses follow the definitions used by the harm reduction programs.

<u>Injecting drug users</u>: This group includes those who are currently injecting (i.e. who require a supply of sterile injecting equipment. Injecting drug users may be male or female. The proportion of female IDU is difficult to estimate in different regions of the country And many female IDU are believed to be either sexual partners of male IDU and/or engaged in selling sex.

The impact assessment considers both IDU who reside in the community as well as those who may be held in Treatment, Education & Social Labor Centres (TESLCs) (i.e. 06 Centers) by the Department of Labor, Invalids, and Social Affairs (DoLISA). Detention centers include those with a history of both injecting and non-injecting drug use and serve as settings for detoxification. As such, drug use within these facilities is clandestine and sterile injecting equipment is not readily available. The level of detainment activity of DoLISA (i.e. the percentage of IDU who are in detention centers vs. in the community) varies from province to province, depending on the both the socio-political climate locally, available resources, and perception of severity of the drug user problem. Persons held in TESLCs may stay for a few months or up to several years. Individuals who are released from TESLCs may or may not relapse and resume injection drug use practices. And persons held in 06 Centers may or may not be residents of the province in which the detention center is located, so that upon release they may or may not remain in the local community.

<u>Female sex workers:</u> There are multiple venues from which women may sell sex in exchange for money. In Vietnam, the most common venues for soliciting clients are street-based locations or entertainment establishments such as karaoke bars, restaurants, and massage parlors. The latter type is often described as indirect sex work, and in Vietnam is commonly referred to as karaoke-based sex workers. These women get paid a regular wage for working in the establishment, and the money earned by selling sex is not the sole or primary source of income. Not all women who work in these types of establishments may sell sex. There is some belief that women who work in establishments and sell sex generally earn more income and take

fewer clients, and therefore may be at lower risk than FSW who solicit clients on the streets. However, there remains some diversity in behavior within these groups and a fluid boundary between street-based and karaoke/entertainment-based sex workers in many areas. TESLCs for female sex workers (i.e. 05 Centers) are also maintained by DoLISA. The policy for detention of sex workers differs from those of IDU. The duration of detention is usually shorter and women who solicit in street-based venues are more likely to be detained than those who solicit clients from an entertainment establishment.

<u>Male clients of female sex workers:</u> According to epidemic modeling conducted in the region, male clients of FSW are a critical group for understanding the potential for spread of HIV in Asian countries. Buying sex is thought to be a common practice in most parts of Asia, in part due to the relatively small percentage of general females who engage in casual, extra-marital sexual activity. The potential size of the male client of FSW population and the large proportion who have vulnerable spouses often represent the populations with the largest numbers of HIV infections identified. At present, most harm reduction interventions in Vietnam do not directly address male clients of FSW. Instead, behavior change, communication and availability of condoms to FSW are intended to have the largest impact on reducing risk through commercial sex work. However, large-scale condom social marketing and some effort to focus prevention efforts among potential male clients found at solicitation points have been undertaken by the government and its partners. For impact assessment, the contribution of male clients of FSW have been accounted for in epidemic modeling, but less so in the direct assessment of program coverage.

<u>Men who have sex with men</u>: In the last few years, increasing attention has been given to the contribution of anal sex among males to the spread of HIV in Asian epidemics. However, except for large cities such as HCMC, Ha Noi and Hai Phong, harm reduction interventions for MSM have only just begun in most provinces. The MSM group, similar to the clients of FSW, has been considered in the impact assessment in terms of the potential contribution to the overall trajectory of the epidemic, rather than in terms of what degree harm reduction interventions may have reduced or slowed transmission among this group. As with all MARP, the MSM population encompasses a group of very diverse behaviors, from those who sell sex to male

clients, or those with large numbers of often anonymous male partners, to men who have occasional or intermittent sexual experiences with other men, but who are well integrated in the general population, having wives and living with their families. The segment of the MSM population most relevant to understanding the HIV epidemic are those with higher risk profiles, i.e. who have frequent anal sex with multiple male partners. This higher risk group is often characterized as those who are venue-based, i.e. those who seek sex partners at venues/cruising points.

<u>Temporal element to defining populations at risk:</u> As these populations are defined in part by the risk behavior they engage in, it is important to recognize that this identity contains a temporal element. For example, someone who injected drugs a year ago may or may no longer inject today, next month, or several years from now. At different points of the analyses, slightly different temporal definitions may be used. For example, the population relevant for assessing program coverage includes those who engaged in risk behaviors at the time of the intervention (i.e. those who would benefit from behavior change communication or commodities to support safe behaviors). However, for the purposes of transmission dynamics, both those who are actively engaged in risk behavior as well as those who may have previously been infected but who no longer engage in risk behavior may be important to consider when estimating the number of infections occurring in a given time period.

There are four main types of data on key populations at higher risk for HIV infection used for the impact assessment¹:

- 1) Population size estimates
- 2) HIV prevalence

¹ In addition to data sources on MARP, the epidemic modeling component of the assessment utilizes other sources of survey data which characterize the underlying general population in an effort to project the larger impact of the harm reduction program, including the prevention of downstream infections among regular partners of most-at-risk populations.

- 3) Behavioral risk factor/patterns of behavior
- 4) Service utilization / delivery data

The data sources available for each of these types of data and for each key population at higher risk for HIV are detailed in the following section.

Institutions involved in supporting data collection:

The data used for this impact assessment comes from multiple sources managed by different partner organizations and departments within the government. The figure below illustrates the flow of data and units responsible for coordinating M&E data within the VAAC. To the extent that the VAAC is the national authority for AIDS control, then routine monitoring data, surveillance data, and special study data should be accessible at the central level. However, in practice, some interventions are managed by central management units funded by international donors and have resulted in separate parallel streams of reporting. Strong efforts over the last two years have been made by the government and its development partners to strengthen and harmonize the M&E system, under the commitment to the 'Three Ones'. This effort is manifest in Decision 28, which enforces a single reporting format and central database for routine program monitoring. Data quality and completeness is considered to have improved under this decision. However, this also implies some issues of data quality through the period being assessed which must be accounted for in the interpretation of the results.



The following sections provide more detailed discussion about different sources of data and the strengths and limitations of each, which influenced decisions on which data should be used and how it was analyzed.

Size estimates of most-at-risk populations

The size of the most-at-risk population is a critical input to understanding the scale and speed of the spread of HIV currently and in the future. In concentrated epidemics, such as the one found in most provinces of Vietnam, the key populations at higher risk for HIV infection are those described earlier: IDU, FSW and their clients, and MSM.

These populations tend to be very fluid, with individuals both joining and leaving the key populations at higher risk for HIV over time. These reasons may be due to factors at the individual level (e.g. aging, personal/familial level of income, etc.) or social-environmental level (e.g. change in drug prices, shift in population or labor markets). Consequently, the size of the population is difficult to quantify and may be continuously changing in unanticipated ways. When interpreting size estimates data from different sources and different time periods, it can be difficult to assess whether changes in size estimates relate to the uncertainty inherent in size

estimation, differences in the methods of measurement, or growth/shrinkage in the size of the populations themselves.

Summary of available data sources from different years for each key population at higher risk for HIV:

| | IDU | FSW | MSM | Clients of |
|------------------------------|------------------------------------------|-----------|-----------|------------|
| | | | | FSW |
| ΜΟΠΙΣΑ/DOLISA | 2004-2008 | 2004-2008 | NA | NA |
| | 20012000 | 20012000 | | |
| Program mapping | 2008 | 2008 | NA | NA |
| | | | | |
| Estimates through expert | 2007,2009 | 2007,2009 | 2007,2009 | 2007-2009 |
| consensus (i.e. EPP inputs) | EPP | EPP | EPP | EPP |
| | | | | |
| Vietnam Population and AIDS | NA | NA | NA | 2005 |
| indicator survey | | | | |
| , | | | | |
| Selected source of data for | 2009 EPP inputs through expert consensus | | | |
| the impact assessment | | | | |
| analyses | | | | |
| | | | | |

DoLISA/MOLISA size estimates: For IDU and FSW, official sources of size estimates come from the MOLISA/DOLISA, the government agency given responsibility for enforcing the laws against illicit drug use and solicitation of sex. Data from MOLISA include the number of IDU or FSW who have been registered by the agency at any point and are believed to still be alive. This number is often referred to as the 'registered' number. Some IDU/FSW counted as registered live in the community while others are still in a detention center. A subset of the registered number of IDU are those who are actively 'managed' by MOLISA, this includes people who are still in the detention center or who are living in the catchment area of the local DOLISA office which registered them and have not moved elsewhere or died. Data from MOLISA do not distinguish between those who inject and do not inject.

Data on the number 'registered' by MOLISA were available from 2004-2008 for both FSW and IDU. The concentration of IDU in different provinces ranges considerably when taking the

MOLISA data and calculating it as a percentage of the total adult male population. These differences may reflect the true variation in distribution of the population as well as different rates of detention practiced by DoLISA in different provinces. The figures on size also vary from year to year, without consistent patterns, e.g. from 2007-2008 the size of the IDU population increased substantially (i.e. by more than a third) in 11/65 provinces; and decreased substantially in 12 provinces. Between 2004 and 2008, the size of the IDU population fluctuated by more than 100% between the smallest and largest estimate of size over the period in more than a third of provinces.

Some of the difficulties in interpreting the MOLISA data for IDU include the likelihood that IDU in the community try to avoid detention and have an incentive to remain hidden from the authorities, making the proportion who do not come into contact with the MOLISA system, difficult to apportion. In HCMC during the period of 2005-2007, a large-scale effort to identify and detain IDU in 06 Centers was enacted. However, the policy of detainment changed in 2007 resulting in a large-scale release of IDU back to the community. This release of IDU from the detention centers would not have shown up as a large fluctuation in the number of 'registered' IDU; however, they would impact the expected number of IDU who could be covered through outreach and change the potential transmission dynamics during this period. There is insufficient information to interpret whether changes in the numbers registered are associated with changes in detention practices, or whether the proportion of drug users who inject has changed over time in different areas. More corroborating information is also needed about the rate of relapse among those who are released from detention or the rate of death among IDU included in the registers.

MOLISA data are believed to severely underestimate the size of the FSW population, due to the much less attention paid to managing or rehabilitating sex workers compared to drug users. The size of the FSW population, according to MOLISA, is one tenth the size of the IDU population. Nonetheless, the size estimates provided by MOLISA fluctuates for FSW to a similar degree as for IDU.

<u>Program Estimates:</u> Size estimates based on mapping exercises conducted by harm reduction intervention programs provide alternative data for the estimated size of IDU, FSW populations

in provinces with WB- or DFID-supported prevention programs. These estimates are based on the numbers of beneficiaries encountered by peer educators and outreach staff during field activities. At the time of the impact assessment, a standardized method for program-based size estimates was not in place. This makes it difficult to evaluate the reliability of the data provided from these estimates. However, the general method suggests that the completeness of the size estimates depends heavily on the level of geographic coverage of outreach activities in the province (i.e. whether outreach services offered in all districts/communes where key populations at higher risk for HIV are located) and the rapport the intervention has with beneficiary community (i.e. key populations at higher risk are likely to remain hidden to outreach staff, due to a lack of trust in the program). Experience from other countries in the region suggests that program mapping data may often overestimate the size of the key populations at higher risk o infection, due to the lack of unique identifiers used for counting, the inability to account for mobility of the population and the double counting of individuals who frequent more than one location where outreach services are provided. This has been a more severe problem in highly urban areas with high population density areas, making it difficult to track individuals' mobility between sites in close proximity to each other.

In almost all provinces with both data sources, the program-based size estimates are larger, often by several times, than the size estimates of the MOLISA data. This is particularly true for the estimated size of the FSW population

<u>Vietnam Population and AIDS indicator survey</u>: This general population household survey of adults (aged >15 years) conducted in 2005, provides some information about the proportion of male respondents who have bought sex in the last year. The survey included a limited number of sites including (Hai Phong, Ha Noi, and HCMC), and the proportion ranged from 0.2-1.1% of respondents. This figure is considerably lower than many other countries in the region and is believed to be under estimated due to social desirability bias.

<u>Consensus adjusted population size estimates:</u> Due to the limitations of the direct size estimation data available through MOLISA or intervention programs, substantial efforts have been made to adopt adjusted population size estimates of IDU, FSW, and MSM for the purpose of epidemic modeling and projections of the burden of disease. Using these estimates helps to

maintain consistency with approaches adopted for other types of epidemic modeling and projections being conducted in country. Differences in the outputs of these analyses reflect differences in modeling or analytic approaches rather than differences in the data inputs.

These adjusted figures have been developed in recent years through consultation with an incountry Strategic Information and Monitoring & Evaluation Technical Working Group (i.e. VAAC, NIHE, UNAIDS, WHO, FHI, USG) and international (East West Center) technical experts for the purpose of producing official national estimates for the burden of disease, through the Estimates and Projections Package (EPP). The following adjustments have been made for IDU population size estimates:

a) applying a correction factor of 0.85 to the MOLISA 'registered' drug user figures in each province, which includes both community and detained individuals, then

b) applying a further correction factor of 2X as the group estimated 50% of current IDU have not been included in the MOLISA system.

For sex workers, the overall number of FSW included in the MOLISA figures is multiplied by 3X to account for the proportion of FSW who are not captured by MOLISA.

For male clients of FSW, the proportion of adult males (i.e. men >15 years old) who bought sex recently is estimated to be between five (low) and 10 (high) % in all provinces.

For MSM, 0.5-1.5% of the adult male population (i.e. men <15 years old) are assumed to have had a male sexual partner (in the last year?) in all provinces except in Hanoi and HCMC, where the population proportion is estimated at 1-3%.

The magnitude of the adjustments used for the size estimates of all key populations at higher risk for HIV are not based on referenced, country-specific data, but reflects consensus on the best estimates of local and international technical experts. The population proportions applied for MSM and male clients of FSW figures are consistent with those used in the region.

<u>Selection of data source for population size estimates</u>: Due to the difficulty in obtaining specific local information on the reliability of the direct size estimates and in verifying the assumptions

made about the adjusted factors on a province by province basis, the team has chosen to use the consensus population size estimates used for the most recent round, 2009, of the estimates and projections program (EPP).

HIV prevalence

The impact of a prevention intervention is measured most directly through changes in the number of new infections which occur over the period of the intervention. However, most impact evaluations of HIV prevention interventions must rely on measures of HIV prevalence, due to the nascent state of development of HIV incidence assays. Trends in HIV prevalence are examined both directly as well as used as inputs in mathematical models to assess whether changes in prevalence and potentially incidence are attributable to the intervention.

Interpreting trends in HIV prevalence as a proxy for incidence trends is complex due to the difficulty in distinguishing factors which may influence the duration of infection (e.g. access to care and treatment to prolong survival) from factors related to actual changes in disease transmission. However, biological trends among key populations at higher risk for HIV are difficult to interpret due to the challenges in obtaining consistent, comparable samples of these hidden and highly mobile groups. Interpreting a prevalence trend also depends on whether the population under study is believed to be closed, dynamically stable, or changing in size and composition. For these reasons, the review of data quality and representativeness of these data sources are critical issues in determining the reliability of results of the impact assessment.

<u>HIV Sentinel surveillance</u>: Vietnam is one of the few countries in the world to have an extensive, long-standing system of sentinel surveillance for most-at-risk populations, specifically IDU and FSW. Data in some provinces are available since 1994, and since 2001 more than 40 provinces have had sentinel surveillance data for these groups. Sentinel surveillance systems are designed to provide reliable measures of trend for a particular location, which is useful for determining whether an epidemic is emerging, growing, stabilizing or declining, but is not intended to be representative of the population in a particular geographic area. To produce reliable trends,

sentinel surveillance sites must adhere to strict protocols of sequential sampling, where eligible individuals are neither incentivized nor coerced into participating. Under ideal circumstances, HIV testing would be unlinked and anonymous using leftover blood specimens which are collected routinely for the provision of other clinical services, such as regular syphilis screening.

The Vietnam sentinel surveillance system for IDU and FSW operate under different protocols which divide the sample of each province in half, to obtain samples from the community and from those currently in a detention center. The actual process of recruitment in each setting varies and is prone to selection bias by local teams responsible for the surveillance activities. Reviews of the quality of sentinel surveillance data conducted by the expert groups preparing inputs for EPP in 2003, 2005, and 2007, identified a number of quality issues with sentinel surveillance data in some provinces, resulting in exclusion of data from some provinces from analysis. In 2005, the protocol for sentinel surveillance was revised by VAAC to update and enforce stricter standards. This change in protocol was accompanied by more resources and technical support from regional institutions such as NIHE, HCMC – Pasteur Institute, and Nha Trang – Pasteur Institute, to strengthen implementation. Some improvements in the quality of sentinel surveillance data have been recognized recently by local experts, however, the reliability of HIV prevalence prior to the start and in the early phase of large scale harm reduction programs is difficult to determine.

Integrated biological and behavioral survey (IBBS): In many countries with concentrated epidemics, IBBS of key populations have been introduced as an important component of HIV surveillance. These surveys employ probability sampling methods designed to accommodate the challenges faced in obtaining representative samples of these groups, of which to make either biological and behavioral inferences. The two most common approaches for sampling used are time location cluster sampling (TLS) and respondent driven sampling (RDS).

Time location cluster sampling is appropriate for populations which congregate in public locations, but are generally mobile (e.g. female sex workers and some types of injecting drug users). To obtain a representative sample of key populations at higher risk for HIV through TLS depends on the development of an updated and comprehensive listing of all types of locations/venues where the relevant key populations congregate. This type of listing is often

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difficult to develop and requires the support of the local key populations at higher risk for HIV community and other groups who are familiar with the local situation such as intervention staff. This may result in a bias toward inclusion of locations or key populations at higher risk for HIV infection which are reached or more familiar to the interventions.

Respondent driven sampling is a method which does not require the development of a sampling frame, but relies on the existing social network structure within a population to recruit a representative sample. This method has been successful in many countries especially with MSM and IDU populations, as well as some types of FSW populations. The design of the survey depends on a fixed survey location where respondents are willing to come after being recruited by peers/friends who have already participated and a system of dual incentives for respondents to participate and recruit others. The representativeness of the survey depends heavily on the convenience on the location of the fixed site, the appropriateness of the incentive, and the completeness of the social network. Bias may result if key populations from only the area close to the fixed survey site, or if incentives are too high or low, resulting in selectivity in the process of recruitment. A poorly networked group will result in low participation and skew the sample according to the characteristics and social network of the initial seeds selected to start the survey. Due to the limited participation of the survey team in the process of sampling/recruitment, it is difficult to assess the introduction of these types of biases or measure the degree to which groups are represented.

In Vietnam, an IBBS has been conducted in a number of provinces by two main research institutes: NIHE and HCMC – PI, with technical support from FHI While TLS sampling methods were used in Vietnam in 2000 and 2002, the IBBS conducted in 2005-6 in 7 provinces represents the first round of surveys including a biological marker for HIV and including RDS approaches for some populations and sites. The second round of IBBS was conducted in 2009-2010 in 10 provinces and provides a critical second time-point with which to assess the trends in HIV prevalence in selected provinces over the time period of the intervention being evaluated.

| | IBBS Round I (2005-6) | IBBS Round II (2009-10) |
|------------|-----------------------|-------------------------|
| Hanoi | IDU, SSW, KSW, MSM* | IDU, SSW, VSW, MSM |
| Hai Phong | IDU, SSW, KSW | IDU, SSW, VSW, MSM |
| Quang Ninh | IDU*, SSW*, KSW | IDU, SSW, VSW, |
| Da Nang | IDU, SSW*, KSW* | IDU, SSW, VSW, |
| НСМС | IDU, SSW*, KSW, MSM* | IDU, SSW, VSW, MSM |
| Can Tho | IDU, SSW*, KSW* | IDU, SSW, VSW, MSM |
| An Giang | IDU, SSW*, KSW* | IDU, SSW, VSW, |

Table of sites and populations covered in each round of IBBS.

*indicates cluster samples where all key populations at higher risk identified at the clusters were included, i.e. "take all" approach was used. SSW – Street based sex workers; KSW – Karaoke bar based sex workers; VSW- Venue based sex workers

The sampling methodology used in the first round of IBBS for IDU in all provinces except for Hai Phong and An Giang was RDS and all the other samples were conducted using time location cluster sampling. The sex worker sample was divided into two groups: street based sex workers (SSW) and karaoke bar sex workers (KSW), the latter group representing a large portion of the sex workers working in entertainment establishments, i.e. indirect sex workers. The separate samples reflected differences in the venues appropriate for sampling as well as the belief that these groups had distinct risk and socio demographic profiles.

The target sample size for IDU and both FSW groups was 300 per site, per group, while for MSM the sample size target was 400. In five of the seven SSW samples, three of the seven KSW samples, and both MSM samples, an insufficient numbers of eligible respondents could be found at the clusters to take a random sample. Instead the survey teams selected all relevant key populations at higher risk for HIV infection found at all clusters identified. The need to adopt a take all method in provinces where the size of the FSW population was expected to be large (e.g. HCMC, Can Tho, and An Giang, where the FSW population is greater than 1000), suggests some potential problem in the ability of the survey team to obtain an unbiased

sample. Similarly, it is surprising that in large metropolitan areas, the sample of MSM required a take-all approach. Given the large estimated size of the MSM population in these cities, the MSM included in the sample may represent a skewed subset of visible MSM found in a limited number of known cruising points.

The eligibility criterion for inclusion in the survey for IDU and FSW was being over 18 years of age.MSM who were 15 years and older were eligible for inclusion. IDU were eligible if they injected in the last month, while FSW had to have sold sex in the last month. Women were classified as SSW rather than KSW, if they primarily solicited clients from street venues, even if they occasionally sold sex from establishments when trying to evade detention. MSM were eligible for the survey if they had sex with another man in the last 12 months.

For the HIV prevalence measure, blood specimens were obtained from all respondents consenting to participate. The testing algorithm used one rapid test and two ELISA tests for confirmation. Testing was conducted by provincial preventive medicine labs using standardized protocols and employing certified lab technicians. No problems with test results from central level quality assurance procedures were reported in the IBBS final report.

<u>Other surveys with biological markers:</u> Since 2002, a number of surveys among key populations at higher risk for HIV infection and general population have been conducted by the HCMC – Pasteur Institute in provinces under their purview in the southern region of Vietnam. These surveys have employed TLS for FSW, IDU, and trucker populations, and stratified sampling for more general population groups such as youth.

| | FSW (TLS) | IDU (TLS) | MSM | Other |
|------------|-------------|-------------|-------|--------------------------------|
| | | | (RDS) | |
| Sóc Trăng | 2002, 2008* | 2002, 2004, | | 2002: Truck drivers; students; |
| | | 2006 | | Youth |
| | | | | 2004, 2006: Youth |
| Bình Dương | 2002 | 2002 | | 2002: Truck drivers; Youth |
| Bình Phước | 2002 | 2002 | | 2002: Truck drivers; Youth |

| Long An | 2002 | 2002 | | 2002: Truck drivers; Youth |
|-----------------|-------------|------------|------|------------------------------|
| Đồng Tháp | 20002, 2004 | 2002, 2004 | | 2002, 2004: Male youth |
| An Giang | 2002. 2004, | 2002, 2004 | 2010 | 2002, 2004: Male youth; |
| | 2008* | | | 2006: Minority groups; 2007: |
| | | | | peasant; |
| Kiên Giang | 2002, 2004 | 2002, 2004 | | 2002, 2004: Male youth; |
| | | | | 2006: Minority groups; 2007: |
| | | | | peasant, Fishermen |
| Tiền Giang, Bến | 2006, 2008* | | | |
| Tre, Vĩnh Long | | | | |
| (combined) | | | | |
| Kiên Giang, Hậu | 2007 | | | |
| Giang | | | | |
| Vĩnh Long | | 2007 | | |
| Bến Tre | | 2008 | | |
| Vũng Tàu | | 2008 | | |
| Đồng Nai | | | | General population (2008) |
| Hậu Giang | | | | General population (2008) |
| Vĩnh Long | | | | General population (2008) |

*combined sample across three provinces in 2008 (Total N=300)

These surveys provide useful measures of the HIV prevalence in the population at the time. However, the approach to using TLS was relatively new in 2002 and the methodology has been improved over time, generating what are believed to be more representative samples in the later years of the survey. Due to shifts in the methodology, trends from the five provinces/sites with data from two or more time points among the same risk groups, are not always easy to interpret, although are indicative of the trajectory of the epidemic in these southern provinces prior to the scale-up of harm reduction programs. Consensus adjusted HIV prevalence numbers: Similar to the consensus process for adjusting the population size estimates, technical experts developing the inputs for the EPP process have also made adjustments to HIV prevalence data from sentinel surveillance the first round of the IBBS. This process includes excluding sentinel surveillance points deemed to be highly biased or skewed in sampling, and adjusting the sentinel surveillance data to reflect the prevalence of the key populations at higher risk for hiv infection in the community (i.e. not in detention centers). Where IBBS data are available, this data point is used for the 2005 time point. In most cases, the EPP input trend is similar to the trend given by raw sentinel surveillance; however, in a few key groups and sites, the trajectory of the epidemic becomes quite different in the most recent period. While great efforts have been made to document the adjustments made for use in EPP, in some cases, it is not possible to determine how final HIV prevalence estimates were arrived at for use in EPP in 2007 or 2009.

<u>Selection of data sources for HIV prevalence trends</u>: Data from the raw sentinel surveillance are used to describe qualitative trends in prevalence measured in different provinces. These gross trends are then compared to the trends in program coverage indicators to determine if the results are generally consistent with the idea that increasing program coverage is associated with a declining or stabilizing HIV prevalence trends over a similar (slightly staggered) period. When looking at the HIV prevalence trends with the coverage data in ecological analysis, the general trajectory of the epidemic is more important to consider than the specific value of prevalence. Given that there is some missing information about the adjustments applied by the consensus prevalence estimates, raw data were thought to be more straightforward to use for this first application.

For the purposes of epidemic modeling, sentinel surveillance data were used after being smoothed by putting three year running averages as inputs in the 2007 version of the EPP software.. The resulting curves are similar but not identical to those projected in the official 2007 EPP report (published in 2009).

Behavioral Risk Factors

Measures of behavioral risk are primarily used in the epidemic modeling to better fit the predicted effect of interventions on risk behaviors, which ultimately change the transmission of

HIV in the populations being studied. These behaviors include the frequency of risk taking (e.g. numbers of clients, numbers of anal sex partners, and numbers of injections per day, week or month), the frequency of exposure to regular partners, and the adoption of safer behaviors (e.g. condom use, sterile needle/syringe use; cleaning of injecting equipment). In addition to risk profile data, these surveys also contain important socio-demographic characteristics of the population and their exposure or interaction with harm reduction interventions.

Due to the use of existing data sources, most behavioral risk factor data were obtained from published reports, slide presentations shared with the M&E technical working group, and other spreadsheets of data collated for other data triangulation activities ongoing in the country (e.g. A2 – Asian Epidemic Modeling, Data Triangulation Capacity Building project). In many cases these reports or existing data tables may not have analyzed the survey questions in the format most useful for the epidemic models. Although the study team advisory group for the impact assessment suggested that collaborators make raw data files available for reanalysis, these raw data sets were not available in time to complete the report. Where necessary, the data provided in tables were transformed into useful parameter values through formulae detailed in Annex 4.

In addition to the IBBS and other surveys conducted by HCMC – Pasteur Institute and Abt, there are a number of important behavioral surveys of FSW and IDU as well as the general population.

End line evaluation surveys of the WB and DFID harm reduction program: At the close of the DFID project and at the end point of the first phase of the WB harm reduction projects, a set of behavioral surveys were conducted in selected provinces where each donor supported program was active. The sampling design for the WB allowed for province specific estimates of a few core behavioral indicators, in nine provinces for IDU², six provinces for FSW³, and two provinces for general adult population⁴. In the DFID project area, behavioral estimates were available for six provinces for IDU⁵ and seven provinces for FSW⁶. To avoid survey fatigue in a province, in

² Son La, Cao Bang, Lai Chau, Thai Nguyen, Bac Giang, Nam Dinh, Thanh Hoa, Ben Tre, Vinh Long

³ Kien Giang, Tien Giang, Ben Tre, Hau Giang, Vinh Long, An Giang

⁴ Thanh Hoa, Dong Nai

⁵ Ha Noi, Hai Phong, Quang Ninh, HCMC, Can Tho, and An Giang

provinces where both DFID- and WB-supported programs, only one project selected the province for evaluation surveys. The exception to this was An Giang province, which was surveyed in both the WB and DFID evaluation surveys as well as for IBBS.

A type of TLS was used to select the sample for both projects' evaluation surveys; however the institution conducting the survey in each case did not have prior experience with this style of sampling and did not work with the organizations with greater experience conducting probability surveys of FSW and IDU (i.e. FHI, NIHE, HCMC – PI). Unlike the surveys conducted by NIHE/FHI and HCMC – PI, cluster listings were drawn from information from the NGOs rather than through mapping of hotspots for the purpose of sampling frame development. This is likely to have skewed the sample toward respondents who had some contact with the program. Because no baseline round of data were collected, it is difficult to draw a conclusion about the impact of the intervention on changes in behavior since the project start date.

<u>VPAIS</u>: AIDS indicator surveys, such as the one conducted in Vietnam, are general population household surveys which ask questions about HIV/AIDS knowledge, attitudes, and some information about risk behaviors, which follow international guidance using standardized instruments and have a reputation for high degree of quality control. The VPAIS was conducted in 2005 through ORC Macro, a research organization which conducts these surveys in many countries globally. The survey was funded by the US government and involved both the general statistics office (GSO) and NIHE. The sampling design allowed for point estimates at national level, for urban vs. rural areas, for three regions (North, South, Central), and four target provinces (Ha Noi, HCMC, Hai Phong,⁷ and Quang Ninh).

<u>Selected data sources for behavioral parameters</u>: Given that epidemic modeling was conducted in eight selected provinces, all behavioral data available in each province were collated and used to develop parameter values/ranges for the province-specific models.

⁶ Ha Noi, Hai Phong, Quang Ninh, Da Nang, HCMC, Can Tho, An Giang

⁷ Blood specimens for an HIV prevalence measure were collected in only Hai Phong. The prevalence was 0.5% among a sample size of N=1791.

Service Utilization/ Delivery Data

Selected measures of coverage: There are multiple measures of coverage for harm reduction programs. While outreach is a key component of harm reduction programs, it is often difficult to distinguish the number of contacts made from the number of individuals who receive outreach services. Measures of coverage that count the number of contacts made may be misleading as it cannot distinguish a situation where a small group of individuals are reached daily from a broad group of individuals reached weekly or monthly. Harm reduction programs are generally more effective by saturating coverage, i.e. offering moderate level of services to a large proportion of the population of MARP. Drop-in centers are another component of programming, which provide an anchor for project visibility in an area, but may attract only a small proportion of the population who require prevention services. The effectiveness of outreach lies both in helping key populations at higher risk for HIV infection to feel empowered and motivated to adopt harm reduction practices, as well as in providing commodities needed for safe behaviors, such as condoms and sterile needles/syringes.

For the purposes of the impact assessment, the indicators felt to use the most standardized definitions and likely to be easiest to verify were:

- the number of districts and communes covered
- the number of peer educators engaged, and
- the volume of free distribution of commodities (either condoms or needle-syringes).

<u>A central repository for routine monitoring data</u>: The large-scale harm reduction programs in Vietnam are supported by international donors, and this results in the flow of service utilization/delivery data reported from the Provincial AIDS Centers (PAC) to the Central program management units of the donor-funded programs (i.e. WB, DFID, Life Gap), as well as being consolidated at the provincial level, across both donor programs and government-funded interventions, and transmitted to the central VAAC database.

Because responsibility for the harm reduction program shifted from the Department of Preventive Medicine to the newly-created VAAC in 2005, it took some time to establish the current, central electronic routine monitoring data base. The early phase of the large-scale harm reduction programs of DFID and WB did not establish a set of core indicators or standardized flow of data for the first 18 months to two years of the program. While the system currently receives routine and relatively complete reporting from the PACs, some provinces continue to provide more reliable data on service utilization than others.

<u>Data collation and verification process</u>: Routine monitoring data were collected from both the central VAAC database as well as the central PMU of the Life Gap, WB and DFID programs for the period 2004/5 to 2008. Data from the latter part of 2004 and the full period of 2005 were consolidated as a single reporting year, as the program was in its initial phases. It was not possible to annualize these data for the purposes of comparison to subsequent years.

In many provinces, large and inconsistent patterns between the summed data reported by WB, DFID and Life Gap and the consolidated number reported by the PAC to VAAC exist in the indicators of free condom and needle-syringe distribution. For example, sometimes the sum of free condoms distributed by WB, DFID, and Life Gap combined greatly exceeded the total free condoms distributed according to the VAAC. In other cases, the VAAC-consolidated number was much higher. To resolve these inconsistencies, the team of regional data collators confirmed the unexplained differences with the M&E officers of the respective PACs between December 2009 and January 2010.

In February 2010, the 2009 routine monitoring data became available and were forwarded to the impact assessment team to incorporate into the analyses. These data were sent only from the VAAC central database and were not compared to the donor-supported program PMU records.

Technical Annex 2: Mathematical details of Vietnam HIV Model

Mathematically, the Vietnam HIV Model (VHM) is described by 48 ordinary differential equations, one for each of eight population group (Error! Reference source not found.) multiplied by the number of disease states (six) tracked by the model (Error! Reference source not found.); the equations are developed according to standard disease modeling frameworks [1] and their mathematical expression and description of each term is as follows:



Rate of change in the number of undiagnosed Rate of disease progression Rate of HIV diagnosis Death rate for chronic-stage cases Per-capita rate of HIV-infected people from chronic infection for people in chronic stage HIV transmission to late stage in chronic stage dI_u $\lambda(t)S$ γI_u (2) $\eta_c I_u$ $\mu_{c}I_{u}$ dt

Rate of change in the number of Rate of HIV diagnosis Rate of disease progression from chronic infection Death rate for undiagnosed late-stage cases HIV-infected people for people in late stage to late stage in late stage dA_u γI_u (3) $\eta_a A_a$ $\mu_a A_u$ =dt

Rate of change in the number of diagnosed Rate of HIV diagnosis Rate of disease progression Death rate for chronic-stage cases for people from chronic infection HIV-infected people in chronic stage to late stage in chronic stage $dI_{\underline{d}}$ γI_d (4) $\eta_c I_u$ $\mu_{c}I_{d}$ =dt

Rate of change in the number Rate of disease Rate of HIV of diagnosed Rate of diagnosed Rate of people on ART Death rate for progression from chronic infection diagnosis for people in late-stage cases people in late stage HIV-infected people to late stage late stage initiating treatment stopping treatment in late stage dA_d τA_d γI_d $\eta_a A_u$ σT (5) + $\mu_a A_d$ = dt

Rate of change in the number Rate of diagnosed Rate of people on ART of people on ART people in late stage Death rate for people on ART initiating treatment stopping treatment dΤ σT μ_{T} (6) τA_d = dt

These differential equations describe the change in the number of people in each of these disease states where the states are: uninfected and potentially susceptible individuals (S), HIV-infected individuals that are undiagnosed with their infection in either chronic (I_u) or AIDS/late disease stage (A_u) , HIV-infected individuals that have been diagnosed with their infection and are in chronic (I_d) or AIDS/late disease stage (A_d) , and those that are receiving antiretroviral treatment (T). The number of people in each compartment changes based on per-capita rates of disease progression, HIV testing, initiation of treatment, and mortality. The per-capita rate of becoming infected, or the 'force of infection', is the most important term in the system of mathematical equations. The mathematical structure of this term differs between exposure routes.

The mathematical expression for the force of infection associated with sexual behavior is based on the standard binomial formula for accumulation of risk over multiple exposures [14-15]. Separate force of infection expressions are used for casual, regular, and commercial partners and for each combination of pairings between individuals of different population groups and disease stages of the HIV-infected partner. The governing structure for each partnership type is given by:

$$\lambda(t) = cP(t) \left[1 - \left(1 - \beta\right)^{n(1-q)} \left(1 - \left(1 - \varepsilon\right)\beta\right)^{n(1-q)} \right],$$

where *c* is the average number of sexual partners, P(t) is the dynamic prevalence level of HIV in the pool of potential partners, β is the probability of transmission per unprotected sexual act, *n* is the frequency of sex in the given partnership, *q* is the frequency of condom use, and ε is the efficacy of condoms. The formula for calculating risk is consistent for each population group and region but the values of each of these parameters differ between groups and regions.

The mathematical expression for the force of infection associated with injecting behavior is given by:

$$\lambda(t) = \frac{n s q \delta_S \beta(1 - p_c \varepsilon_c)}{m^2} \sum_{r=1}^{m-1} {m \choose r} P(t)^r (1 - P(t))^{m-r} \frac{rm - r^2}{r+1}$$

where *n* is the average number of times an IDU injects per year, *s* is the proportion of IDUs who share syringes and *q* is the frequency of sharing among these IDUs; the average number of people who share injecting equipment in a given sharing event is defined by *m*, δ_s is the average number of times each shared needle-syringe is used before it is disposed, *P(t)* is the dynamic prevalence level of HIV in the IDU population, β is the probability of transmission from a contaminated needle-syringe per use, p_c is the frequency of cleaning of shared injecting equipment and ε_c is the efficacy of cleaning. This expression calculates the chance of transmission occurring across all shared injecting events, incorporating different possible sizes of sharing groups (*m*) and considering the probability of transmission. The derivation of this formula has been published previously [11].

Free distribution of needle-syringes/condoms is expected to decrease sharing of injecting equipment/unprotected sex. The extent of expected change is not known from empirical data as it a hypothetical scenario. However, if it is assumed that the saturation in need for sterile injecting equipment/condoms has not been reached and greater supply would result in greater coverage then a mathematical relationship can be developed that balances the total number of units in circulation with how they were used; e.g. the total number of needle-syringes available in the population, from personal purchasing and free distribution from harm reduction programs, must equal the sum of total number of needle-syringes used in personal injections, shared injections, and units that are not used. Based on this rationale, if *P* needle-syringes are in circulation each year and a proportion ω of all needle-syringes are not used, then the number of needle-syringes that are used is $P(1-\omega)$. The number of needle-syringes used for individual injecting episodes among non-sharing IDUs is $\frac{nN(1-s)}{\delta_n}$, where *N* is the size of the

IDU population and δ_P is the average number of times each non-shared needle-syringe is used before it is disposed. Similarly, the total number of needle-syringes used for individual injecting among all IDUs who share some of the time is $\frac{n(1-q)sN}{\delta_p}$ and the total number of syringes

used in sharing events is $\frac{nqsN}{\delta_s}$. Therefore,

$$P(1-\omega) = \frac{nN(1-s)}{\delta_p} + \frac{n(1-q)sN}{\delta_p} + \frac{nqsN}{\delta_s} = \frac{nN}{\delta_p\delta_s} \left[\delta_s - sq\left(\delta_s - \delta_p\right)\right]$$

defines a relationship between the total number of needle-syringes in circulation and the use of needle-syringes. Changes in the number of needle-syringes distributed are likely to change any, or all, of the following factors in a way that is consistent with this balancing relationship: the proportion of needle-syringes that remain unused (ω), the proportion of IDUs who share injecting equipment (*s*), the proportion of injections that are shared (*q*), or the average number of times each needle-syringe is used (in shared (δ_s) or individual (non-shared) injections (δ_p)). Changes to ω and δ_p will not influence transmission levels but changes to *s*, *q* and δ_s could potentially result in large reductions in incidence. Numerous studies from a variety of international settings have provided evidence that needle-syringe programs have been effective in reducing sharing rates (e.g. [16-21]); these studies typically report sharing rates in terms of the proportion of IDUs who share injecting equipment (*s*). Therefore, this balancing relationship was used to calculate the expected change in the sharing rate according to changes in the total number of needle-syringes distributed (i.e. if the number of needle-syringes in circulation decreased by the number freely distributed by the harm reduction programs).

Similar to the derivation of a balancing equation for needle-syringes and sharing rates, a balancing equation was derived for the number of condoms distributed in the population and average condom usage per FSW. If N_{FSW} is the total number of FSWs in the population and the average condom usage rate (specifically, the average proportion of acts in which condoms are used) is p_{condom} and the total number of condoms used by the population is C_{FSW} then the balancing equation is: $C_{FSW} = p_{condom}N_{FSW}$.

Uncertainty/sensitivity analysis

The VHM was programmed using the Matlab (2009b, Mathworks, MA) computer language and solved numerically. Due to large confidence intervals in data and to account for intrinsic heterogeneity that exists between behaviors, epidemiology and biology of different groups of people, a range of plausible values for each parameter was defined rather than using point estimates. Where only point estimates were available from data, an uncertainty range of ±25% of the best value was assumed to account for possible distribution in the parameter value. Specific values and ranges used for each parameter and their sources are provided in Technical Annex 2. To translate the uncertainty in input data into uncertainty in the model output, Latin hypercube sampling [12, 22-23], an efficient type of stratified Monte Carlo sampling, along with Monte Carlo filtering [24-25], was used to sample 100 parameter sets from the large parameter space (using the SaSAT software [12]). The VHM was run once for each set of parameter values, as an uncertainty analysis. This process enabled the VHM to expose the extent of uncertainty that exists in available data. In order to determine the factors of greatest importance for yielding variation in model outputs, sensitivity analyses were also carried out using the SaSAT software [12].

Population data used in model calibration

The VHM was calibrated through the optimization routine to reflect available data on the prevalence of HIV among various at-risk population groups. The calibration process also ensured consistency with data on the numbers of people who initiated ART and general consistency with the numbers of HIV diagnoses and reported AIDS cases in each province, acknowledging that reported cases are likely to be highly under-reported. Sentinel surveillance data provided annual raw estimates of HIV prevalence among key population groups (FSW, IDU, and ANC). Smooth prevalence curves were obtained by inputting a three-yearly running average of the raw data for each year into the UNAIDS Estimations and Projections Package (EPP 2007 R10). These estimates were similar to the official prevalence outputs published for Vietnam but were produced independently from the official reported EPP values. This procedure was carried out in order to obtain smooth epidemic trajectories rather than base estimations on sampling 'blips' that cause jumps in trends. Comparisons of the input (three-

year running averages) and output prevalence data from EPP are shown in **Error! Reference source not found.**. The VHM was calibrated to reflect the prevalence curves generated as outputs from EPP among each population group.











Figure 1: HIV prevalence of specific at-risk populations estimated from 3-year running averages of MOLISA data and smoothed prevalence curves fitted with EPP, independent of official EPP estimates.

Optimization

Another unique feature of the VHM was the incorporation of formal optimization procedures around the numerical solvers of the ordinary differential equations. Most epidemic models do not include this component but its relatively innovative inclusion in this study provides more rigor and robustness of the modeling results. A rationale for this feature is as follows. Essentially, mathematical models incorporate a large variety of epidemiological, behavioral, biological, clinical and social data sources into a single mechanistic framework that examines how all of these factors interact and together contribute to the observed epidemic. However, due to uncertainties, inaccuracies or heterogeneity in survey data or large complexity in the interacting factors, the large number of parameter values may not seem to be consistent when viewed as an interacting whole (e.g. if condom use increases by a certain amount in a sample of a given population group then calculations would yield estimates of change in prevalence but this might not be precisely how prevalence was observed to change). Given the uncertainty around all parameter values, within confidence intervals or plausible bounds provided by empirical evidence, the optimization procedure determines how all the complex parameters can be reconciled together to produce the observed epidemiology by finding values within each confidence interval for all interacting factors. Further details of this mathematical routine and an example are provided in Technical Annex 2 along with model results from the calibration and optimization procedures over 100 model simulations that represent past epidemic trends among all population subgroups. It should be noted that any systematic changes in underlying base populations need to be captured through empirical surveys and sociological studies and not the optimization routine.

For parameters in which there were multiple time-points, linear regression was performed and the shortest distance between the 95% confidence interval bounds was taken as the uncertainty bound to be applied in parallel to the best-fitting regression line (see Figure 2); where applicable, the uncertainty bounds of all percentage/proportion parameters were constrained to have a minimum upper bound of 5%, minimum lower bound of 0%, maximum upper bound of 100% and maximum lower bound of 95%.

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Figure 2: Example of how the uncertainty bound was devised for time-dependent parameters. The blue diamonds and error bars are the best estimates and 95% confidence intervals from reported data; the black solid line is the best-fitting linear regression line and the red curves are the 95% confidence intervals for the regression; the dashed lines represent the lines parallel to the best-fitting regression that coincide with the 95% bounds.

The VHM incorporates a large variety of different factors that interact in yielding epidemic trajectories, in the same way that many behavioral, biological, clinical and social factors contribute to epidemic trends in the real work. There are some data sources available, from different settings and population samples, to provide estimates of the interacting factors incorporated in the VHM. However, due to inaccuracies in survey data, heterogeneity, other biases or large complexity in the epidemiology, parameter values may not seem to be consistent when analyzed as a complex dynamical system of interactions. For example, many factors contribute to the time trends in prevalence among IDUs but when their measured estimates from available sources are included in quantitative calculations, they are unlikely to match exactly to the observed prevalence trend. For the purposes of illustration, two of the most important factors associated with risk for IDUs are shown in Figure 3, namely, frequency of injecting and rates of sharing injecting equipment for the province of Can Tho. According to exact fits of the point-estimates of these factors, and all other variables that influence transmission among IDUs, model-simulated trends did not match to accepted national prevalence estimates (Figure 3). However, if model input values were allowed to have flexibility to be any value within the uncertainty bounds, a mathematical optimization procedure can ensure input values used are consistent with the confidence limits of the data and also match the national prevalence

estimates (Figure 4). Thus, this procedure adjusts inputs such that they are still consistently within their confidence limits but ensures that all factors, when interacting in the model calculations, can be reconciled with prevalence estimates.



Figure 3: Survey data from Can Tho and uncertainty bounds in (a) injecting frequency and (b) injecting sharing rate, as well as (c) prevalence trends among IDUs in Can Tho. In (c) the black circles represent national consensus estimates and the blue curve represents the model-simulated trend according to exact fits of the point-estimates of all variables.



Figure 4: Survey data from Can Tho with uncertainty bounds and input values used in the model derived from the optimization procedure for (a) injecting frequency and (b) injecting sharing rate, as well as (c) prevalence trends among IDUs in Can Tho. In (c) the black circles represent national consensus estimates and the red curve represents the model-simulated trend according to optimized fits of the variables to remain within all parameter uncertainty bounds.

This relatively complex mathematical optimization routine was accomplished in the Matlab software package and consists of two major components. The first component includes a process that 'force-fits' the available epidemiological data (i.e. HIV prevalence for specific population subgroups, and numbers of HIV and AIDS diagnoses and people receiving antiretroviral therapy across all populations) to estimate the annual incidence and 'force of infection' that is required to yield these population levels. A subsequent component simultaneously optimizes the values of behavioral and biological parameters, constrained by their pre-defined confidence limits/plausible bounds while also ensuring trends are conserved, and such that they produce the required force of infection. This is carried out through a nonlinear regression routine. However,

in the event of apparent inconsistencies between behavioral, biological and epidemiological data that cannot be reconciled, the bounds on behavioral parameter values were widened until the optimization routine could achieve reconciliation between the various data sources. The parameters included in the optimization procedure were:

- Among female sex workers: the number of regular and casual sexual partners, condom usage, and the number sexual acts with both their clients and other male partners in the past 12 months;
- Among injecting drug users: the number of injections in the past 12 months, rates of sharing injecting equipment, the number of sexual partners and rates of condom usage;
- HIV transmission probabilities associated with receptive sharing of injecting equipment, and probabilities of HIV transmission for heterosexual and homosexual exposure among discordant couples.

Prevalence estimates are not available for some population groups. After the optimization procedure was completed, the model was used to infer expected prevalence levels and trends for population groups for which no data exist, capturing degrees of uncertainty as influenced by uncertainty in available data for model inputs. These model results are shown in Figure 5 for An Giang, Figure 6 for Can Tho, Figure 7 for Da Nang, Figure 8 for Dien Bien, Figure 9 for Hai Phong, Figure 10 for Ha Noi and Figure 11 for Ho Chi Minh City.




Figure 5: Prevalence of HIV among population groups of IDU, FSW, general females, male clients of FSW, general males, and men who have sex with men in An Giang. Circles represent EPP-fitted curves to available data, the dark blue curves represent the best-fitting VHM simulation and the cyan curves represent 100 VHM simulations that account for uncertainty in model input data.

Range of VHM simulated trajectories for Can Tho



Figure 6: Prevalence of HIV among population groups of IDU, FSW, general females, male clients of FSW, general males, and men who have sex with men in Can Tho. Circles represent EPP-fitted curves to available data, the dark blue curves represent the best-fitting VHM simulation and the cyan curves represent 100 VHM simulations that account for uncertainty in model input data.



Figure 7: Prevalence of HIV among population groups of IDU, FSW, general females, male clients of FSW, general males, and men who have sex with men in Da Nang. Circles represent EPP-fitted curves to available data, the dark blue curves represent the best-fitting VHM simulation and the cyan curves represent 100 VHM simulations that account for uncertainty in model input data.

Range of VHM simulated trajectories for Dien Bien



Figure 8: Prevalence of HIV among population groups of IDU, FSW, general females, male clients of FSW, general males, and men who have sex with men in Dien Bien. Circles represent EPP-fitted curves to available data, the dark blue curves represent the best-fitting VHM simulation and the cyan curves represent 100 VHM simulations that account for uncertainty in model input data.

Range of VHM simulated trajectories for Hai Phong



Figure 9: Prevalence of HIV among population groups of IDU, FSW, general females, male clients of FSW, general males, and men who have sex with men in Hai Phong. Circles represent EPP-fitted curves to available data, the dark blue curves represent the best-fitting VHM simulation and the cyan curves represent 100 VHM simulations that account for uncertainty in model input data.



Figure 10: Prevalence of HIV among population groups of IDU, FSW, general females, male clients of FSW, general males, and men who have sex with men in Ha Noi. Circles represent EPP-fitted curves to available data, the dark blue curves represent the best-fitting VHM simulation and the cyan curves represent 100 VHM simulations that account for uncertainty in model input data.

Range of VHM simulated trajectories for Ho Chi Minh City



Figure 11: Prevalence of HIV among population groups of IDU, FSW, general females, male clients of FSW, general males, and men who have sex with men in HCMC. Circles represent EPP-fitted curves to available data, the dark blue curves represent the best-fitting VHM simulation and the cyan curves represent 100 VHM simulations that account for uncertainty in model input data.

Technical Annex 3: Mathematical modeling inputs

Table of inputs and parameters for evaluation of harm reduction programs in An Giang, Can Tho, Da Nang, Dien Bien, Hai Phong, Ha Noi, HCMC

Main data sources:

- 1. 2000 HIV/AIDS Behavioral Surveillance Survey (2000 BSS): Can Tho, Da Nang, Hai Phong, Ha Noi, HCMC [1].
- 2. 2002 Baseline Survey Report: An Giang, Dien Bien (Lai Chau) [2].
- 3. 2005 HIV/STI Integrated Biological and Behavioral Surveillance (2005-2006 IBBS): An Giang, Can Tho, Da Nang, Hai Phong, Ha Noi, HCMC [3].
- 4. Vietnam Population and AIDS Indicator Survey (VPAIS) 2005 [4].
- 5. MOLISA Data 2007 [5].
- 6. Sentinel Surveillance Data from all provinces.

Notes:

See the footnotes for detailed comments on the sources and derivation of all parameter estimates.

Due to uncertainty and to account for intrinsic heterogeneity in parameter values, the mathematical model samples from a range of plausible values for each parameter rather than using point estimates. The model independently samples values from each parameter with a triangular distribution of peak at the given value and a range defined by the uncertainty bound.

| | | An Giang | Can Tho | Da Nang | Dien Bien | Hai Phong | Hanoi | HCMC | Footnote |
|---------------------------------|------------|------------------------|-----------------------|----------------------|-----------------------|---------------------|-----------------|-----------------|----------|
| Parameters | Year | Estimated value | Estimated value | Estimated value | Estimated value | Estimated value | Estimated value | Estimated value | |
| | | bound) | bound) | bound) | bound) | bound) | bound) | bound) | |
| Size of sexually active | 2007 | 1,283,000 | 661,000 | 456,000 | 271,000 | 1,052,000 | 1,881,000 | 3,615,000 | p1 |
| population (~ aged 15-49 years) | | | | | | | | | |
| General Males (men who do no | t inject o | drugs, clients of fema | le sex workers, or mo | en who have sex with | n men) | | | | m1 |
| Proportion of overall | | 50 |).2% minus the percer | ntage of men who are | e clients, IDUs, or N | 1SM as described in | n the footnote | | m2 |
| population | | | | | | | | | |
| Average number of casual | 2005 | 0.025 | 0.025 | 0.025 | 0.025 | 0.025 | 0.025 | 0.025 | m3 |
| sexual partners per year | | (0.019-0.031) | (0.019-0.031) | (0.019-0.031) | (0.019-0.031) | (0.019-0.031) | (0.019-0.031) | (0.019-0.031) | |
| Average number of regular | 2005 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | m4 |
| sexual partners per year | | (0.75-1.25) | (0.75-1.25) | (0.75-1.25) | (0.75-1.25) | (0.75-1.25) | (0.75-1.25) | (0.75-1.25) | |
| Average number of sexual acts | 2005 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | m5 |
| per regular partner per year | | (65-109) | (65-109) | (65-109) | (65-109) | (65-109) | (65-109) | (65-109) | |
| Frequency of condom use with | 2005 | 67.6% | 67.6% | 67.6% | 67.6% | 67.6% | 67.6% | 67.6% | m6 |
| casual partners | | (50.7-84.5%) | (50.7-84.5%) | (50.7-84.5%) | (50.7-84.5%) | (50.7-84.5%) | (50.7-84.5%) | (50.7-84.5%) | |
| Frequency of condom use with | 2005 | 6.1% | 6.1% | 6.1% | 6.1% | 6.1% | 6.1% | 6.1% | m7 |
| regular partners | | (4.6-7.6%) | (4.6-7.6%) | (4.6-7.6%) | (4.6-7.6%) | (4.6-7.6%) | (4.6-7.6%) | (4.6-7.6%) | |
| Percentage tested for HIV per | 2005 | 2.6% | 2.6% | 2.6% | 2.6% | 2.6% | 2.6% | 2.6% | m8 |

| | An Giang | Can Tho | Da Nang | Dien Bien | Hai Phong | Hanoi | нсмс | Footnote |
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| Year | Estimated value | Estimated value | Estimated value | Estimated value | Estimated value | Estimated value | Estimated value | |
| | (uncertainty | (uncertainty | (uncertainty | (uncertainty | (uncertainty | (uncertainty | (uncertainty | |
| | bound) | bound) | bound) | bound) | bound) | bound) | bound) | |
| | (1-5%) | (1-5%) | (1-5%) | (1-5%) | (1-5%) | (1-5%) | (1-5%) | |
| s | | | | | | | | c1 |
| | | | | | | | | |
| 2005 | 0.50% | 0.50% | 0.50% | 0.50% | 1.10% | 0.20% | 0.30% | c2 |
| | (0.1-10%) | (0.1-10%) | (0.1-10%) | (0.1-10%) | (0.5-10%) | (0.1-10%) | (0.1-10%) | |
| 2005 | 2.6% | 2.6% | 2.6% | 2.6% | 2.6% | 2.6% | 2.6% | c3 |
| | (1-5%) | (1-5%) | (1-5%) | (1-5%) | (1-5%) | (1-5%) | (1-5%) | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | i1 |
| | | | | | | | | |
| 004- | 1634 | 1,872 | 1,278 | 6,967 | 5,942 | 26,820 | 25,573 | i2 |
| 2008 | (1,090-2,179) | (936-2,808) | (608-1,947) | (4,644-9,289) | (3,597-8,286) | (15,777-37,864) | (17,049-34,097) | |
| | | | | | | | | |
| 2009 | 10% | 10% | 10% | 10% | 10% | 10% | 10% | i3 |
| | | (5.450()) | (5.452()) | (5.4.50()) | (5.450()) | (5.450()) | | 13 |
| | (5-15%) | (5-15%) | (5-15%) | (5-15%) | (5-15%) | (5-15%) | (5-15%) | |
| 2005 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | i4 |
| | (2.25-3.75) | (2.25-3.75) | (2.25-3.75) | (2.25-3.75) | (2.25-3.75) | (2.25-3.75) | (2.25-3.75) | |
| | <pre>''ear ''ear '</pre> | An Giang 'ear Estimated value (uncertainty bound) (1-5%) 005 0.50% (0.1-10%) 005 2.6% (1-5%) (1-5%) 0 004- 1634 (1,090-2,179) 009 10% (5-15%) 005 3 (2.25-3.75) | An Giang Can Tho /ear Estimated value (uncertainty bound) Estimated value (uncertainty bound) 01 (1-5%) (1-5%) 005 0.50% 0.50% 005 0.50% 0.50% 005 2.6% 2.6% 005 2.6% 2.6% 005 2.6% 1.5%) 005 2.6% 2.6% 004- (1-5%) (1-5%) 004- 1634 1,872 008 (1,090-2,179) (936-2,808) 009 10% 10% 005 3 3 005 3 3 | An Giang Can Tho Da Nang /ear Estimated value Estimated value Estimated value (uncertainty bound) (uncertainty bound) (uncertainty bound) (uncertainty bound) 01 (1-5%) (1-5%) (1-5%) (1-5%) 005 0.50% 0.50% 0.50% 005 0.50% 0.50% 0.50% 005 2.6% 2.6% 2.6% 005 2.6% 2.6% 2.6% 005 1.5%) (1-5%) (1-5%) 005 2.6% 2.6% 2.6% 006 (1.5%) (1-5%) (1-5%) 007 1634 1.872 1.278 008 (1,090-2,179) (936-2,808) (608-1,947) 009 10% 10% 10% 009 10% 10% 10% 005 3 3 3 005 3 3 3 | An Giang Can Tho Da Nang Dien Bien rear Estimated value Estimated value Estimated value Estimated value Estimated value Increasing Can Thy Can Thy Estimated value Estimated value Estimated value Estimated value Can Thy Can Thy Can Thy Estimated value Estimated value Estimated value Can Thy Can Thy Can Thy Estimated value Estimated value Estimated value Estimated value Can Thy Can Thy <t< td=""><td>An Giang Can Tho Da Nang Dien Bien Hai Phong fear Estimated value (uncertainty bound) Estimated value (uncertainty bound) Estimated value (uncertainty bound) Estimated value (uncertainty bound) Estimated value (uncertainty bound) 0 (1-5%) (1-5%) (1-5%) (1-5%) (1-5%) (1-5%) 005 0.50% 0.50% 0.50% 0.50% 0.50% (0.5-10%) 005 0.50% 0.50% 0.50% 0.50% (0.5-10%) 005 0.50% 0.50% 0.50% 0.50% (0.5-10%) 005 0.50% 0.50% 0.50% 0.50% (0.5-10%) 004 1.10% (0.1-10%) (0.1-10%) (0.1-10%) (1.5%) (1.5%) 004 1.634 1.872 1.278 6.967 5.942 008 (1,090-2,179) (936-2,808) (608-1,947) (4,644-9,289) (3,597-8,286) 009 10% 10% 10% 10% 10% 10% 005 3<</td><td>An Giang Can Tho Da Nang Dien Bien Hai Phong Hanoi rear Estimated value Can Soluti<td>An Giang Can Tho Da Nang Dien Bien Ha Phong Hanoi HCMC rear Estimated value Estimated value</td></td></t<> | An Giang Can Tho Da Nang Dien Bien Hai Phong fear Estimated value (uncertainty bound) Estimated value (uncertainty bound) Estimated value (uncertainty bound) Estimated value (uncertainty bound) Estimated value (uncertainty bound) 0 (1-5%) (1-5%) (1-5%) (1-5%) (1-5%) (1-5%) 005 0.50% 0.50% 0.50% 0.50% 0.50% (0.5-10%) 005 0.50% 0.50% 0.50% 0.50% (0.5-10%) 005 0.50% 0.50% 0.50% 0.50% (0.5-10%) 005 0.50% 0.50% 0.50% 0.50% (0.5-10%) 004 1.10% (0.1-10%) (0.1-10%) (0.1-10%) (1.5%) (1.5%) 004 1.634 1.872 1.278 6.967 5.942 008 (1,090-2,179) (936-2,808) (608-1,947) (4,644-9,289) (3,597-8,286) 009 10% 10% 10% 10% 10% 10% 005 3< | An Giang Can Tho Da Nang Dien Bien Hai Phong Hanoi rear Estimated value Can Soluti <td>An Giang Can Tho Da Nang Dien Bien Ha Phong Hanoi HCMC rear Estimated value Estimated value</td> | An Giang Can Tho Da Nang Dien Bien Ha Phong Hanoi HCMC rear Estimated value Estimated value |

| | | An Giang | Can Tho | Da Nang | Dien Bien | Hai Phong | Hanoi | HCMC | Footnote |
|-------------------------------------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------|
| Parameters | Year | Estimated value | |
| | | (uncertainty | |
| | | bound) | |
| Average frequency of injecting | 2000 | 562* | 681 | 192 | 562* | 540 | 491 | 906 | i5 |
| per year | | (422-703) | (511-851) | (144-240) | (422-703) | (405-675) | (368-614) | (679-1132) | |
| | 2002 | 326 | 756 | 375 | 236 | 917 | 662 | 862 | |
| | | (244-407) | (567-945) | (281-468) | (177-295) | (688-1,146) | (497-828) | (647-1,078) | |
| | 2005 | 547 | 586 | 173 | 684‡ | 1,004 | 939 | 860 | |
| | | (411-684) | (440-733) | (130-216) | (513-855) | (753-1,255) | (704-1,174) | (645-1,075) | |
| | 2009 | 637 | 688 | 456 | 843 | 981 | 981 | 926 | |
| | | (478-796) | (516-860) | (342-570) | (632-1054) | (736-1226) | (516-860) | (695-1158) | |
| Percentage of people who | 2002 | 5.3% | 8% | 21.6% | 25.7% | 23.4% | 13.7% | 20.6% | i6 |
| shared needle/syringe last month | | (4-6.6%) | (6-10%) | (16.2-27%) | (19.3-32.1%) | (17.6-29.3%) | (10.3-17.1%) | (15.5-25.8%) | |
| | 2005 | 28.7% | 16.3% | 24.9% | 17.7%† | 6.3% | 7.2% | 35.4% | |
| | | (21.5-35.9%) | (12.2-20.4%) | (18.7-31.1%) | (13.3-22.1%) | (4.7-7.9%) | (5.4-9.0%) | (26.6-44.3%) | |
| | 2009 | 44.2% | 29.2% | 26.9% | 33.7% | 10.6% | 19.6% | 31.1% | |
| | | (33.2-55.3%) | (21.9-36.5%) | (20.1-33.6%) | (25.3-42.1%) | (8.0-13.3%) | (14.7-24.5%) | (23.4-38.9%) | |
| Percentage of shared syringes | | 1% | 1% | 1% | 1% | 1% | 1% | 1% | i7 |
| that are cleaned | | (0.1-10%) | (0.1-10%) | (0.1-10%) | (0.1-10%) | (0.1-10%) | (0.1-10%) | (0.1-10%) | |
| Average number of casual | 2000 | 0.10* | 0.06 | 0.3 | 0.10* | 0.09 | 0.1 | 0.12 | i8 |
| sexual partners per year | | (0.07-0.12) | (0.05-0.08) | (0.23-0.38) | (0.07-0.12) | (0.07-0.12) | (0.07-0.12) | (0.09-0.15) | |

| | | An Giang | Can Tho | Da Nang | Dien Bien | Hai Phong | Hanoi | HCMC | Footnote |
|------------------------------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------|
| Parameters | Year | Estimated value | |
| | | (uncertainty | |
| | | bound) | |
| | 2002 | 0.28 | 0.02 | 0.14 | 0.19 | 0.09 | 0.13 | 0.12 | |
| | | (0.21-0.35) | (0.01-0.03) | (0.11-0.18) | (0.14-0.24) | (0.07-0.11) | (0.09-0.16) | (0.09-0.14) | |
| | 2005 | 0.34 | 0.16 | 0.27 | 0.26‡ | 0.06 | 0.39 | 0.5 | |
| | | (0.26-0.43) | (0.12-0.20) | (0.20-0.34) | (0.19-0.32) | (0.04-0.07) | (0.29-0.49) | (0.37-0.62) | |
| | 2009 | 0.39 | 0.81 | 1.16 | 0.31 | 0.79 | 6.05 | 0.39 | |
| | | (0.29-0.49) | (0.61-1.01) | (0.87-1.45) | (0.23-0.39) | (0.59-0.99) | (4.54-7.56) | (0.29-0.49) | |
| Average number of regular | 2000 | 0.3* | 0.4 | 0.4 | 0.3* | 0.4 | 0.4 | 0.2 | i9 |
| sexual partners per year | | (0.2-0.3) | (0.3-0.5) | (0.3-0.5) | (0.2-0.3) | (0.3-0.5) | (0.3-0.5) | (0.1-0.3) | |
| | 2002 | 0.3 | 0.5 | 0.6 | 0.5 | 0.5 | 0.6 | 0.4 | |
| | | (0.2-0.4) | (0.4-0.6) | (0.4-0.7) | (0.4-0.6) | (0.3-0.6) | (0.5-0.8) | (0.3-0.5) | |
| | 2005 | 0.7 | 0.8 | 0.6 | 0.6† | 0.3 | 0.7 | 0.6 | |
| | | (0.6-0.9) | (0.6-1.0) | (0.5-0.8) | (0.5-0.8) | (0.2-0.4) | (0.5-0.8) | (0.5-0.8) | |
| | 2009 | 1.20 | 0.76 | 1.31 | 1.05 | 0.74 | 1.31 | 1.04 | |
| | | (0.90-1.50) | (0.57-0.95) | (0.98-1.64) | (0.79-1.31) | (0.56-0.93) | (0.98-1.64) | (0.78-1.30) | |
| Average number of commercial | 2000 | 0.77* | 0.11 | 0.61 | 0.77* | 0.4 | 0.92 | 0.19 | i10 |
| sex partners per year | | (0.58-0.96) | (0.08-0.13) | (0.46-0.77) | (0.58-0.96) | (0.3-0.51) | (0.69-1.15) | (0.14-0.23) | |
| | 2002 | 0.83 | 0.27 | 1.33 | 0.33 | 1.17 | 2.18 | 0.45 | |
| | | (0.62-1.03) | (0.2-0.34) | (1.0-1.66) | (0.25-0.41) | (0.88-1.46) | (1.64-2.73) | (0.34-0.57) | |

| | | An Giang | Can Tho | Da Nang | Dien Bien | Hai Phong | Hanoi | HCMC | Footnote |
|-------------------------------|------|-----------------|--------------------|--------------------|-----------------|-----------------|-----------------|-----------------|----------|
| Parameters | Year | Estimated value | Estimated value | Estimated value | Estimated value | Estimated value | Estimated value | Estimated value | |
| | | (uncertainty | (uncertainty | (uncertainty | (uncertainty | (uncertainty | (uncertainty | (uncertainty | |
| | | bound) | bound) | bound) | bound) | bound) | bound) | bound) | |
| | 2005 | 1.3 | 0.68 | 1.07 | 0.74‡ | 0.4 | 0.54 | 0.78 | |
| | | (0.97-1.62) | (0.51-0.85) | (0.8-1.34) | (0.56-0.93) | (0.3-0.5) | (0.40-0.67) | (0.59-0.98) | |
| | 2009 | 1.58 | 4.07 | 3.41 | 0.34 | 2.47 | 12.94 | 1.11 | |
| | | (1.19-1.98) | (3.05-5.09) | (2.56-4.26) | (0.26-0.43) | (1.85-3.09) | (9.71-16.2) | (0.83-1.39) | |
| Probability of condom use per | 2000 | 46.8%* | 25% | 62.3% | 46.8%* | 77.3% | 41.2% | 28% | i11 |
| act with casual partners | | (35.1-58.5) | (18.8-31.3%) | (46.7-77.9%) | (35.1-58.5) | (58-96.6%) | (30.9-51.5%) | (21-35%) | |
| | 2002 | 19.3% | 26.0%† | 16.3% | 33.3% | 10.5% | 40.4% | 36.4% | |
| | | (14.5-24.1%) | (19.5-32.5%) | (12.2-20.4%) | (25-41.6%) | (7.9-13.1%) | (30.3-50.5%) | (27.3-45.5%) | |
| | 2005 | 41.7% | 36.7% [§] | 41.7% [§] | 51.0%‡ | 54.6% | 59.4% | 38.4% | |
| | | (31.3-52.1%) | (27.5-45.9%) | (31.3-52.1%) | (38.3-63.8%) | (41-68.3%) | (44.6-74.3%) | (28.8-48%) | |
| | 2009 | 56.7% | 44.0% | 64.9% | 60.2% | 100% | 78.3% | 20.5% | |
| | | (42.5-70.8%) | (33.0-55.0%) | (48.7-81.2%) | (45.2-75.3%) | (75.0%-100%) | (58.7-97.8%) | (15.4-25.6%) | |
| Frequency of condom use with | 2000 | 31.0%* | 22.90% | 47.2% | 31.0%* | 39.8% | 25.4% | 19.7% | i12 |
| regular partners | | (23.3-38.8%) | (17.2-28.6%) | (35.4-59%) | (23.3-38.8%) | (30-49.8%) | (19.1-31.8%) | (14.8-24.6%) | |
| | 2002 | 14.3% | 13.6% | 39.3% | 3% | 42.5% | 27.6% | 24.8% | |
| | | (10.7-17.9%) | (10.2-17%) | (29.5-49.1%) | (2.3-3.8%) | (31.9-53.1%) | (20.7-34.5%) | (18.6-31%) | |
| | 2005 | 40.0% | 27.3% | 31.6% | 36.0%‡ | 33.7% | 32.9% | 39.9% | |
| | | (30-50%) | (20.5-34.1%) | (23.7-39.5%) | (27.0-45.0%) | (25.3-42.1%) | (24.7-41.1%) | (30-50%) | |

| | | An Giang | Can Tho | Da Nang | Dien Bien | Hai Phong | Hanoi | HCMC | Footnote |
|---------------------------------------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------|
| Parameters | Year | Estimated value | |
| | | (uncertainty | |
| | | bound) | |
| | 2009 | 38.8% | 34.2% | 53.9% | 51.8% | 66.7% | 61.0% | 24.8% | |
| | | (29.1-48.5%) | (25.6-42.7%) | (40.4-67.4%) | (38.8-64.7%) | (50.0-83.3%) | (45.7-76.2%) | (18.6-31.0%) | |
| Frequency of condom use with | 2000 | 70.3%* | 57.1% | 69% | 70.3%* | 83.7% | 82.4% | 59.5% | i13 |
| commercial sex workers | | (52.8-87.9%) | (42.8-71.4%) | (51.8-86.3%) | (52.8-87.9%) | (62.8-100%) | (61.8-100%) | (44.6-74.4%) | |
| | 2002 | 37.7% | 58.5% | 78% | 58.1% | 57.9% | 70% | 86.4% | |
| | | (28.3-47.1%) | (43.9-73.1%) | (58.5-97.5%) | (43.6-72.6%) | (43.4-72.4%) | (52.5-87.5%) | (64.8-100%) | |
| | 2005 | 65.9% | 60.7% | 78.7% | 69.3%‡ | 83.7% | 58.7% | 46.6% | |
| | | (49.4-82.4%) | (45.5-75.9%) | (59-98.4%) | (52.0-86.6%) | (62.8-100%) | (44-73.4%) | (35-58.3%) | |
| | 2009 | 81.7% | 72.3% | 82.0% | 77.5% | 91.5% | 81.8% | 48.3% | |
| | | (61.3-100%) | (54.2-90.4%) | (61.5-100%) | (58.1-96.9%) | (68.6-100%) | (61.4-100%) | (36.2-60.4%) | |
| Number of sexual acts between | 2009 | 60 | 281 | 57 | 119 | 43 | 265 | 71 | i14 |
| IDUs and regular partners per year | | (45-75) | (211-351) | (42-71) | (89-149) | (32-54) | (199-331) | (54-89) | |
| Number of sexual acts between | 2009 | 50 | 112 | 47 | 84 | 21 | 263 | 46 | i15 |
| IDUs and commercial sex | | (37-62) | (84-140) | (35-59) | (63-105) | (16-27) | (198-329) | (34-57) | |
| workers per year | | | | | | | | | |
| Number of sexual acts between | 2009 | 18 | 171 | 37 | 129 | 192 | 354 | 120 | i16 |
| IDUs and casual partners per year | | (13-22) | (129-214) | (28-46) | (97-161) | (144-240) | (266-443) | (90-150) | |
| Percentage tested for HIV per | 2005 | 5% | 5% | 5% | 5% | 5% | 5% | 5% | i17 |

| | | An Giang | Can Tho | Da Nang | Dien Bien | Hai Phong | Hanoi | нсмс | Footnote |
|-------------------------------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------|
| Parameters | Year | Estimated value | |
| | | (uncertainty | |
| | | bound) | |
| year | | (2.6-9%) | (2.6-9.3%) | (2.6-4.9%) | (2.6-4.9%) | (2.6-29.9%) | (2.6-24.5%) | (2.6-14.3%) | |
| | | | | | | | | · | |
| Men who have sex with men (M | ISM) | | | | | | | | h1 |
| | | | | | | | | | |
| Proportion of male population | 2008 | 2% | 2% | 2% | 2% | 2% | 2% | 2% | h2 |
| | | (1-3%) | (1-3%) | (1-3%) | (1-3%) | (1-3%) | (1-3%) | (1-3%) | |
| | | | | | | | | | |
| Average annual number of | 2005 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.27 | 0.13 | h3 |
| regular male sexual partners | | (0.15-0.25) | (0.15-0.25) | (0.15-0.25) | (0.15-0.25) | (0.15-0.25) | (0.2-0.34) | (0.1-0.17) | |
| Average number of casual male | 2005 | 26.3 | 26.3 | 26.3 | 26.3 | 26.3 | 19 | 33.6 | h4 |
| sexual partners per year | | (19.7-32.9) | (19.7-32.9) | (19.7-32.9) | (19.7-32.9) | (19.7-32.9) | (14.3-23.8) | (25-42) | |
| Average number of female | 2005 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | h5 |
| sexual partners per year | | (0.3-0.5) | (0.3-0.5) | (0.3-0.5) | (0.3-0.5) | (0.3-0.5) | (0.3-0.5) | (0.3-0.5) | |
| Frequency of condom use with | 2005 | 57.4% | 57.4% | 57.4% | 57.4% | 57.4% | 63.4% | 51.4% | h6 |
| other MSM in last act | | (43-71.8%) | (43-71.8%) | (43-71.8%) | (43-71.8%) | (43-71.8%) | (47.5-79.2%) | (38.6-64.3%) | |
| | 2009 | 60.9% | 58.8% | 60.9% | 60.9% | 69.0% | 70.7% | 45.3% | |
| | | (45.7-76.1%) | (44.1-73.5%) | (45.7-76.1%) | (45.7-76.1%) | (51.8-86.2%) | (53.0-88.4%) | (34.0-56.6%) | |

| | | An Giang | Can Tho | Da Nang | Dien Bien | Hai Phong | Hanoi | HCMC | Footnote |
|-------------------------------|------|--------------------|---------------------|-----------------------|--------------------|----------------------|---------------------|-----------------------|----------|
| Parameters | Year | Estimated value | Estimated value | Estimated value | Estimated value | Estimated value | Estimated value | Estimated value | |
| | | (uncertainty | (uncertainty | (uncertainty | (uncertainty | (uncertainty | (uncertainty | (uncertainty | |
| | | bound) | bound) | bound) | bound) | bound) | bound) | bound) | |
| Frequency of condom use with | 2005 | 43.9% | 43.9% | 43.9% | 43.9% | 43.9% | 65.3% | 22.5% | h7 |
| females in last act | | (32.9-54.9%) | (32.9-54.9%) | (32.9-54.9%) | (32.9-54.9%) | (32.9-54.9%) | (49-81.6%) | (16.9-28.1%) | |
| | 2009 | 63.7% | 45.9% | 63.7% | 63.7% | 67.9% | 80% | 61.1% | |
| | | (47.8-79.6%) | (34.4-57.4%) | (47.8-79.6%) | (47.8-79.6%) | (50.9-84.9%) | (69.0-100%) | (45.8-76.4%) | |
| % of MSM have had sex with a | 2009 | 42.2% | 46.4% | 42.2% | 42.2% | 28.5% | 48.6% | 45.4% | h8 |
| women in the past 12 months | | (31.7-52.8%) | (34.8-57.9%) | (31.7-52.8%) | (31.7-52.8%) | (21.4-35.6%) | (36.5-60.8%) | (34.0-56.7%) | |
| Percentage tested for HIV per | 2005 | 5% | 5% | 5% | 5% | 5% | 5% | 5% | h9 |
| year | | (2.6-15.7%) | (2.6-15.7%) | (2.6-15.7%) | (2.6-15.7%) | (2.6-15.7%) | (2.6-15.4%) | (2.6-16%) | |
| | · | | | | | | | | |
| Females (general population) | | | | | | | | | f1 |
| Proportion of population | | 49.8% minus the pe | rcentage of women w | ho are (karaoke- or s | treet-based) sex w | orkers, or injecting | drug users as desci | ribed in the footnote | f2 |
| Average number of casual | 2005 | 0.025 | 0.025 | 0.025 | 0.025 | 0.025 | 0.025 | 0.025 | f3 |
| sexual partners per year | | (0.019-0.031) | (0.019-0.031) | (0.019-0.031) | (0.019-0.031) | (0.019-0.031) | (0.019-0.031) | (0.019-0.031) | |
| Average number of regular | 2005 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | f4 |
| sexual partners per year | | (0.75-1.25) | (0.75-1.25) | (0.75-1.25) | (0.75-1.25) | (0.75-1.25) | (0.75-1.25) | (0.75-1.25) | |
| Average number of sexual acts | 2005 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | F5 |
| per regular partner per year | | | | | | | | | |

| | | An Giang | Can Tho | Da Nang | Dien Bien | Hai Phong | Hanoi | НСМС | Footnote |
|-------------------------------|-------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------|
| Parameters | Year | Estimated value | |
| | | (uncertainty | |
| | | bound) | |
| | | (65-109) | (65-109) | (65-109) | (65-109) | (65-109) | (65-109) | (65-109) | |
| Percentage tested for HIV per | 2005 | 2.10% | 2.10% | 2.10% | 2.10% | 2.10% | 2.10% | 2.10% | F6 |
| year | | (0.5-5%) | (0.5-5%) | (0.5-5%) | (0.5-5%) | (0.5-5%) | (0.5-5%) | (0.5-5%) | |
| | | | | | 1 | <u> </u> | I I | | |
| Karaoke-based sex workers (KS | Ws) | | | | | | | | k1 |
| | | | | | | | | | |
| Proportion of sex workers who | 2009 | 35% | 35% | 35% | 35% | 35% | 35% | 35% | k2 |
| are KSWs | | (26-44%) | (26-44%) | (26-44%) | (26-44%) | (26-44%) | (26-44%) | (26-44%) | |
| Population size | 2004- | 560 | 496 | 186 | 92 | 700 | 1,120 | 7,000 | k3 |
| (lower and upper estimates) | 2008 | (280-840) | (248-743) | (93-279) | (46-138) | (350-1,050) | (560-1,680) | (3,500-10,500) | |
| Average number of years of | 2002 | 2 | 2.0* | 2.0* | 2 | 2.0* | 2.0* | 2.0* | k4 |
| selling sex | | (1.5-2.5) | (1.5-2.5) | (1.5-2.5) | (1.5-2.5) | (1.5-2.5) | (1.5-2.5) | (1.5-2.5) | |
| | 2005 | 5 | 2.3 | 3.4 | 3.3† | 3.3 | 3.1 | 2.6 | |
| | | (3.7-6.2) | (1.7-2.8) | (2.6-4.3) | (2.5-4.1) | (2.4-4.1) | (2.3-3.9) | (2-3.3) | |
| | 2009 | 3.0 | 3.1 | 4.1 | 3.7 | 3.6 | 4.9 | 4.5 | |
| | | (2.3-3.8) | (2.3-3.8) | (3.1-5.2) | (2.8-4.6) | (2.7-4.5) | (3.7-6.1) | (3.4-5.6) | |
| Average number of one-time | 2000 | 186* | 24 | 60 | 186* | 768 | 104 | 160 | k5 |

| | | An Giang | Can Tho | Da Nang | Dien Bien | Hai Phong | Hanoi | HCMC | Footnote |
|--------------------------------------------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------|
| Parameters | Year | Estimated value | |
| | | (uncertainty | |
| | | bound) | |
| clients per year | | 140-233 | 18-30 | 45-75 | 140-233 | 576-960 | 78-130 | 120-200 | |
| | 2002 | 140 | 129† | 129† | 52 | 129† | 129† | 129† | |
| | | 105-175 | 97-162 | 97-162 | 39-65 | 97-162 | 97-162 | 97-162 | |
| | 2005 | 133 | 65 | 47 | 93‡ | 134 | 131 | 77 | |
| | | 100-166 | 49-81 | 35-58 | 70-117 | 101-168 | 98-163 | 57-96 | |
| | 2009 | 80 | 97 | 94 | 122‡ | 210 | 168 | 96 | |
| | | 60-100 | 73-121 | 71-118 | 92-153 | 159-263 | 126-210 | 72-120 | |
| Average number of regular | 2000 | 68* | 28 | 16 | 68* | 128 | 96 | 140 | k6 |
| clients per year | | 51-85 | 21-35 | 12-20 | 51-85 | 96-160 | 72-120 | 105-175 | |
| | 2002 | 92 | 83† | 83† | 16 | 83† | 83† | 83† | |
| | | 69-115 | 62-103 | 62-103 | 12-20 | 62-103 | 62-103 | 62-103 | |
| | 2005 | 67 | 45 | 41 | 46‡ | 41 | 58 | 46 | |
| | | 51-84 | 34-56 | 31-51 | 34-57 | 31-52 | 43-72 | 35-58 | |
| | 2009 | 62 | 54 | 43 | 61‡ | 77 | 76 | 58 | |
| | | 47-78 | 41-68 | 32-54 | 46-76 | 58-96 | 57-95 | 44-73 | |
| Average number of non- | 2005 | 7.2 | 5.9 | 4.6 | 5.4* | 4.2 | 5.2 | 3.7 | k7 |
| commercial casual sexual partners per year | | 5.4-9.0 | 4.4-7.4 | 3.5-5.8 | 4.1-6.8* | 3.2-5.3 | 3.9-6.5 | 2.8-4.6 | |
| Average number of non- | 2000 | 0.06* | 0.08 | 0.04 | 0.06* | 0.04 | 0.03 | 0.11 | k8 |

| | | An Giang | Can Tho | Da Nang | Dien Bien | Hai Phong | Hanoi | НСМС | Footnote |
|-------------------------------------------------------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------|
| Parameters | Year | Estimated value | |
| | | (uncertainty | |
| | | bound) | |
| commercial regular sexual | | 0.05-0.08 | 0.06-0.11 | 0.03-0.05 | 0.05-0.08 | 0.03-0.05 | 0.02-0.04 | 0.09-0.14 | |
| partners per year | 2002 | 0.06 | 0.05† | 0.05† | 0.04 | 0.05+ | 0.05† | 0.05† | |
| | | 0.05-0.08 | 0.04-0.06 | 0.04-0.06 | 0.03-0.05 | 0.04-0.06 | 0.04-0.06 | 0.04-0.06 | |
| | 2005 | 0.16 | 0.14 | 0.14 | 0.19‡ | 0.21 | 0.21 | 0.12 | |
| | | 0.12-0.20 | 0.11-0.18 | 0.11-0.18 | 0.14-0.24 | 0.16-0.26 | 0.16-0.26 | 0.09-0.14 | |
| | 2009 | 0.57 | 0.65 | 0.49 | 0.57‡ | 0.40 | 0.54 | 0.50 | |
| | | 0.43-0.71 | 0.49-0.81 | 0.37-0.61 | 0.43-0.71 | 0.30-0.50 | 0.41-0.68 | 0.38-0.63 | |
| Average number of sexual acts | 2005 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | k9 |
| per regular client per year | | (6-24) | (6-24) | (6-24) | (6-24) | (6-24) | (6-24) | (6-24) | |
| Average number of sexual acts | 2005 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | k10 |
| per non-commercial regular Sexual partner per year | | (65-109) | (65-109) | (65-109) | (65-109) | (65-109) | (65-109) | (65-109) | |
| | 2009 | 62 | 80 | 66 | 71 | 65 | 118 | 60 | |
| | | (47-78) | (60-100) | (50-83) | (53-89) | (49-81) | (88-147) | (45-75) | |
| Frequency of condom use with | 2000 | 92.0%* | 96.0% | 97.5% | 92.0%* | 95.1% | 89.6% | 81.8% | k11 |
| one-time clients | | (69-100%) | (72-100%) | (73.1-100%) | (69-100%) | (71.3-100%) | (67.2-100%) | (61.4-100%) | |
| | 2002 | 73.7% | 79.5%† | 79.5%† | 85.30% | 79.5%† | 79.5%† | 79.5%† | |
| | | (55.3-92.1%) | (59.6-99.4%) | (59.6-99.4%) | (64-100%) | (59.6-99.4%) | (59.6-99.4%) | (59.6-99.4%) | |
| | 2005 | 94.4% | 99.2% | 90.6%* | 95.9%‡ | 96.7% | 97.9% | 96.1% | |

| | | An Giang | Can Tho | Da Nang | Dien Bien | Hai Phong | Hanoi | HCMC | Footnote |
|------------------------------------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------|
| Parameters | Year | Estimated value | |
| | | (uncertainty | |
| | | bound) | |
| | | (70.8-100%) | (74.4-100%) | (68-100%) | (71.9-100%) | (72.5-100%) | (73.4-100%) | (72.1-100%) | |
| | 2009 | 97.9% | 98.3% | 100% | 91.8%‡ | 98.0% | 82.3% | 77.3% | |
| | | (73.5-100%) | (73.7-100%) | (75.0-100%) | (68.9-100%) | (73.5-100%) | (62.1-100%) | (58.0-96.6%) | |
| Frequency of condom use with | 2000 | 83.1%* | 93.3% | 94% | 83.1%* | 85.5% | 78.3% | 64.3% | k12 |
| regular clients | | (62.3-100%) | (70-100%) | (70.5-100%) | (62.3-100%) | (64.1-100%) | (58.7-97.9%) | (48.2-80.4%) | |
| | 2002 | 62.8% | 64.8%† | 64.8%† | 66.7% | 64.8%† | 64.8%† | 64.8%† | |
| | | (47.1-78.5%) | (48.6-80.9%) | (48.6-80.9%) | (50-83.4%) | (48.6-80.9%) | (48.6-80.9%) | (48.6-80.9%) | |
| | 2005 | 86.1% | 98.4% | 94.9% | 90.0%‡ | 91.3% | 92.1% | 90.9% | |
| | | (64.6-100%) | (73.8-100%) | (71.2-100%) | (67.5-100%) | (68.5-100%) | (69.1-100%) | (68.2-100%) | |
| | 2009 | 94.0% | 88.4% | 97.0% | 85.7% | 95.6% | 73.4% | 65.6% | |
| | | (70.5-100%) | (66.3-100%) | (72.6-100%) | (64.3-100%) | (71.7-100%) | (55.3-92.1%) | (49.2-82.0%) | |
| Frequency of condom use with | 2000 | 48.6%* | 76.3% | 71.9% | 48.6%* | 46.8% | 33.5% | 14.6% | k13 |
| non-commercial casual partners | | (36.5-60.8%) | (57.2-95.4%) | (53.9-89.9%) | (36.5-60.8%) | (35.1-58.5%) | (25.1-41.9%) | (11-18.3%) | |
| | 2005 | 54.8% | 22.5% | 36.8% | 36.8%† | 34.5% | 36.6% | 29% | |
| | | (41.1-68.4%) | (16.9-28.2%) | (27.6-46%) | (27.6-45.9%) | (25.8-43.1%) | (27.5-45.8%) | (21.7-36.2%) | |
| Frequency of condom use with | 2002 | 54.4% | 50% | 50% | 3% | 50% | 50% | 50% | k14 |
| non-commercial regular partners | | (40.8-68%) | (37.2-62%) | (37.2-62%) | (2.1-3.8%) | (37.2-62%) | (37.2-62%) | (37.2-62%) | |
| | 2009 | 41.4% | 24.7% | 66.1% | 41.8% | 46.5% | 38.5% | 22.1% | |

| | | An Giang | Can Tho | Da Nang | Dien Bien | Hai Phong | Hanoi | НСМС | Footnote |
|---------------------------------|----------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------|
| Parameters | Year | Estimated value | |
| | | (uncertainty | |
| | | bound) | |
| | | (31.1-51.8%) | (18.9-30.9%) | (49.6-82.6%) | (31.4-52.3%) | (34.9-58.1%) | (28.9-48.1%) | (16.6-27.6%) | |
| Proportion of KSW who inject | 2000 | 5.0%* | 5.0%* | 5.0%* | 5.0%* | 5.0%* | 5.6% | 4.30% | k15 |
| drugs | | (3.7-6.2%) | (3.7-6.2%) | (3.7-6.2%) | (3.7-6.2%) | (3.7-6.2%) | (1-10%) | (3-6%) | |
| | 2002 | 3.0% | 3.0%† | 3.0%† | 3.0%† | 3.0%† | 3.0%† | 3.0%† | |
| | | (2.3-3.8%) | (2.3-3.8%) | (2.3-3.8%) | (2.3-3.8%) | (2.3-3.8%) | (2.3-3.8%) | (2.3-3.8%) | |
| | 2005 | 8.9% | 1.0% | 0.64% | 4.7%‡ | 4.7% | 4.0% | 5.3% | |
| | | (6.6-11.1%) | (0.8-1.3%) | (0.5-0.8%) | (3.5-5.8%) | (3.6-5.9%) | (3-5%) | (4-6.6%) | |
| Percentage tested for HIV per | 2005 | 5% | 5% | 5% | 5% | 5% | 5% | 5% | k16 |
| year | | (2.1-15.3%) | (2.1-14.3%) | (2.1-17.3%) | (2.1-25%) | (2.1-27.4%) | (2.1-33%) | (2.1-15.6%) | |
| | | | | | | | | | |
| | | | | | | | | | |
| Female street-based sex worke | rs (SSWs |) | | | | | | | s1 |
| | | | | | | | | | |
| Population size | 2004- | 1,040 | 920 | 346 | 170 | 1,300 | 2,080 | 13,000 | s2 |
| (lower and upper estimates) | 2008 | (520-1,560) | (460-1,381) | (173-519) | (85-255) | (650-1,950) | (1,040-3,120) | (6,500-19,500) | |
| Mean duration of selling sex in | 2002 | 3.0 | 2.8* | 2.8* | 2.5 | 2.8* | 2.8* | 2.8* | s3 |
| years | | (2.3-3.8) | (2.1-3.5) | (2.1-3.5) | (1.9-3.1) | (2.1-3.5) | (2.1-3.5) | (2.1-3.5) | |
| | 2005 | 5.4 | 5.2 | 3.9 | 4.4† | 3.7 | 3.7 | 4.5 | |

| | | An Giang | Can Tho | Da Nang | Dien Bien | Hai Phong | Hanoi | НСМС | Footnote |
|----------------------------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------|
| Parameters | Year | Estimated value | |
| | | (uncertainty | |
| | | bound) | |
| | | (4-6.7) | (3.9-6.4) | (2.9-4.9) | (3.3-5.5) | (2.8-4.6) | (2.7-4.6) | (3.4-5.6) | |
| | 2009 | 5.9 | 5.9 | 5.8 | 4.9† | 4.6 | 4.6 | 5.5 | |
| | | (4.5-7.4) | (4.5-7.4) | (4.3-7.2) | (3.7-6.1) | (3.5-5.8) | (3.4-5.7) | (4.1-6.8) | |
| Average number of one-time | 2000 | 346* | 516 | 268 | 346* | 604 | 308 | 380 | s4 |
| clients per year | | (260-433) | (387-645) | (201-335) | (260-433) | (453-755) | (231-385) | (285-475) | |
| | 2002 | 168 | 212 | 103 | 371† | 1,318 | 168 | 425 | |
| | | (126-210) | (159-266) | (77-128) | (278-464) | (989-1,648) | (126-210) | (319-531) | |
| | 2005 | 149 | 151 | 83 | 124‡ | (195) | 141 | 81 | |
| | | (112-187) | (113-189) | (62-104) | (93-154) | (147-244) | (106-176) | (61-102) | |
| | 2009 | 150 | 117 | 152 | 162‡ | 237 | 176 | 232 | |
| | | (133-188) | (88-146) | (114-190) | (122-203) | (178-296) | (132-220) | (174-290) | |
| Average Number of regular | 2000 | 92* | 88 | 64 | 92* | 84 | 84 | 232 | s5 |
| clients per year | | (69-115) | (66-110) | (48-80) | (69-115) | (63-105) | (63-105) | (174-290) | |
| | 2002 | 45† | 76 | 54 | 24 | 45 | 21 | 72 | |
| | | (34-56) | (57-95) | (41-68) | (18-30) | (34-56) | (16-27) | (54-90) | |
| | 2005 | 93 | 66 | 39 | 48‡ | 41 | 46 | 45 | |
| | | (70-116) | (50-83) | (29-48) | (36-60) | (31-51) | (34-56) | (34-56) | |
| | 2009 | 62 | 60 | 64 | 63‡ | 62 | 80 | 73 | |

| | | An Giang | Can Tho | Da Nang | Dien Bien | Hai Phong | Hanoi | НСМС | Footnote |
|--------------------------------------------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------|
| Parameters | Year | Estimated value | |
| | | (uncertainty | |
| | | bound) | |
| | | (47-78) | (45-75) | (48-80) | (47-79) | (47-78) | (60-100) | (55-91) | |
| Average number of non- | 2002 | 2.7* | 4.2 | 5.5 | 2.7* | 2.7* | 4.1 | 4.9 | S6 |
| commercial casual sexual partners per year | | (2.0-3.3) | (3.1-5.2) | (4.1-6.8) | (2.0-3.3) | (2.0-3.3) | (3.1-5.1) | (3.7-6.1) | |
| | 2005 | 7.8 | 5.3 | 6.0 | 5.2† | 4.1 | 4.3 | 4.3 | |
| | | (5.9-9.8) | (3.9-6.6) | (4.5-7.5) | (3.9-6.5) | (3.0-5.1) | (3.3-5.4) | (3.3-5.4) | |
| Average number of non- | 2000 | 0.12* | 0.14 | 0.11 | 0.12* | 0.13 | 0.05 | 0.17 | S7 |
| commercial regular sexual | | 0.09-0.15 | 0.1-0.17 | 0.08-0.13 | 0.09-0.15 | 0.1-0.16 | 0.04-0.07 | 0.13-0.21 | |
| partners per year | 2002 | 0.4 | 0.27+ | 0.27+ | 0.12 | 0.27+ | 0.27+ | 0.27+ | |
| | 2002 | 0.4 | 0.371 | 0.371 | 0.13 | 0.371 | 0.371 | 0.371 | |
| | | 0.3-0.5 | 0.28-0.46 | 0.28-0.46 | 0.1-0.16 | 0.28-0.46 | 0.28-0.46 | 0.28-0.46 | |
| | 2005 | 0.24 | 0.30 | 0.13 | 0.20‡ | 0.15 | 0.21 | 0.14 | |
| | | 0.18-0.30 | 0.23-0.38 | 0.09-0.16 | 0.15-0.25 | 0.12-0.19 | 0.16-0.26 | 0.11-0.18 | |
| | 2009 | 0.42 | 0.51 | 0.42 | 0.49 | 0.29 | 0.39 | 0.53 | |
| | | 0.32-0.53 | 0.38-0.64 | 0.32-0.53 | 0.37-0.61 | 0.22-0.36 | 0.29-0.49 | 0.40-0.66 | |
| Average number of sexual acts | 2005 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | s8 |
| per regular client per year | | (6-24) | (6-24) | (6-24) | (6-24) | (6-24) | (6-24) | (6-24) | |
| Average number of sexual acts | 2005 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | s9 |
| per non-commercial regular | | (65-109) | (65-109) | (65-109) | (65-109) | (65-109) | (65-109) | (65-109) | |
| isenual partiter per year | 2009 | 75 | 69 | 57 | 73 | 65 | 82 | 107 | |

| | | An Giang | Can Tho | Da Nang | Dien Bien | Hai Phong | Hanoi | НСМС | Footnote |
|------------------------------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------|
| Parameters | Year | Estimated value | |
| | | (uncertainty | |
| | | bound) | |
| | | (56-94) | (52-86) | (43-72) | (54-91) | (48-81) | (61-102) | (80-134) | |
| Frequency of condom use with | 2000 | 94.1%* | 94.8% | 99.7% | 94.1%* | 90.5% | 93.5% | 91.9% | s10 |
| one-time clients | | (70.6-100%) | (71.1-100%) | (67.9-100%) | (70.6-100%) | (67.9-100%) | (70.1-100%) | (68.9-100%) | |
| | 2002 | 52.5% | 98.0% | 99.1% | 87.0% | 91.5% | 84.6 | 97.9% | |
| | | (39.4-65.6%) | (73.5-100%) | (74.3-100%) | (65.3-100%) | (68.6-100%) | (63.5-100%) | (73.4-100%) | |
| | 2005 | 96.8% | 98.7% | 99.2% | 97.4%‡ | 96.8% | 99.0% | 93.4% | |
| | | (72.6-100%) | (74.0-100%) | (74.4-100%) | (73.1-100%) | (72.6-100%) | (74.3-100%) | (70.1-100%) | |
| | 2009 | 98.0% | 85.1% | 98.9% | 91.4%‡ | 99.3% | 79.7% | 73.8% | |
| | | (73.5-100%) | (63.8-100%) | (74.2-100%) | (68.5-100%) | (74.5-100%) | (59.8-99.6%) | (55.4-92.3%) | |
| Frequency of condom use with | 2000 | 82.4%* | 79.5% | 95.3% | 82.4%* | 82.1% | 75.9% | 79.1% | s11 |
| regular clients | | (61.8-100%) | (59.6-99.4%) | (71.5-100%) | (61.8-100%) | (61.6-100%) | (56.9-94.9%) | (59.3-98.9%) | |
| | 2002 | 48.1% | 92.8% | 97.4% | 55.6% | 78.8% | 73.2% | 93.9% | |
| | | (36.1-60.1%) | (69.6-100%) | (73.1-100%) | (41.7-69.5%) | (59.1-98.5%) | (54.9-91.5%) | (70.4-100%) | |
| | 2005 | 92.2% | 96.3% | 94.8% | 92.0% | 91.9% | 93.4% | 85.9% | |
| | | (69.1-100%) | (72.2-100%) | (71.1-100%) | (69.0-100%) | (68.9-100%) | (70.1-100%) | (64.4-100%) | |
| | 2009 | 94.8% | 93.8% | 96.5% | 86.3%‡ | 96.9% | 63.5% | 65.8% | |
| | | (71.1-100%) | (70.3-100%) | (72.4-100%) | (64.7-100%) | (72.7-100%) | (47.6-79.3) | (49.3-82.2%) | |
| Frequency of condom use with | 2000 | 31.6%* | 23.6% | 29.1% | 31.6%* | 34.3% | 34.3% | 36.6% | s12 |

| | | An Giang | Can Tho | Da Nang | Dien Bien | Hai Phong | Hanoi | НСМС | Footnote |
|------------------------------------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------|
| Parameters | Year | Estimated value | |
| | | (uncertainty | |
| | | bound) | |
| non-commercial casual partners | | (23.7-39.5%) | (17.7-29.5%) | (21.8-36.4%) | (23.7-39.5%) | (25.7-42.9%) | (25.7-42.9%) | (27.5-45.8%) | |
| | 2002 | 36.1%† | 34.5% | 37.9% | 36.1%† | 52.6% | 30.0% | 25.6% | |
| | | (27.1-45.2%) | (25.9-43.1%) | (28.4-47.4%) | (27.1-45.2%) | (39.5-65.8%) | (22.5-37.5%) | (19.2-32.0%) | |
| | 2005 | 61.0% | 30.20% | 42.5% | 40.7%‡ | 33.3% | 32.8% | 33.6% | |
| | | (45.8-76.3%) | (27.7-37.8%) | (31.9-53.1%) | (30.5-50.9%) | (25.0-41.7%) | (24.6-41.0%) | (25.2-42.0%) | |
| Frequency of condom use with | 2002 | 48.6% | 47.0%* | 47.0%* | 25% | 47.0%* | 47.0%* | 47.0%* | s13 |
| non-commercial regular partners | | (36.5-60.8%) | (34.9-58.2%) | (34.9-58.2%) | (18.8-31.3%) | (34.9-58.2%) | (34.9-58.2%) | (34.9-58.2%) | |
| | 2009 | 33.3% | 35.0% | 75.0% | 44.3% | 57.7% | 16.7% | 30.1% | |
| | | (25.0-41.7%) | (26.3-43.8%) | (56.3-93.8%) | (33.2-55.4%) | (43.2-72.1%) | (12.5-20.8%) | (22.6-37.6%) | |
| Proportion of SSW who inject | 2000 | 18.6%* | 18.6%* | 18.6%* | 18.6%* | 18.6%* | 21.5% | 15.6% | s14 |
| drugs | | (13.9-23.2) | (13.9-23.2) | (13.9-23.2) | (13.9-23.2%) | (13.9-23.2%) | (16.1-26.9%) | (11.7-19.5%) | |
| | 2002 | 8.3% | 14.1%† | 14.1%† | 57.1% | 14.1%† | 14.1%† | 14.1%† | |
| | | (6.2-10.4%) | (10.6-16.8%) | (10.6-16.8%) | (42.8-71.4%) * | (10.6-16.8%) | (10.6-16.8%) | (10.6-16.8%) | |
| | 2005 | 2.9% | 17.3% | 0.58% | 10.9%‡ | 7.2% | 16.7% | 5.0% | |
| | | (2.2-3.7%) | (13-21.6%) | (0.4-0.7%) | (8.2-13.6%) | (5.4-9.0%) | (12.5-20.9%) | (3.8-6.3%) | |
| Percentage tested for HIV per | 2005 | 5% | 5% | 5% | 5% | 5% | 5% | 5% | s15 |
| year | | (2.1-23.1%) | (2.1-27.2%) | (2.1-19.4%) | (2.1-25%) | (2.1-17.4%) | (2.1-24%) | (2.1-11.4%) | |
| | | l | 1 | 1 | I | 1 | I | | |

| | | An Giang | Can Tho | Da Nang | Dien Bien | Hai Phong | Hanoi | НСМС | Footnote |
|-------------------------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------|
| Parameters | Year | Estimated value | |
| | | (uncertainty | |
| | | bound) | |
| | | | | | I | | | | |
| Harm reduction programs | | | | | | | | | |
| | | | | | | | | | |
| Number of condoms | 2006 | 303,828 | 5,800 | 751,904 | 758,642 | 100,000 | 7,150 | 300,000 | hr1 |
| distribution | 2007 | 356,813 | 369,385 | 379,465 | 44,746 | 487,108 | 405,736 | 2,102,683 | |
| | 2008 | 390,092 | 162,417 | 214,280 | 47,200 | 1,468,262 | 395,820 | 1,968,605 | |
| | 2009 | 2,346,789 | 287,899 | 235,927 | 158,225 | 1,043,614 | 2,104,066 | 3,113,937 | |
| Needles and syringes | 2006 | 8,781 | 55,759 | | | 622,779 | 160,345 | 235,442 | |
| distributed | 2007 | 146,729 | 297,427 | | 48,475 | 1,983,473 | 1,164,375 | 320,511 | |
| | 2008 | 253,267 | 672,113 | | 45,000 | 3,635,830 | 12,180,739 | 849,839 | |
| | 2009 | 319,700 | 635,156 | | 85,160 | 2,861,278 | 3,020,996 | 1,395,520 | |

p1: The total size of the population in each province was estimated from the latest released data (in 2007) from the official website of the General Statistics Office of Vietnam (http://www.gso.gov.vn/) and we assume 57% of the population to be sexually active (those aged 15-49 years) based on http://www.nationmaster.com/country/vm-vietnam.

m1: There are very little data on the sexual behavior of men in the general community. Unless otherwise specified for each province we have assumed that men in the general male population have the same sexual behavior on average. This behavior is based on data in the Vietnam

Population and AIDS Indicator Survey conducted in 2005 [4].

m2: The percentage of the population that is classified as general male is given by 50.2% (as obtained from http://www.nationmaster.com/country/vm-vietnam [7] minus the percentage of males that are clients of sex workers, IDUs, and MSM. This is applied across all provinces. No uncertainty range is given as the overall population size is fixed in the model.

m3 & m4: The Vietnam Population and AIDS Indicator Survey (VPAIS) conducted in 2005 [4] provides evidence of very little pre-marital sex, with ~8% of men who have never been married having had sex (Table 6.1.2, page 54 from the VPAIS report [4]) and 0.7% of men not previously married reporting more than one sexual partner in the past (Table 6.2.2, page 57 from the VPAIS report [4]). The overall male population surveyed in the VPAIS was 6,707 (VPAIS 2005, Table 6.1.2. page 54 [4]). Of these, 4,128 were men who had sexual intercourse in the past 12 months (VPAIS 2005, Table 6.2.2. page 57 [4]). It is reported that 3.7% of the 4,128 surveyed men who had sexual intercourse in the past 12 months had higher risk sex (VPAIS 2005, Table 6.2.2. page 57 [4]). Thus, for the overall male population, 2.3% of men surveyed had higher risk sex (defined to be sex with a non-marital or non-cohabitating partner) calculated by 3.7% of 4128/6707.

The overall mean number of sexual partners men have had in their lifetime is 1.4 (Table 6.2.2, page 57 of the VPAIS report [4]). While ~60% of men (Table 3.1, page 24 of the VPAIS report [4]) are married, we assume that men in the general male population have 1 regular partner in a given year (their wife, cohabiting partner, or girlfriend). We assume there are very few casual partners per year, reflecting the small percentage of men who have multiple partners each year (0.7% according to the VPAIS report; Table 6.2.2, page 57 [4]). The value 0.025 is used such that males have 1 casual partner in total over a 40 year period of sexual activity. We assume 1-10 acts per casual partner. The range is an assumption, taken to be + 25% of the value, to account for the potential uncertainty in the data.

m5: The average number of sexual acts per regular partner per year is equal to 87 as reported in Global Sex Survey 2005 [26], with an assumed

m6: According to the Vietnam Population and AIDS Indicator Survey conducted in 2005 [4] 67.6% of 15-24 year old men reported using a condom at last higher-risk sex (Table 7.5, page 75 of the VPAIS report [4]). The range is an assumption, taken to be + 25% of the value, to account for the potential uncertainty in the data.

m7: From the Vietnam Population and AIDS Indicator Survey conducted in 2005 [4] 12.3% and 43.1% of urban females and males aged 15-24 years reported using a condom at first sex, respectively, and 3.5% and 19.2% of all males and females reported using a condom at first sex (Table 7.3, page 72 of the VPAIS report [4]). For those who have ever been married the percentage who reported using a condom at first sex was 2.9% for females and 6.1% for males. Given the low level of premarital sex in Vietnam and first sex is likely to be within a marriage, condom use per act within a regular partnership is therefore assumed to be low at 6.1% with an assumed uncertainty range of + 25% of this value.

m8: We assume the overall population percentage of 2.6% of males and 2.1% of females who tested for HIV and received their results in the previous year (Table 6.4, page 60 of the VPAIS report [4]) to be representative of yearly HIV testing rates. The uncertainty bound is base on the 95% confidence interval which is calculated from the sample size ever tested (n=355, 5.3% of 6,707 men surveyed) and the proportion tested and received results in the previous year (2.6%). However, in the VPAIS 2005 due to the President's Emergency Plan for AIDS Relief (Table 6.4, page 60 of the VPAIS report [4]) the percentage of men aged 15-49 who were tested for HIV and received their results in the previous year before the survey for Hai Phong is 6.3%, 15.3% for Ha Noi and 5.1% for HCMC. These higher percentages reflect the impact of this intervention so we use the overall population value (2.6% and 2.1%) for the baseline testing rates.

c1: Male respondents (aged 15-49 years) to the Vietnam Population and AIDS Indicator Survey (VPAIS) 2005 who reported that they had sex with a

prostitute in the 12 months preceding the survey [4].

c2: The proportion of males who reported paying for sexual intercourse in the past 12 months was reported in the Vietnam Population and AIDS Indicator Survey (VPAIS) conducted in 2005 (Table 6.3, page 58 of the VPAIS report [4]). The proportion of males who had paid for sex was 1.1% (n=141) for Hai Phaong, 0.2% (n=218) for Ha Noi, and 0.3% (n=427) for HCMC (Table 6.3, page 58 of the VPAIS report [4]). There are no equivalent data for men in An Giang, Dien Bien, Da Nang, and Can Tho. We assume a proportion equal to the overall proportion of men aged 15-49 years in Vietnam reporting payment for sexual intercourse in the past 12 months, estimated to be 0.5% (n=6,707) (Table 6.3, page 58 of the VPAIS report [4]). However, based on expert opinion, anecdotal evidence and data from comparable settings outside Vietnam, it is thought that a greater proportion of men pay for sex. Other studies report that up to 33% of Vietnamese men have visited a FSW in their lifetime [27] and the estimates used in the Vietnam HIV/AIDS Estimates and Projections 2007-2012 are also higher than indicated in the VPAIS report. To incorporate this uncertainty a range of 0.1-10% is used for all provinces. This high estimate of 10% of adult males aged 15-49 years is consistent with that used in the Vietnam HIV/AIDS Estimates and Projections 2007-2012 for the 'high' scenario [8].

c3: There are no specific data on HIV testing in clients of commercial sex workers. We assume the same testing rate as general males aged 15-49 as reported in the Vietnam Population and AIDS Indicator Survey (VPAIS) conducted in 2005 (Table 6.4, page 60 of the VPAIS report [4]). See m8 for details.

i1: In the 2000 BSS report [1], an IDU was defined as an individual who has injected illegal drugs (e.g., heroin, opium) or injected various other drugs or combination of drugs for the purpose of getting high rather than for medical reasons. In the 2002 Baseline Survey Report [2] IDUs were defined to be men who used intravenous drugs (not drugs following a medical prescription) within the last six months. In the IBBS 2005-2006 report [3], IDUs were defined as 18 years or older, currently injecting drugs (identified by reported drug injection in the month prior to the survey), being at

selected locations (Hai Phong and An Giang only) at the time of the survey, and willing to participate.

i2: Size estimates of IDUs and their lower and upper bounds were provided by the Vietnam HIV/AIDS Estimates and Projections 2007-2012 [8].

i3: The estimated percentage of IDUs who are female was obtained through correspondence with Dr. Quang at the Pasteur Institute of Ho Chi Minh City, Vietnam. As there are very little data on this proportion we have assumed a larger range of ± 50% to reflect this uncertainty.

i4: The average size of the sharing group is estimated from the number of people an IDU shared a needle with the last time they shared in the 2005-2006 IBBS report (Figure 8 page 23 [3]). The figure in the report gives the proportion of IDUs who shared with one other person and those that shared with two or more people (size of sharing group (n)). To calculate the estimated value we assumed 2 or more can be estimated as 3 people on average. This gives an average size of a sharing group of 3. There are no specific data for Hai Phong, Ha Noi, and Dien Bien. We assume that the average size of the sharing group is same across all provinces, with an assumed uncertainty of ± 25%.

| Numberof other IDUs | An Giar | ng | Da Nar | ıg | НСМС | | Can Tho | |
|-----------------------|------------|-------|------------|-------|------------|-------|------------|-------|
| who hared usd needle | Proportion | | Proportion | | Proportion | | Proportion | |
| (n | shared (s) | n x s |
| 1 | 0.67 | 0.67 | 0.75 | 0.75 | 0.69 | 0.69 | 0.52 | 0.52 |
| <u>></u> 2 | | | | | | | | |
| (assume 3 on average) | 0.33 | 0.99 | 0.25 | 0.75 | 0.31 | 0.93 | 0.48 | 1.44 |
| Weighted average | | 2 | | 2 | | 2 | | 2 |

i5: The frequency of injecting for 2000 is calculated from the 2000 BSS report (Table 14, page 28 [1]). For 2002, it is calculated from data provided by the Vietnamese Data Triangulation Team. For 2005, it is calculated from the 2005-2006 IBBS survey (Table 10, page 48 [3]). These surveys provide data on the percentage of surveyed IDUs who report injecting less than once per day, once per day, 2-3 times per day, and >=4 times per day. We assume those who inject less than once per day is equivalent to injecting once per week, those who inject 2-3 times inject on average 2.5 times per day and those who inject >= 4 times a day inject 5 times per day. The average frequency of injecting per year is then given by the weighted average $365(0.15p_1 + p_2 + 2.5p_3 + 5p_4)$ where the corresponding proportion is p_x . The2005 value is calculated from the 2005-2006 IBBS (Table 10, page 48 [3]) as above. The 2009 value is calculated from the 2009 IBBS, IDU Questionnaire, Q204. In the 2002 Baseline Survey Report (Table 24, page 58 [2]), the survey provides data on the percentage of surveyed IDUs who report injecting at least once a month, at least once a week, and at least once per day. We assume those who inject at least once a month inject on average once per month, those who inject at least once a week inject on average once per week, and those who inject at least once per day inject on average once per day. The frequency of injection per year is then given by the weighted average $365(0.04p_1 + 0.15p_2 + p_3)$ where the corresponding proportion is p_x .

*For 2000, the values used for An Giang and Dien Bien are taken from an average across all other provinces.

‡ For 2005, the values used for Dien Bien are taken from an average across all other provinces.

The range for this value is based on an assumed ± 25% of the given value to account for uncertainty in the data.

| Frequency of injecting/day | | Can | Tho | Da N | lang | Hai P | hong | На | Noi | HC | мс |
|----------------------------|--------------|---------------------------------|----------------|---------------------------------|----------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|
| f | days | Proportion (p _x) | f* p_x *days | Proportion (p _x) | f* p_x *days | Proportion (p_x) | f* p_x *days | Proportion (p_x) | f* p_x *days | Proportion (p_x) | f* p_x *days |
| 2000 | 2000 BSS rej | port Table 14, | page 28 [1] | | | | | | | | |

| 0.15 | 365 | 0.063 | 3 | 0.684 | 37 | 0.399 | 22 | 0.314 | 17 | 0.033 | 2 |
|------------------|------------|------------------|----------------|------------|---------------------|------------|----------------|------------|----------------|------------|----------------|
| 1 | 365 | 0.354 | 129 | 0.246 | 90 | 0.34 | 124 | 0.278 | 101 | 0.167 | 61 |
| 2.5 | 365 | 0.565 | 516 | 0.071 | 65 | 0.252 | 230 | 0.408 | 372 | 0.676 | 617 |
| 5 | 365 | 0.018 | 33 | 0 | 0 | 0.09 | 164 | 0 | 0 | 0.124 | 226 |
| Weighted average | | | 681 | | 192 | | 540 | | 491 | | 906 |
| | 1 | | <u>I</u> | <u>I</u> | I | <u>I</u> | <u>I</u> | <u>I</u> | I | <u>I</u> | <u>I</u> |
| Frequency of | | | | | | | | | | | |
| injecting/day | | Can | Tho | Da M | Nang | Hai P | Phong | На | Noi | нс | мс |
| | | Proportion | | Proportion | | Proportion | | Proportion | | Proportion | |
| f | days | (p_x) | f* p_x *days | (p_x) | f* p_{χ} *days | (p_x) | f* p_x *days | (p_x) | f* p_x *days | (p_x) | f* p_x *days |
| 2002 | Vietnam Da | ata Triangulatio | n Team | 1 | | 1 | 1 | 1 | | 1 | 1 |
| 0.15 | 365 | 0.023 | 1 | 0.014 | 1 | 0.424 | 23 | 0.056 | 3 | 0.039 | 2 |
| 1 | 365 | 0.433 | 158 | 0.142 | 52 | 0.325 | 119 | 0.164 | 60 | 0.267 | 97 |
| 2.5 | 365 | 0.539 | 492 | 0.741 | 676 | 0.247 | 225 | 0.68 | 621 | 0.669 | 610 |
| 5 | 365 | 0.006 | 11 | 0.103 | 188 | 0.004 | 7 | 0.098 | 179 | 0.025 | 46 |
| Weighted average | | | 662 | | 917 | | 375 | | 862 | | 756 |
| L | 1 | | <u>I</u> | <u>I</u> | <u> </u> | <u>I</u> | <u>I</u> | <u>I</u> | <u> </u> | <u>I</u> | <u>I</u> |
| Frequency of | | | | | |] | | | | | |
| injecting/day | | An (| Giang | Dien | Bien | | | | | | |
| f | days | Proportion | f* p_x *days | Proportion | f* p_x *days | | | | | | |
| 1 | | - | | 1 | 1 | 1 | | | | | |

| | | (p_x) | | (<i>p</i> _{<i>x</i>}) | | | | | | | |
|--------------------------------------------------------------------------------------------------------|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------------|-------------------------------------------------------|
| 2002 | Baseline Su | rvey Report (Ta | able 24, page | 58 [2]) | | | | | | | |
| 0.04 | 365 | 0.008 | 0 | 0.157 | 2 | | | | | | |
| 0.15 | 365 | 0.117 | 6 | 0.239 | 13 | | | | | | |
| 1 | 365 | 0.875 | 319 | 0.604 | 220 | | | | | | |
| Weighted average | 365 | | 326 | | 236 | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Frequency of | | | | | | | | | | | |
| Frequency of injecting/day | | An G | Giang | Can | Tho | Da l | Nang | Hai F | Phong | На | Noi |
| Frequency of injecting/day | | An G Proportion | Biang | Can Proportion | Tho | Da I Proportion | Nang | Hai F | Phong | Ha Proportion | Noi |
| Frequency of injecting/day f | days | An C Proportion (p _x) | Giang f* p_x *days | Can Proportion (p_x) | Tho f* p_x *days | Da l Proportion (p _x) | Nang $f^*p_x^*$ days | Hai F Proportion (p _x) | Phong f* p_x *days | Ha Proportion (p_x) | Noi $f^*p_x^*$ day: |
| Frequency of injecting/day f 2005 | days As sourced | An C Proportion (p_x) from the Vietn | Giang $f^*p_x^*$ days am Data Triang | Can Proportion (p_x) gulation Team | Tho f* p_x *days | Da f Proportion (p_x) | Nang f* p_{χ} *days | Hai F Proportion (p_x) | Phong f* p_x *days | Ha Proportion (p_x) | Noi $f^*p_x^*$ day |
| Frequency of injecting/day f 2005 0.15 | days As sourced 365 | An CProportion (p_x) from the Vietn0.175 | Giang $f^*p_x^*$ days am Data Triang 10 | Can Proportion (p_x) gulation Team 0.215 | Tho f*p _x *days | Da I Proportion (<i>p_x</i>) 0.774 | Nang f*p _x *days 42 | Hai F Proportion (p_x) 0.007 | Phong f*p _x *days | Ha Proportion (p_x) 0.018 | Noi f* p_x *day |
| Frequency of injecting/day f 2005 0.15 1 | days As sourced 365 365 | An GProportion (p_x) from the Vietn0.1750.406 | Giang f*p _x *days am Data Triang 10 148 | Can Proportion (p_x) gulation Team 0.215 0.279 | Tho f*p _x *days 12 102 | Da f Proportion (<i>p_x</i>) 0.774 0.142 | Nang f*p _x *days 42 52 | Hai F Proportion (<i>p_x</i>) 0.007 0.04 | Phong f*p _x *days 0 15 | Ha Proportion (<i>p_x</i>) 0.018 0.115 | Noi f*p _x *day 1 42 |
| Frequency of injecting/day f 2005 0.15 1 2.5 | days As sourced 365 365 365 | An G Proportion (p _x) from the Vietn 0.175 0.406 0.413 | Giang f*p _x *days am Data Triang 10 148 377 | Can Proportion (<i>p_x</i>) gulation Team 0.215 0.279 0.494 | Tho f*p _x *days 12 102 451 | Da I Proportion (<i>p_x</i>) 0.774 0.142 0.082 | Nang f*p _x *days 42 52 75 | Hai F Proportion (<i>p_x</i>) 0.007 0.04 0.824 | Phong f*p _x *days 0 15 752 | Ha Proportion (<i>p_x</i>) 0.018 0.115 0.746 | Noi f*p _x *day 1 42 681 |
| Frequency of injecting/day f 2005 0.15 1 2.5 5 | days As sourced 365 365 365 365 | An G Proportion (p _x) from the Vietn 0.175 0.406 0.413 0.007 | Fiang f*p _x *days am Data Triang 10 148 377 13 | Can Proportion (p_x) gulation Team 0.215 0.279 0.494 0.012 | Tho f*p _x *days 12 102 451 22 | Da 1 Proportion (<i>p_x</i>) 0.774 0.142 0.082 0.002 | Nang f*p _x *days 42 52 75 4 | Hai F Proportion (<i>p_x</i>) 0.007 0.04 0.824 0.13 | Phong f*p _x *days 0 15 752 237 | Ha Proportion (<i>p_x</i>) 0.018 0.115 0.746 0.118 | Noi f*p _x *day 1 42 681 215 |

| Frequency of | | | | | | | | | | | |
|------------------|--------------|--------------|---------------------|------------|---------------------|------------|----------------|------------|---------------------|------------|---------------------|
| injecting/day | | нс | МС | | | | | | | | |
| | | Proportion | | | | | | | | | |
| f | days | (p_x) | f* p_{χ} *days | | | | | | | | |
| | Baseline Su | urvey Report | (Table 24, | | | | | | | | |
| 2005 | page 58 [2 |]) | | | | | | | | | |
| 0.15 | 365 | 0.015 | 1 | | | | | | | | |
| 1 | 365 | 0.126 | 46 | | | | | | | | |
| 2.5 | 365 | 0.825 | 753 | | | | | | | | |
| 5 | 365 | 0.033 | 60 | | | | | | | | |
| Weighted average | | | 860 | | | | | | | | |
| | | 1 | | | | | | | | | |
| Frequency of | | | | | | | | | | | |
| injecting/day | | An G | Giang | Can | Tho | Da l | Nang | Hai P | hong | На | Noi |
| | | Proportion | | Proportion | | Proportion | | Proportion | | Proportion | |
| f | days | (p_x) | f* p_x *days | (p_x) | f* p_{χ} *days | (p_x) | f* p_x *days | (p_x) | f* p_{χ} *days | (p_x) | f* p_{χ} *days |
| 2009 | IBBS 2009, I | DU Questionn | aire Q204 | | | | | | 1 | | |
| 0.15 | 365 | 0.1639 | 9 | .0830 | 5 | 0.2715 | 15 | 0.0033 | 0 | 0.1067 | 6 |
| 1 | 365 | 0.2575 | 94 | 0.3032 | 111 | 0.4364 | 159 | 0.0367 | 13 | 0.3100 | 113 |
| 2.5 | 365 | 0.5719 | 522 | 0.5993 | 547 | 0.2749 | 251 | 0.8600 | 785 | 0.5300 | 484 |

| 0.0467 | 85 | 0.0467 | 183 | 0.1000 | 31 | 0.0172 | 26 | 0.0144 | 12 | 0.0067 | 365 | 5 |
|--------|-----|--------|-----|--------|-----|--------|------------------------|----------------------------|-------------------------|----------------------|-------------------|----------------------------|
| | 688 | | 981 | | 456 | | 688 | | 637 | | | Weighted average |
| | | | | | | | | | | | | |
| | | | | | | | Bien | Dien | мс | нсі | | Frequency of injecting/day |
| | | | | | | | | Proportion | | Proportion | | |
| | | | | | | | f* p_x *days | (p_x) | f* p_x *days | (p_x) | days | f |
| | | | | | | | | I | aire Q204 | DU Questionna | IBBS 2009, I | 2009 |
| | | | | | | | 3 | 0.0530 | 1 | 0.0097 | 365 | 0.15 |
| | | | | | | | 48 | 0.1325 | 34 | 0.0935 | 365 | 1 |
| | | | | | | | 695 | 0.7616 | 745 | 0.8161 | 365 | 2.5 |
| | | | | | | | 97 | 0.0530 | 147 | 0.0806 | 365 | 5 |
| | | | | | | | | | | | | Weighted |
| | | | | | | | 843 | | 926 | | | average |
| | | | | | | | | 1 | | | | |
| | | | | | | | | | | | | |
| | | | | | | | 48 695 97 843 | 0.1325 0.7616 0.0530 | 34 745 147 926 | 0.0935 0.8161 0.0806 | 365 365 365 | 12.55Weightedaverage |



i6: There are no data available for 2000. For 2002, the data for An Giang and Dien Bien is obtained from the percentage that shared a needle/syringe in the last month in the 2002 Baseline Survey Report (Table 24, page 58 [2]) which is 5.3% and 25.7%, respectively. The 2002 data for Can Tho (8%), Da Nang (21.6%), Hai Phong (23.4%), Ha Noi (13.7%), HCMC (20.6%) is obtained from the percentage that reused someone else's needle/syringe in the last month in the data provided by the Vietnamese Data Triangulation Team. For 2005, the percentage of receptive sharing of needle/syringe among IDUs in the last month for An Giang (28.7%), Can Tho (16.3%), Da Nang (24.9%), Hai Phong (6.3%), Ha Noi (7.2%), HCMC (35.4%) is obtained from the 2005-2006 IBBS (Table 11, page 50 [3]). For 2009, we assume condom usage: always = 100%, most of time = 67%, occasionally = 33% and never = 0%. The weighted average is calculated for each province in the following table. The data is from IBBS 2009, IDU Questionnaire, Q303 [28].

[†]For 2005, values used for Dien Bien are taken from an average across all other provinces.

The range is based on ± 25% the given value to account for uncertainty in the estimated sharing of needle and syringe.
| Needle/syringe Sharing | Assumed sharing rate percentage | An Giang | Can Tho | Da Nang | Hai Phong | Ha Noi | НСМС |
|---------------------------|---------------------------------------|----------|---------|---------|-----------|--------|--------|
| Always | 100% | 0.1522 | 0.0417 | 0.0000 | 0.0000 | 0.0147 | 0.0263 |
| Most of time | 67% | 0.2174 | 0.1458 | 0.1019 | 0.0000 | 0.0882 | 0.1184 |
| Occasionally | 33% | 0.4348 | 0.4583 | 0.6019 | 0.3182 | 0.3676 | 0.6184 |
| Never | 0% | 0.1957 | 0.3542 | 0.2963 | 0.6818 | 0.5294 | 0.2368 |
| | Weighted | 0.4421 | 0 2017 | 0.2000 | 0.1001 | 0.1000 | 0.2114 |
| | Average | 0.4421 | 0.2917 | 0.2686 | 0.1061 | 0.1960 | 0.3114 |



i7: There are no data available for rates of cleaning shared injecting equipment. We assume that the percentage of shared syringes that are cleaned is 1%, with a range of 0.1-10%.

i8: For 2000, the number of casual partners an IDU has per year is calculated from the 2000 BSS (Table 16, page 30 [1]), which gives the percentage of IDUs who have 0, 1, 2, and >=3 partners per year. We assume that >=3 partners per year is equivalent to 4 partners per year and the overall number of partners is given by the weighted average $0p_0 + p_1 + 2p_2 + 4p_3$ where p_x is the corresponding proportion. For 2002 and 2005, the number of regular, casual, and commercial (sex worker) partners an IDU has each year is calculated from the data obtained from the Vietnamese Data Triangulation Team (for 2002) and from the 2005-2006 IBBS survey (Table 12, page 50 [3]) which give the percentage of IDUs who have 0, 1 and >=2 partners per year. We assume that >=2 partners per year is equivalent to 3 partners per year and the overall number of partners is given by the weighted average $0p_0 + p_1 + 3p_2$ where p_x is the corresponding proportion. For An Giang and Dien Bien provinces for 2002, the data is estimated based on the percentage of IDUs who have 0, 1, 2, 3 and >=4 partners per year and the overall number of partners is given by the weighted average $0p_0 + p_1 + 2p_2 + 3p_3 + 5p_4$ where p_x is the corresponding proportion. For 2009, the number of partners is given by the weighted average $0p_0 + p_1 + 2p_2 + 3p_3 + 5p_4$ where p_x is the corresponding proportion. For 2009, the number of casual partners in the past 12 months is measured directly as one of the indicators in IBBS 2009, IDU Questionnaire, Q605c [28].

*For 2000, the values used for An Giang and Dien Bien are taken from an average across all other provinces.

‡For 2005, the values used for Dien Bien are taken from an average across all other provinces.

The range is assumed to be ± 25% of the given value to account for uncertainty in the estimated number of partners per year.

| 2000 BSS (Table 16, page 30 [1]) | | | | | |
|--------------------------------------------------------|---------|---------|-----------|--------|------|
| Number of casual sexual partners in the past 12 months | Can Tho | Da Nang | Hai Phong | Ha Noi | НСМС |

| | порогноп | n*p _x | Proportion | n^*p_x | Proportion | $n^* p_x$ | Proportion | n^*p_x | Proportion | n^*p_x |
|---------------------------------|--------------------------------|------------------|------------|------------------|------------|-----------|------------|------------------|------------|------------------|
| Ν | (p_x) | | (p_x) | | (p_x) | | (p_x) | | (p_x) | |
| 0 | 0.961 | 0 | 0.797 | 0 | 0.936 | 0 | 0.918 | 0 | 0.952 | 0 |
| 1 | 0.031 | 0.031 | 0.139 | 0.139 | 0.046 | 0.046 | 0.073 | 0.073 | 0.019 | 0.019 |
| 2 | 0.00 | 0.006 | 0.047 | 0.094 | 0.012 | 0.024 | 0.006 | 0.012 | 0.007 | 0.014 |
| 4 | 0.006 | 0.024 | 0.017 | 0.068 | 0.006 | 0.024 | 0.003 | 0.012 | 0.022 | 0.088 |
| Weighted average | | 0.06 | | 0.30 | | 0.09 | | 0.10 | | 0.12 |
| Number of casual sexual | Imber of casual sexual Can Tho | | | | Hai Pho | ong | Ha No | oi | НСМС | |
| 2002 data from the Vietnam Data | Triangulation | Team | | | | | | | | |
| partners in the past 12 months | | | | | | 0 | | | | - |
| N | Proportion | n*p _x | Proportion | n*p _x | Proportion | n^*p_x | Proportion | n*p _x | Proportion | n*p _x |
| | (p_x) | | (p_x) | | (p_x) | | (p_x) | | (p_x) | |
| 0 | 0.992 | 0 | 0.935 | 0 | 0.937 | 0 | 0.901 | 0 | 0.935 | 0 |
| 1 | 0.003 | 0.003 | 0.026 | 0.026 | 0.052 | 0.052 | 0.086 | 0.086 | 0.031 | 0.031 |
| 3 | 0.006 | 0.018 | 0.039 | 0.117 | 0.012 | 0.036 | 0.013 | 0.039 | 0.028 | 0.084 |
| Weighted average | | 0.02 | | 0.14 | | 0.09 | | 0.13 | | 0.12 |
| | | | | | | | | | | |
| | | | | | I | | | | | |

| Number of casual sexual partners in the past 12 | | | | | |
|-------------------------------------------------|------------|----------|------------|----------|--|
| months | An Gia | ang | Dien Bien | | |
| | Proportion | n^*p_x | Proportion | n^*p_x | |
| n | (p_x) | | (p_x) | | |
| 0 | 0.812 | 0 | 0.888 | 0 | |
| 1 | 0.119 | 0.119 | 0.064 | 0.064 | |
| 2 | 0.051 | 0.102 | 0.032 | 0.064 | |
| 3 | 0.014 | 0.042 | 0.008 | 0.024 | |
| 5 | 0.003 | 0.015 | 0.008 | 0.04 | |
| Weighted average | | 0.28 | | 0.19 | |

| 2005-2006 IBBS surv | :005-2006 IBBS survey (Table 12, page 50 [3]) | | | | | | | | | | | | | |
|-----------------------------------------------------------------|-----------------------------------------------|----------|--------|----------|--------|-----------|--------|----------|--------|----------|--------|----------|--|--|
| Number of casual sexual partners in the past 12 months | An G | ilang | Can | Tho | Da N | lang | Hai P | hong | Ha | Noi | HC | мс | | |
| n | Propor | n^*p_x | Propor | n^*p_x | Propor | $n^* p_x$ | Propor | n^*p_x | Propor | n^*p_x | Propor | n^*p_x | | |
| | tion | | tion | | tion | | tion | | tion | | tion | | | |





i9: For 2000, the number of regular partners an IDU has per year is calculated from the 2000 BSS (Table 16, page 30 [1]), which gives the percentage of IDUs who have 0, 1, 2, and >=3 partners per year. We assume that >=3 partners per year is equivalent to 4 partners per year and the overall number of partners is given by the weighted average $0p_0 + p_1 + 2p_2 + 4p_3$ where p_x is the corresponding proportion. For 2002 and 2005, the

number of regular partners an IDU has each year is calculated from the data obtained from the Vietnamese Data Triangulation Team (for 2002) and from the 2005-2006 IBBS survey (Table 12, page 50 [3]) which give the percentage of IDUs who have 0, 1, 2, 3 and >=4 partners per year. We assume that >=4 partners per year is equivalent to 5 partners per year and the overall number of partners is given by the weighted average $0p_0 + p_1 + 2p_2 + 3p_3 + 5p_4$ where p_x is the corresponding proportion. For An Giang and Dien Bien provinces for 2002, the data is estimated based on the percentage of IDUs currently married reported in the 2002 Baseline Survey Report (Table 23, page 57 [2]). For 2009, the number of regular sexual partners in the past 12 months is measured directly as one of the indicators in IBBS 2009, IDU Questionnaire, Q605a [28].

*For 2000, the values used for An Giang and Dien Bien are taken from an average across all other provinces.

‡For 2005, the values used for Dien Bien is taken from an average across all other provinces.

The range is assumed to be ± 25% of the given value to account for uncertainty in the estimated number of partners per year.

| Number of regular sexual partners in the past | Can 1 | Гho | Da Nang | | Hai F | Phong | Ha Noi | | HCMC | |
|-----------------------------------------------|-------------|----------|--------------|----------|--------------|------------------|--------------|------------------|---------------|----------|
| 12 months | | | | | | | | | | |
| | Proportio | n^*p_x | Proporti | n^*p_x | Proporti | n*p _x | Proporti | n*p _x | Proport | n^*p_x |
| n | n (p_x) | | on (p_x) | | on (p_x) | | on (p_x) | | ion (p_x) | l |
| 0 | 0.659 | 0 | 0.572 | 0 | 0.592 | 0 | 0.63 | 0 | 0.854 | 0 |
| 1 | 0.318 | 0.318 | 0.418 | 0.418 | 0.396 | 0.396 | 0.35 | 0.35 | 0.127 | 0.127 |
| 2 | 0.01 | 0.02 | 0.01 | 0.02 | 0.012 | 0.024 | 0.017 | 0.034 | 0.01 | 0.02 |
| 4 | 0.013 | 0.052 | 0 | 0 | 0 | 0 | 0.003 | 0.012 | 0.01 | 0.04 |

| Weighted average | | | 0.4 | | 0.4 | | 0.4 | 0. | 4 | 0.2 |
|---------------------------------------------------------|----------------------------------|------------------|------------|------------------|-------------|------------------|------------|------------------|------------|----------|
| 2002 data from the Vietnam Data | a Triangulation | Team | | | · · · · · · | | | • | | |
| Number of regular sexual partners in the past 12 months | Can T | ho | Da Na | ng | Hai Pho | ong | Ha N | oi | НСМ | с |
| N | Proportion | n*p _x | Proportion | n*p _x | Proportion | n*p _x | Proportion | n*p _x | Proportion | n^*p_x |
| | (<i>p</i> _{<i>x</i>}) | | (p_x) | | (p_x) | | (p_x) | | (p_x) | |
| 0 | 0.572 | 0 | 0.474 | 0 | 0.571 | 0 | 0.401 | 0 | 0.661 | 0 |
| 1 | 0.392 | 0.392 | 0.487 | 0.487 | 0.384 | 0.384 | 0.583 | 0.583 | 0.303 | 0.303 |
| 2 | 0.022 | 0.044 | 0.039 | 0.078 | 0.041 | 0.082 | 0.016 | 0.032 | 0.022 | 0.044 |
| 3 | 0.006 | 0.018 | 0 | 0 | 0 | 0 | 0 | 0 | 0.011 | 0.033 |
| 5 | 0.008 | 0.04 | 0 | 0 | 0 | 0 | 0 | 0 | 0.003 | 0.015 |
| Weighted average | | 0.5 | | 0.6 | | 0.5 | | 0.6 | | 0.4 |
| | | | | | | | | | | |
| 2005-2006 IBBS survey (Table 12 | page 50 [3]) | | | | | | | | | |
| Number of regular An Gia | ng C | an Tho | Da Nar | ng | Hai Phong | Ha | a Noi | нсмс | | |
| sexual partners in | | | | | | | | | | |
| the past 12 | | | | | | | | | | |
| months | | | | | | | | | | |

| n | Propor | n^*p_x |
|------------------|---------|----------|---------|----------|---------|----------|---------|----------|---------|----------|---------|----------|
| | tion | | tion | | tion | | tion | | tion | | tion | |
| | (p_x) | | (p_x) | | (p_x) | | (p_x) | | (p_x) | | (p_x) | |
| 0 | 0.467 | 0 | 0.606 | 0 | 0.467 | 0 | 0.724 | 0 | 0.403 | 0 | 0.549 | 0 |
| 1 | 0.4 | 0.4 | 0.134 | 0.134 | 0.447 | 0.447 | 0.249 | 0.249 | 0.547 | 0.547 | 0.376 | 0.376 |
| 2 | 0.087 | 0.174 | 0.159 | 0.318 | 0.062 | 0.124 | 0.023 | 0.046 | 0.039 | 0.078 | 0.031 | 0.062 |
| 3 | 0.03 | 0.09 | 0.064 | 0.192 | 0.018 | 0.054 | 0.003 | 0.009 | 0.004 | 0.012 | 0.015 | 0.045 |
| 5 | 0.017 | 0.085 | 0.037 | 0.185 | 0.003 | 0.015 | 0 | 0 | 0.004 | 0.02 | 0.027 | 0.135 |
| Weighted average | | 0.7 | | 0.8 | | 0.6 | | 0.3 | | 0.7 | | 0.6 |



i10: The number of commercial sex partners an IDU has each year is calculated from the 2000 BSS (Table 16, page 30 [1]), data obtained from the

Vietnamese Data Triangulation Team (for 2002) and from the 2005-2006 IBBS survey (Table 12, page 50 [3]), which gives the percentage of IDUs who have 0, 1, 2, 3 and >=4 partners per year. We assume that >=4 partners per year is equivalent to 5 partners per year and the overall number of partners is given by the weighted average $0p_0 + p_1 + 2p_2 + 3p_3 + 5p_4$ where p_x is the corresponding proportion. Data for An Giang and Dien Bien for 2002 is calculated from the 2002 Baseline Survey Report (Table 25, page 59 [2]). For 2009, the number of female commercial sexual workers an IDU has in the past 12 months is measured directly as one of the indicators in IBBS 2009, IDU Questionnaire, Q605b [28].

*For 2000, the values used for An Giang and Dien Bien are taken from an average across all other provinces.

‡For 2005, the values used for Dien Bien are taken from an average across all other provinces.

The range is assumed to be \pm 25% of the given value to account for uncertainty in the estimated number of partners per year.

| 2000 BSS (Tabl | e 16, page 30 [1]) | | | | | | | | | | |
|-----------------------------------------------------|--------------------|--------------------|------------------|---------------------------------|----------|--------------------|------------------|--------------------|----------|--------------------|----------|
| Number of commercial partners in the past 12 months | | Can | Can Tho | | ng | Hai Phong | | Ha Noi | | НСМС | |
| | n | Proportion (p_x) | n*p _x | Proportion (p _x) | n* p_x | Proportion (p_x) | n*p _x | Proportion (p_x) | n* p_x | Proportion (p_x) | n* p_x |
| | 0 | 0.943 | 0 | 0.797 | 0 | 0.849 | 0 | 0.769 | 0 | 0.919 | 0 |
| | 1 | 0.026 | 0.026 | 0.051 | 0.051 | 0.059 | 0.059 | 0.028 | 0.028 | 0.029 | 0.029 |
| | 2 | 0.023 | 0.046 | 0.058 | 0.116 | 0.025 | 0.05 | 0.017 | 0.034 | 0.025 | 0.05 |
| | 3 | 0.003 | 0.009 | 0.015 | 0.045 | 0.025 | 0.075 | 0.037 | 0.111 | 0.012 | 0.036 |

| 5 | 0.005 | 0.025 | 0.08 | 0.4 | 0.044 | 0.22 | 0.149 | 0.745 | 0.014 | 0.07 |
|---------------------------------|----------------|----------|------------|------------------|------------|------------------|------------|------------------|------------|------------------|
| Weighted average | | 0.11 | | 0.61 | | 0.40 | | 0.92 | | 0.19 |
| | | | 1 | <u> </u> | | 1 | | 1 | | |
| 2002 data from the Vietnam Dat | a Triangulatio | n Team | | | | | | | | |
| Number of commercial | Can | Tho | Da Na | ng | Hai Ph | ong | Ha N | oi | НСМ | с |
| partners in the past 12 months | | | | | | | | | | |
| n | Proportion | n^*p_x | Proportion | n*p _x |
| | (p_x) | | (p_x) | | (p_x) | | (p_x) | | (p_x) | |
| 0 | 0.886 | 0 | 0.581 | 0 | 0.513 | 0 | 0.391 | 0 | 0.828 | 0 |
| 1 | 0.047 | 0.047 | 0.062 | 0.062 | 0.114 | 0.114 | 0.063 | 0.063 | 0.054 | 0.054 |
| 2 | 0.033 | 0.066 | 0.138 | 0.276 | 0.198 | 0.396 | 0.139 | 0.278 | 0.04 | 0.08 |
| 3 | 0.006 | 0.018 | 0.052 | 0.156 | 0.108 | 0.324 | 0.098 | 0.294 | 0.04 | 0.12 |
| 5 | 0.028 | 0.14 | 0.167 | 0.835 | 0.067 | 0.335 | 0.309 | 1.545 | 0.04 | 0.2 |
| Weighted average | | 0.27 | | 1.33 | | 1.17 | | 2.18 | | 0.45 |
| | | | | | | | <u> </u> | | | <u> </u> |
| 2002 Receline Survey Penert /Te | ble 25 page 50 | 0 [2]) | | | |] | | | | |
| 2002 baseline Survey Report (Ta | nie zo, hage o | 9 [2]) | | | | | | | | |

| Number of commercial partners in the past 12 months | An Gi | ang | Dien B | ien |
|-----------------------------------------------------|------------|----------|------------|------------------|
| n | Proportion | n^*p_x | Proportion | n*p _x |
| | (p_x) | | (p_x) | |

| | 0 | | | (|).654 | 0 | 0.86 | 7 (| D | |
|----------------------------------------------|---------------------------|------------------|---------------------------|----------|---------------------------|------------------|---------------------------|----------|---------------------------|------------------|
| | 1 | | | (|).118 | 0.118 | 0.044 | 4 0.0 |)44 | |
| | 2 | | | (| 0.093 | 0.186 | 0.029 | 9 0.0 |)58 | |
| | 3 | | | (| 0.066 | 0.198 | 0.03 | 6 0.1 | 108 | |
| | 5 | | | (| 0.065 | 0.325 | 0.024 | 1 0. | 12 | |
| Weighted average | | | | | | 0.83 | | 0. | 33 | |
| 2005-2006 IBBS SURVEY | (Table 12 | nage 50 [2 | 31) | | | | | | | |
| Number of | An G | biang | Can | Tho | Da l | Nang | Hai P | hong | На | Noi |
| commercial partners in the past 12 months | | | | | | | | | | |
| n | Propor tion (p_x) | n*p _x | Propor tion (p_x) | n* p_x | Propor tion (p_x) | n*p _x | Propor tion (p_x) | n* p_x | Propor tion (p_x) | n*p _x |
| 0 | 0.57 | 0 | 0.713 | 0 | 0.651 | 0 | 0.86 | 0 | 0.795 | 0 |
| 1 | 0.094 | 0.094 | 0.121 | 0.121 | 0.091 | 0.091 | 0.053 | 0.053 | 0.044 | 0.044 |
| 2 | 0 1 0 4 | 0 200 | 0.075 | 0.15 | 0.072 | 0 1 4 4 | 0.017 | 0.024 | 0.000 | 0.164 |

| n | Propor | n^*p_x |
|------------------|---------|----------|---------|----------|---------|----------|---------|----------|---------|----------|---------|----------|
| | tion | | tion | | tion | | tion | | tion | | tion | |
| | (p_x) | | (p_x) | | (p_x) | | (p_x) | | (p_x) | | (p_x) | |
| 0 | 0.57 | 0 | 0.713 | 0 | 0.651 | 0 | 0.86 | 0 | 0.795 | 0 | 0.725 | 0 |
| 1 | 0.094 | 0.094 | 0.121 | 0.121 | 0.091 | 0.091 | 0.053 | 0.053 | 0.044 | 0.044 | 0.081 | 0.081 |
| 2 | 0.104 | 0.208 | 0.075 | 0.15 | 0.072 | 0.144 | 0.017 | 0.034 | 0.082 | 0.164 | 0.049 | 0.098 |
| 3 | 0.074 | 0.222 | 0.023 | 0.069 | 0.038 | 0.114 | 0.017 | 0.051 | 0.029 | 0.087 | 0.054 | 0.162 |
| 5 | 0.155 | 0.775 | 0.068 | 0.34 | 0.144 | 0.72 | 0.053 | 0.265 | 0.048 | 0.24 | 0.088 | 0.44 |
| Weighted average | | 1.30 | | 0.68 | | 1.07 | | 0.40 | | 0.54 | | 0.78 |

HCMC



i11, i12, & i13: The proportion of sexual acts where a condom has been used for 2000, 2002 and 2005 is given by the percentage of people who used a condom the last time they had sex with a regular, casual, and commercial sex worker partners in the 2000 BSS (Figure 7, page 32 [1]), data provided by the Vietnam Data Triangulation Team and in the 2005-2006 IBBS (Table 13, page 51 [3]). For An Giang and Dien Bien in 2002, the percentage condom use with regular partners is given by the condom use with wife/girlfriend in the last 12 months for IDUs: An Giang (14.3%) and Dien Bien (3%)from the 2002 Baseline Survey Report (Table 27, page 60 [2]). The percentage condom use in 2002 with casual partners and CSWs for IDUs in An Giang and Dien Bien is from the 2002 Baseline Survey Report (Table 26, page 60 [2]). The 2009 data is obtained from IBBS 2009, IDU Questionnaire, Q702, 802 and 902 [28]. Condom usage in Dien Bien is estimated as the average of other provinces. The range (+ 25%) is an assumption to account for uncertainty in the data.

*For 2000, the values used for regular partnerships for An Giang and Dien Bien are taken from an average across all other provinces.

⁺For 2002, the values used for Can Tho are taken from an average across all other provinces.

‡For 2005, the values used for Dien Bien are taken from an average across all other provinces.

§Unadjusted data.





i14, i15, i16: These are numbers of sexual acts between IDUs and regular partners, commercial sex workers and casual partners per year. The solely available 2009 data is obtained from IBBS 2009, IDU Questionnaire, Q701, 801 and 901 [28]. We assume the parameters stay constant during the studied years. The values used for Dien Bien are taken from an average across all other provinces.





i17: There are no data available on the percentage of IDUs who receive a test for HIV every year. However, data are available in the 2005-2006 IBBS report (Table 15, page 52 [3]) on the percentage of IDUs who have ever voluntarily tested for HIV. We use this value as an upper bound on the proportion tested each year. It is assumed that IDUs are more likely to be tested than the general population due to their relative level of risk. Thus, the testing rate for the general population is used as a lower bound.

h1: MSM who participated in the 2005-2006 IBBS included men 15 years or older, who had engaged in sex with men at least once in the previous 12 months and who would consent to the survey. There are no data available for MSM in An Giang, Can Tho, Da Nang, Dien Bien and Hai Phong. The 2005-2006 IBBS only surveyed MSM in Hanoi and HCMC. There was essentially the same number of MSM surveyed in Hanoi and HCMC during the 2005-2006 IBBS (397 and 393 respectively) (Table 2, page 8 [3]), so for the other provinces an average of the Hanoi and HCMC values is used.

h2: There is no direct estimate on the size of the MSM population in Viet Nam. Studies in Asia suggest that 1% to 3% of the male population 15 years or older has practiced same-sex behavior in the last year [8, 29]. Because Ha Noi and Ho Chi Minh City are the principal economic, social, and cultural centers in Viet Nam, the number of MSM in these provinces are thought to be much higher than in other provinces. For the low scenario, it was assumed that 1% of males that are 15 years or older in Ha Noi and Ho Chi Minh City are MSM. In other provinces, the corresponding assumed value is 0.5% [8, 29]. It has been suggested that the national prevalence of MSM will remain at 2% until 2012 [8].

* For the other provinces an average of the Hanoi and HCMC values is used.

The uncertainty range is assumed to be \pm 25% of these values.

h3: The value for male sexual partners (regular) per year is based on the proportion of MSM who reported they live with male partners from the 2005-2006 IBBS report (Table 34, page 66 [3]) with an assumed range of \pm 25% the given value to account for uncertainty in the estimated number of partners per year.

* For the other provinces an average of the Hanoi and HCMC values is used.

h4: The average number of casual male sexual partners that men who have sex with men have each year is calculated from the 2005-2006 IBBS report (Table 36 page 68 [3]) which gives the percentage of MSM who have 0, 1, 2, 3 and >=4 partners in the past month. It is assumed that >=4 partners per month is equivalent to 5 partners per month and the overall number of partners is given by the weighted average $(0p_0 + 1p_1 + 2p_2 + 3p_3 + 5p_4) * 12$ where p_x is the corresponding proportion. The range is an assumption, ± 25% the given value to account for uncertainty in the estimated number of partners per year.

* For the other provinces an average of the Hanoi and HCMC values is used.

The uncertainty range is assumed to be $\pm 25\%$ of these values.

| Number of male partners (casual) in the past month | | Ha No | i | нсмс | |
|-------------------------------------------------------|------------|----------------------|-------------|----------------------|----------------------------|
| n | months (m) | Proportion (p_x) | n* p_x *m | Proportion (p_x) | n* <i>p_x</i> *m |
| 0 | 12 | 0.359 | 0 | 0.5 | 0.00 |
| 1 | 12 | 0.202 | 2.424 | 0.291 | 3.49 |
| 2 | 12 | 0.207 | 4.968 | 0.246 | 5.90 |
| 3 | 12 | 0.091 | 3.276 | 0.132 | 4.75 |
| 5 | 12 | 0.139 | 8.34 | 0.324 | 19.44 |

| Weighted average | | 19.0 | 33.6 | |
|------------------|--|------|------|---|
| | | | | 1 |

h5: The average number of female sexual partners per year is based on the percentage of MSM who had sex with female partners in the previous year in Hanoi and HCMC as presented in the 2005-2006 IBBS report (Table 37, page 69 [3]), with an assumed range of \pm 25% the given value to account for uncertainty in the estimated number of partners per year.

* For the other provinces an average of the Hanoi and HCMC values is used. The uncertainty range is assumed to be ± 25% of these values.

h6: The value for condom use last act with other MSM is based on the proportion of MSM who reported using condom during last sex with male sex workers and consensual partners in the 2005-2006 IBBS report (Table 38, page 69 [3]). There is a large difference between these values: for Ha Noi (51.2% and 75.5%, respectively); for HCMC (48.5% (unadjusted) and 54.4%, respectively) so we have taken an intermediate value. For the other provinces an average of the Hanoi and HCMC values is used. For 2009, condom usage frequencies from Can Tho, HCMC, Ha Noi and Hai Phong are used to estimate the weighted frequency of condom usage among MSM in these four provinces, as in the following table. Condom usage in other provinces is estimated as an average of the data from these four provinces. The available data are obtained from IBBS 2009, MSM Questionnaire, Q302 [28]. The uncertainty range is assumed to be ± 25% of these values.

| | Percentage | Can Tho | Hai Phong | Ha Noi | НСМС |
|--------------|------------|---------|-----------|--------|--------|
| Always | 1.0000 | 0.3958 | 0.3185 | 0.5190 | 0.4497 |
| Most of time | 0.6667 | 0.2153 | 0.0514 | 0.1962 | 0.2275 |
| Occasionally | 0.3333 | 0.1458 | 0.3014 | 0.1709 | 0.2646 |



h7: The value for condom use last act with general females is based on the proportion of MSM who reported using a condom during last sex with consensual female partners in the last 12 months in the 2005-2006 IBBS report (Table 39, page 70 [3]) with an assumed range of ± 25% the given value to account for uncertainty. For 2005, only data of Hanoi and HCMC is available, and an average of the Hanoi and HCMC values is used for other provinces. For 2009, data from Can Tho, HCMC, Ha Noi and Hai Phong are available; values for other provinces are estimated as averages of these four provinces. The available data are obtained from IBBS 2009, MSM Questionnaire, Q231 [28]. The uncertainty range is assumed to be ± 25% of these values.



h8: Bisexual behavioral of MSM is important for understanding HIV transmission routes. This set of data indicates the percentage of MSM who have had sexual relationships with females in the past 12 months. The data are obtained from IBBS 2009, MSM Questionnaire, Q229 [28].

h9: There are no data available on the percentage of MSM who receive a test for HIV every year. However, there are data on the percentage of MSM who have ever voluntarily tested for HIV in the 2005-2006 IBBS report (Table 42, page 71 [3]). We use this value as an upper bound on the proportion tested each year. It is assumed that MSM are more likely to be tested than the general population due to their at risk behavior. Thus the testing rate for the male general population is used as a lower bound. We have chosen a value of 5% slightly above this lower bound for our initial testing rate, this value may change during the modeling calibration process.

f1: As with general males there are little data on the sexual behavior of females in the general population (numbers of partners and condom use). Unless otherwise specified we have assumed that females in the general population have the same sexual behavior in each province on average. This behavior is based on data in the Vietnam Population and AIDS Indicator Survey conducted in 2005 [4].

f2: The proportion of the population that is a general female is given by 49.8% (as obtained from http://www.nationmaster.com/country/vm-vietnam) minus the percentage of females that are IDUs, SSWs, and KSWs.

f3 & f4: From the Vietnam Population and AIDS Indicator Survey (VPAIS) conducted in 2005 [4] there appears to be very little pre-marital sex, with 1.4% of women who have never been married having had sex (Table 6.1.1, page 53 from the VPAIS report [4]) and 0% of women not previously married reporting more than one sexual partner in the past (Table 6.2.1, page 56 from the VPAIS report [4]). The overall female population surveyed in the VPAIS was 7,289 (VPAIS 2005, Table 6.1.1. page 53 [4]). Of these, 4,721 were women who had sexual intercourse in the past 12 months (VPAIS 2005, Table 6.2.1. page 56 [4]). It is reported that 0.4% of 4,721 women who had sexual intercourse in the past 12 months had higher risk sex (VPAIS 2005, Table 6.2.1. page 56 [4]). Thus, for the overall female population, 0.3% of women surveyed had higher risk sex (defined to be sex with a non-marital or non-cohabitating partner) which equals 0.4% of 4721/7289 where 7289 is the total number of women surveyed.

The overall mean number of sexual partners women have in their lifetime is 1.0 (Table 6.2.1, page 56 of the VPAIS report [4]). While ~65% of women (Table 3.1, page 24 of the VPAIS report [4]) are married, we assume that women in the general female population have 1 regular partner per year (their husband, cohabiting partner, or boyfriend). We assume there are very few casual partners per year, reflecting the small percentage of women who have multiple partners each year (0% according to the VPAIS report; Table 6.2.1, page 56 [4]). The value 0.025 is used such that females have an average of 1 casual partner in total over a 40 year period of sexual activity. The uncertainty range is an assumed to be + 25%.

f5: The average number of sexual acts per regular partner per year is equal to 87 as reported in Global Sex Survey 2005 [26], with an assumed

uncertainty range of + 25%.

f6: See m8 above.

k1: In the 2000 BSS [1], karaoke-based sex workers (KSWs) were defined as women who work in a variety of establishments such as karaoke-bars, restaurants, hotels, massage parlors, truck stops who also sell sex to customers, considered to be indirect sex workers.

In the 2002 Baseline Survey Report [2] KSWs were defined to be commercial sex workers who meet male clients at entertainment places such as karaoke bars or cafes. Their income comes primarily from working as waitresses or drink and food sellers; sex work is their second source of income. Before participating in this study, karaoke commercial sex workers were carefully selected: only hospitality workers who are commercial sex workers on the side were invited to participate in this survey.

The 2005-2006 IBBS [3] recruited commercial sex workers based on the following criteria: women who were 18 years or older, who reported having sex for money at least once in the month prior to the survey, and were working on the street (as SSWs) or in establishments such as karaoke bars or massage venues (as KSWs). In some provinces, even though sex workers were identified at some establishments, based on the characteristics and nature of their workplaces, they were considered street-based sex workers. For example, in Hai Phong some sex workers who were working at in-house places were considered street-based since they moved in from the streets to avoid 'social evils' campaigns.

k2: In Vietnam, it is generally perceived that the number of SSWs is much greater than the number of KSWs. This is consistent throughout all provinces although the exact ratio may vary. Currently there is no sufficient data enabling a reasonable estimate of the ratio, but communication with Dr. Huang, from Pasteur Institute of Ho Chi Minh City, indicates that an approximation of the KSW:SSW ratio is 0.35:0.65. This means the proportion of sex workers that are KSWs is 35%. To account for any uncertainty we assume a range of approximately + 25% of this value.

k3: Estimates of the total number of female sex workers (and lower and upper bounds) were provided by the Vietnam HIV/AIDS Estimates and Projections 2007-2012 [8]. The number of KSWs is estimated by multiplying 35% to the number of FSWs (see k2).

k4: There are no available data for 2000. In the 2002 Baseline Survey Report (Table 14, page 47 [9]) the duration that KSWs sell sex is stratified into <1, 1-2, 3-4, and >= 5 year spans. To calculate the average duration we assume >= 5 years corresponds to 6 years and take a weighted average given by $0.5p_1 + 1.5p_2 + 3.5p_3 + 6p_4$ where the corresponding proportion is p_x . The values for the proportions are taken from the 2002 Baseline Survey Report (Table 14, page 47 [2]). For 2005 the average duration of selling sex in KSWs is as reported in the 2005-2006 IBBS (Table 26, page 60 [3]). For 2009, the average number of years of selling sex is directly measured by the IBBS 2009 KSW Questionnaire, Q203 [28].

*For 2002, the average between An Giang and Dien Bien is taken for all other provinces.

⁺The 2005 and 2009 values used for Dien Bien are the averages across all other provinces. The uncertainty range for both 2002 and 2005 data given is an assumed ± 25% of the given value.

| 2002 Baseline Survey Rep | port (Table 14, page | 47 [2]) | | |
|------------------------------------|------------------------------|------------------|------------------------------|------------------|
| Duration of selling sex (years) | An Giang | | Dien Bie | n |
| d | Proportion (p _x) | d*p _x | Proportion (p _x) | d*p _x |
| <1 = 0.5 | 0.139 | 0.1 | 0.224 | 0.1 |
| 1-2 = 1.5 | 0.609 | 0.9 | 0.51 | 0.8 |
| 3-4 = 3.5 | 0.192 | 0.7 | 0.204 | 0.7 |
| <u>≥</u> 5 = 6 | 0.06 | 0.4 | 0.061 | 0.4 |

| Weighted average | 2.0 | 2.0 | |
|------------------|-----|-----|--|
| | | | |

k5: The number of one-time clients per year for KSWs is calculated from the 2000 BSS (Table 9, page 22 [1]), 2002 Baseline Survey report (Table 16, page 50 [2]) and from the 2005-2006 IBBS (Table 27, page 61 [3]). It is assumed that KSWs and SSWs engaged in sex work about 40 weeks each year and inactive during the remaining 12 weeks. This assumption is based on a discussion between the NCHECR/UNSW modeling team and the Vietnam team during their first meeting in Vietnam in October 2009. Casual clients are assumed to be one-time clients. For 2009, monthly number of one-time clients of KSW is given by IBBS 2009, KSW Questionnaire Q403.1 [28], this number is multiplied by 12 to give the estimated number of one-time clients of KSW per year.

For 2000 and 2002 data, there is no report for the 'number of clients in the past month' which has been used for the calculation of annual estimate in other provinces. Thus the number of partners per week (n) was multiplied by the assumed weeks engaged in sex (w) 40 to get the yearly estimate.

For 2005, the number of one-time clients per year and regular clients per year for KSWs is calculated from the 2005-2006 IBBS (Table 27, page 61 [3]). The number of partners per month (n) was multiplied by assumed months engaged in sex work (m) 9.23 to obtain the annual estimate.

*For 2000, the values used for An Giang and Dien Bien are taken from an average across all other provinces.

⁺For 2002, a weighted average between An Giang and Dien Bien is taken from across all other provinces.

‡For 2005 and 2009, the values used for Dien Bien are taken from an average across all other provinces.

An uncertainty range of \pm 25% of the given value is assumed.

2000 BSS (Table 9, page 22 [1])- one-time clients

| 0 | ged in se | x work | | Can Tho | | Da Na | ang | Hai | Phong | | Ha Noi | | H | CMC |
|------------------------------------------------------------------------------|--------------------------------|------------------------------------|------------------------|-----------------|------------|-------------|-------------|-------|-------|------------|--------|-----|---|-----|
| W | , | | n | n | ı*w | n | n*w | n | n*w | n | | n*w | n | n* |
| 40 |) | | 0.6 | 5 | 24 | 1.5 | 60 | 19.2 | 768 | 2. | 6 | 104 | 4 | 16 |
| | | | | | | | | | | | | | | |
| 2002 Baseline Survey | report (T | able 16, p | age 50 [2] |) – one-tir | ne clients | | |] | | | | | | |
| Assumed weeks enga | ged in se | x work | | An Giang | | Dien I | Bien | | | | | | | |
| w | | | n | n | *w | n | n*w | - | | | | | | |
| | | | | | | | | - | | | | | | |
| 40 |) | | 3.5 | 1 | 40 | 1.3 | 52 | | | | | | | |
| 40 |) | | 3.5 | 1 | 40 | 1.3 | 52 | | | | | | | |
| 40 2005 -2006 IBBS (Table | e 27, page | e 61 [3]) – | 3.5 one-time | clients | .40 | 1.3 | 52 | | | | | | | |
| 40 2005-2006 IBBS (Table Assumed months | e 27, page An (| e 61 [3]) – Giang | 3.5 one-time Can | clients Tho | 240 | 1.3 | 52 | Phong | На | Noi | Н | CMC | | |
| 40 2005-2006 IBBS (Table Assumed months engaged in sex | e 27, page An (| e 61 [3]) – Giang | 3.5 one-time Can | clients Tho | _40 | 1.3 | 52 | Phong | На | Noi | Н | СМС | | |
| 40 2005-2006 IBBS (Table Assumed months engaged in sex work | e 27, page An (| e 61 [3]) – Giang | 3.5 one-time Can | clients Tho | _40 | 1.3 | 52 | Phong | На | Noi | Н | CMC | | |
| 40 2005-2006 IBBS (Table Assumed months engaged in sex work m | e 27, page An (n | e 61 [3]) – Giang n*m | 3.5 one-time Can | clients Tho n*m | _40 Da | 1.3 Nang | 52 Hai P | Phong | Ha | Noi n*m | n Ho | CMC | | |



k6: The number of regular clients per year for KSWs is calculated from the 2000 BSS (Table 9, page 22 [1]), 2002 Baseline Survey report (Table 16, page 50 [2]) and from the 2005-2006 IBBS (Table 27, page 61 [3]). It is assumed that KSWs and SSWs engaged in sex work about 40 weeks each year and inactive during the remaining 12 weeks. This assumption is based on a stakeholder discussions/expert opinion. Casual clients are assumed to be one-time clients.

For 2000 and 2002 data, there is no report for the "number of clients in the past month" which has been used for the calculation of annual estimate in other provinces. Thus the number of partners per week (n) was multiplied by the assumed weeks engaged in sex (w) 40 to get the yearly estimate.

For 2005, the number of one-time clients per year and regular clients per year for KSWs is calculated from the 2005-2006 IBBS (Table 27 page 61 [3]). The number of partners per month (n) was multiplied by assumed months engaged in sex work (m) 9.23 to obtain the annual estimate. For 2009, monthly number of regular clients of KSW is given by IBBS 2009, KSW Questionnaire Q403.2 [28], this number is multiplied by 12 to give the

estimated number of regular clients of KSW per year.

*For 2000, the values used for An Giang and Dien Bien are taken from an average across all other provinces.

[†]For 2002, a weighted average between An Giang and Dien Bien is taken across all other provinces.

‡For 2005 and 2009, the values used for Dien Bien are taken from an average across all other provinces.

An uncertainty range of \pm 25% of the given value is assumed.

2000 BSS (Table 9, page 22 [1]) – average number of regular clients per year

| Assumed weeks engage in sex work | Can | Tho | Da l | Nang | Hai P | Phong | На | Noi | нс | MC |
|----------------------------------|-----|-----|------|------|-------|-------|-----|-----|-----|-----|
| w | n | n*w | N | n*w | n | n*w | n | n*w | n | n*w |
| 40 | 0.7 | 28 | 0.4 | 16 | 3.2 | 128 | 2.4 | 96 | 3.5 | 140 |

| 2002 Baseline Survey report (Table 16, pa | ge 50 [2]) – aver | age number of | f regular client | s per year |
|--------------------------------------------------|-------------------|---------------|------------------|------------|
| Assumed weeks engage in sex work | An G | iang | Dien | Bien |
| w | n | n*w | n | n*w |
| 40 | 2.3 | 92 | 0.4 | 16 |

| 2005-2006 IBBS (Ta | ole 27, page 61 [3]) – | average number of | regular clients per y | ear | | |
|--------------------|------------------------|-------------------|-----------------------|-----------|--------|------|
| Assumed months | An Giang | Can Tho | Da Nang | Hai Phong | Ha Noi | НСМС |
| engage in sex work | | | | | | |



k7: The average number of non-commercial casual sexual partners per year for 2005 is based on the average number of non-commercial sex partners in the past month reported in the 2005-2006 IBBS (Table 27, page 61 [3]). It is assumed that KSWs engage in sex work about 40 weeks (~9 months) each year and inactive during the remaining 12 weeks. Thus, the number of non-commercial casual sexual partners per month (n) is multiplied by assumed months engaged in sex work (m) 9.23 to obtain the annual estimate as below.

*There are no available data for Dien Bien in 2005. Thus, an average (5.4) of the other 7 provinces is used for Dien Bien. There are also no available data for 2000 and 2002. The uncertainty range is assumed to be ± 25% of the given value.



k8: The average number of non-commercial regular sexual partners per year for all provinces is based on the proportion of KSWs who reported they were currently married in the 2000 BSS report (Table 3, page 14 [1]), 2002 Baseline Survey Report (Table 14, page 47 [2]) and 2005-2006 IBBS

(Table 26, page 60 [3]), with an assumed range of \pm 25% the given value to account for uncertainty in the data. For 2009, monthly number of regular male partners (boyfriends/husband) of KSW is given by IBBS 2009, KSW Questionnaire Q403.3 [28], this number is assumed to be identical to the number of regular male partners of KSW per year.

*For 2000, the values used for An Giang and Dien Bien are taken from an average across all other provinces.

⁺For 2002, an average between An Giang and Dien Bien is taken from across all other provinces.

‡For 2005 and 2009, the values used for Dien Bien are taken from an average across all other provinces. The uncertainty ranges are assumed to be ± 25% of the given value.



k9: The average number of sexual acts per regular client per year is equal to 12 corresponding to one visit per month. The number of times a regular client visits a sex worker is highly uncertain as there is no available data. To take this high uncertainty into account we assume a range from 6-24 representing a visit frequency of 2 months to once every two weeks.

k10: The average number of sexual acts per regular partner per year for the general male and female populations is taken to be 87, as reported in the Global Sex Survey 2005 [26]. For 2009, the monthly number of sexual acts a KSW has with regular male partners (boyfriends/husband) is taken to be the data obtained from the IBBS 2009, KSW Questionnaire Q701 [28]; this number is multiplied by 12 to give the number of regular sexual acts per year. The Dien Bien data is estimated as the average of other provinces in 2009.

This value has an assumed uncertainty range of + 25%.

k11 & k12: The proportions of condom use per act with one-time/casual clients and regular clients during last sex (or most recent sex) among KSWs are taken from the 2000 BSS report (Figure 2, page 25 [1]), 2002 Baseline Survey Report(Table 7, page 23 and Table 17, page 50 [2]) and 2005-2006 IBBS (Table 28, page 62 [3]). The reported condom use with both one-time/casual clients and regular clients during last sex was high, which may have affected due to social desirability bias. For 2009, the percentage of condom usage of a KSW with a one-time client/regular client in the last sexual act is measured by IBBS 2009, KSW Questionnaire Q504 [28]. The ranges for these parameters are assumed to be ± 25% of the given value to account for uncertainty in the data.

*The original 2005 percentage condom use per act among KSWs with one-time/casual clients during last sex for Da Nang reported is 100%. Because this appears to be unrealistically high, we have used the data for "consistent condom use with one-time clients in the past month", which is 90.63%.

*For 2000, the values used for An Giang and Dien Bien are taken from an average across all other provinces.

⁺For 2002, an average between An Giang and Dien Bien is taken for data from across all other provinces.





k13: For 2000, the proportion of condom use per act with non-commercial casual partners during last sex among KSWs is based on condom use at last sex with non-paying partner reported in 2000 BSS (Figure 2, page 25 [1]). There is no available data for 2002. For 2005, this data is based on condom use with non-commercial sex partner during last sex among KSWs reported in the 2005-2006 IBBS (Table 28, page 62 [3]). The uncertainty range for this value is assumed to be \pm 25% of the given value.

*For 2000, the values used for An Giang and Dien Bien are taken from an average across all other provinces.

‡For 2005, the value used for Dien Bien is taken from an average across all other provinces.



k14: The percentage of acts in which condoms are used with non-commercial regular partners is based on reported data of condom use in the most recent sex with husband/boyfriends among KSWs in An Giang and Dien Bien (Lai Chau); reported in the 2002 Baseline Survey Report (Table 7, page 23 and Table 17, page 50 [2]). There was 0% reported for Dien Bien. However, we assume that per-act condom use with non-commercial regular partners is 3% in Dien Bien. There is no available data for 2000 and 2005 and in other provinces. A weighted average (50%) between An Giang and Dien Bien has been used for all other provinces for 2002, where n= sample size and p=proportion condom use in most recent sex with husband/boyfriends among KSWs. For 2009, the percentage of acts in which condoms are used between KSW and a regular male partner (boyfriend/husband) is taken to be the reported measure of condom use at the last sexual act by IBBS 2009, KSW Questionnaire Q702 [28]. Dien Bien data in 2009 is estimated as the average of other provinces. The uncertainty range for this value is assumed to be ± 25% of the given value.

| 2002 Baseline Survey Report (Table 7, page 23 and Table 1 | .7, page 50 [2]) | | |
|-----------------------------------------------------------|------------------|----------------|-----|
| Condom use in most recent sex with | n | Proportion (p) | n*p |

| husband/boyfriends | | | |
|----------------------------------------|-----|-------|-------|
| An Giang | 331 | 0.544 | 180.1 |
| Dien Bien | 34 | 0.03 | 1.0 |
| Total | 365 | | 181.1 |
| Weighted average - total n*p / total n | | | 0.496 |



k15: The percentage of KSWs who inject drugs in 2000 is based on data reporting injection of drugs in the past six months reported in the 2000 BSS (Table 8, page 21 [1]), and is available for only Ha Noi and HCMC.

*An average (5%) between these two provinces has been used for other provinces.
For 2002, these data are based on ever injected drugs reported in the 2002 Baseline Survey Report (Table 15, page 48 [2]); 0% for Dien Bien. †It is assumed that the percentage of KSWs who inject drugs for 2002 in other provinces is the same as for An Giang, which is 3%.

For 2005, the data are based on KSWs who reported ever injected drugs in the 2005-2006 IBBS (Table 30, page 63 [3]).

‡The 2005 value used for Dien Bien is an average of all other provinces, which is 4.7%. The range for this value is assumed to be ± 25% the given value to account for uncertainty in the data.

k16: There are no data available on the percentage of KSWs who get tested every year. However, there are data on the percentage of KSWs who have ever voluntarily tested for HIV in the 2005-2006 IBBS report (Table 31, page 64 [3]). We use this value as an upper bound on the proportion tested each year. It is assumed that KSWs are more likely to be tested than the general population due to their at risk behavior. Thus, the testing rate for the general population is used as a lower bound.

* For Dien Bien, the upper bound for the uncertainty range is assumed to be 25%.

s1: In the 2000 BSS report [1], street-based sex workers (SSWs) are defined as women who sell directly on the streets actively soliciting clients outside or with the help of a pimp. Sex work is their primary source of income. According to the 2002 Baseline Survey Report [2] SSWs are classified as those who do not work at entertainment establishments but meet male clients in alleys, football stadiums, bus stations, in low-price guesthouses, or outside of bars. Sex work is their primary source of income. See k1 above for the definition of SSWs in the 2005-2006 IBBS [3].

s2: Estimates of the total number of female sex workers (and lower and upper bounds) were provided by the Vietnam HIV/AIDS Estimates and Projections 2007-2012 [8]. The number of SSWs is estimated by multiplying 65% to the number of FSWs (see k2).

s3: There are no available data for 2000. In the 2002 Baseline Survey Report (Table 14, page 47 [2]) the duration that SSWs sell sex is stratified into <1, 1-2, 3-4, and >= 5 year spans. To calculate the average duration we assume >= 5 years corresponds to six years and take a weighted average given by $0.5p_1 + 1.5p_2 + 3.5p_3 + 6p_4$ where the corresponding proportion is p_x . The values for the proportions are taken from the 2002 Baseline Survey Report (Table 14, page 47 [2]). For 2009, the average number of years of selling sex is directly measured by the IBBS 2009 SSW Questionnaire, Q203 [28].

*For 2002, the average between An Giang and Dien Bien is taken for all other provinces.

For 2005, the average duration of selling sex in SSWs is as reported in the 2005-2006 IBBS (Table 18, page 54 [3]).

[†]The 2005 and 2009 values used for Dien Bien are taken to be the average across all other provinces.

The uncertainty range for both 2002 and 2005 data given is assumed to be \pm 25% of the given value.

| 2002 Baseline Survey Report (Table 14, page 47 [2]) | | | | | | | | |
|------------------------------------------------------------|------------------------------|------------------|------------------------------|------------------|--|--|--|--|
| Duration of selling sex | An Giang | | Dien Bie | n | | | | |
| (years) | | | | | | | | |
| d | Proportion (p _x) | d*p _x | Proportion (p _x) | d*p _x | | | | |
| <1 = 0.5 | 0.09 | 0.05 | 0.019 | 0.0 | | | | |
| 1-2 = 1.5 | 0.433 | 0.6 | 0.611 | 0.9 | | | | |
| 3-4 = 3.5 | 0.206 | 0.7 | 0.259 | 0.9 | | | | |
| <u>≥</u> 5 = 6 | 0.271 | 1.6 | 0.111 | 0.7 | | | | |
| Weighted average | | 3.0 | | 2.5 | | | | |

s4: The average number of one-time clients per year for SSWs is calculated from the 2000 BSS (Table 11, page 24 [1]), 2002 Baseline Survey report

(Table 16, page 50 [2]), data obtained from the Vietnam Data Triangulation Team, and from the 2005-2006 IBBS (Table 19, page 55 [3]). It is assumed that SSWs engaged in sex work about 40 weeks each year and inactive during the remaining 12 weeks. This assumption is based on a discussion between the NCHECR/UNSW modeling team and the Vietnam team during their first meeting in Vietnam in October 2009. Casual clients are assumed to be one-time clients.

In the 2000 BSS [1] and 2002 Baseline Survey Report [2], there is no report for the "number of clients in the past month" which has been used for the calculation of annual estimate in other provinces. Thus the number of partners per week (n) was multiplied by the assumed weeks engaged in sex work (w) (equal to 40) to get the yearly estimate. For 2009, the monthly number of one-time clients of SSW is given by IBBS 2009, SSW Questionnaire Q403.1 [28], this number is multiplied by 12 to give the estimated number of one-time clients of SSW per year.

*2000 data for An Giang and Dien Bien is not available. Thus, the average across other provinces is taken.

For 2002 and 2005, the number of partners per month (n) is multiplied by an assumed number of months engaged in sex work per year (m) (equal to 9.23) to obtain the annual estimate.

†2002 data for Dien Bien is not available. Thus, the average across other provinces is taken.

\$Similarly, 2005 and 2009 values used for Dien Bien are obtained from the average of all other provinces.

An uncertainty range of \pm 25% of the given value is assumed.

| 2000 BSS (Table 11, page 24 [1]) – average number of one-time clients per year | | | | | | | | | | |
|--------------------------------------------------------------------------------|---------|-----|------|------|-------|------|-----|-----|------|-----|
| Assumed weeks engaged in sex work | Can Tho | | Da l | Nang | Hai P | hong | На | Noi | HCMC | |
| W | n | n*w | n | n*w | n | n*w | n | n*w | n | n*w |
| 40 | 12.9 | 516 | 6.7 | 268 | 15.1 | 604 | 7.7 | 308 | 9.5 | 380 |

| Assumed weeks enga | ged in se | x work | | An Giar | ng | | Dien Bie | n | | | | | | |
|-----------------------------------------------------------|--------------------|----------------------|------------------|------------------------|----------------|---------------------------|-----------------|--------------|-------|------------|--------|-----|-------|-----|
| W | | | n n | ۱ | n*w | n | | n*w | | | | | | |
| 40 |) | | 4 | 2 | 168 | 3. | 1 | 124 | | | | | | |
| 202 Vietnem Dete Tri | iangulati | n Toom | | umbor of | ono timo | | | |] | | | | | |
| Assumed weeks enga | ged in se | x work | | Can Tho | | Da Na | ang | Hai | Phong | | Ha Noi | | HC | мс |
| m | 1 | | n | n | *w | n | n*w | n | n*w | n | r | ו*w | n | n*v |
| 40 |) | | 23.0 |)2 9 | 21 | 11.13 | 445 | 142.8 | 5712 | 18. | 2 | 728 | 46.02 | 184 |
| 2005-2006 IBBS (Table Assumed months engaged in sex | e 19, page An G | 2 55 [3]) – Diang | average n Can | umber of Tho n*m | one-time Da | clients pe Nang n*m | r year Hai F | Phong n*m | Ha | Noi n*m | HC | CMC | | |
| m | n | n.m | | | | | | | 1 | 1 | | | | |



s5: The number of regular clients per year for SSWs is calculated from the 2000 BSS (Table 11, page 24 [1]), 2002 Baseline Survey report (Table 16, page 50 [2]), data obtained from the Vietnam Data Triangulation Team and from the 2005-2006 IBBS (Table 19, page 55 [3]). It is assumed that SSWs engaged in sex work about 40 weeks each year and inactive during the remaining 12 weeks. This assumption is based on a discussion between the NCHECR/UNSW modeling team and the Vietnam team during their first meeting in Vietnam in October 2009. Casual clients are assumed to be one-time clients.

In the 2000 BSS [1] and 2002 Baseline Survey Report [2], there is no report for the "number of clients in the past month" which has been used for the calculation of annual estimate in other provinces. Thus the number of partners per week (n) was multiplied by the assumed weeks engaged in sex work (w) (equal to 40) to get the yearly estimate. For 2009, the monthly number of regular clients of SSW is measured by IBBS 2009, SSW Questionnaire Q403.2 [28], this number is multiplied by 12 to provide an estimated number of regular clients of SSW per year and to be consistent with the estimates in previous years.

*2000 data for An Giang and Dien Bien is not available. Thus, the average across other provinces is taken.

For 2002 and 2005, the number of partners per month (n) is multiplied by assumed months engaged in sex work (m) (equal to 9.23) to obtain the annual estimate.

†2002 data for Dien Bien is not available. Thus, the average across other provinces is taken.

\$Similarly, 2005 values used for Dien Bien are obtained from the average of all other provinces.

An uncertainty range of \pm 25% of the given value is assumed.

2000 BSS (Table 11, page 24 [1]) – average number of regular clients per year

| Assumed weeks engaged in sex work | Can Tho | | Da N | Nang | Hai F | Phong | На | Noi | НСМС | |
|-----------------------------------|---------|-----|------|------|-------|-------|-----|-----|------|-----|
| W | n | n*w | n | n*w | n | n*w | n | n*w | n | n*w |
| 40 | 2.2 | 88 | 1.6 | 64 | 2.1 | 84 | 2.1 | 84 | 5.8 | 232 |

| 2002 Baseline Survey report (Table 16, page 50 [2]) – average number of regular clients per year | | | | | | | | |
|---------------------------------------------------------------------------------------------------------|------|-------|-----------|-----|--|--|--|--|
| Assumed weeks engaged in sex work | An G | iiang | Dien Bien | | | | | |
| w | n | n*w | n | n*w | | | | |
| 40 | 1.8 | 72 | 0.6 | 24 | | | | |

| 2002 Vietnam Data Triangulation Team – average number of regular clients per year | | | | | | | | | |
|------------------------------------------------------------------------------------------|---------|---------|-----------|--------|------|--|--|--|--|
| Assumed weeks engaged in sex work | Can Tho | Da Nang | Hai Phong | Ha Noi | НСМС | | | | |

| r | ו | | n | n | *w | n | n*w | n | n*w | n | r | ו*w | n | n*w |
|-----------------------------------------|-------------------|----------------------|-----------|------------------|------------------|---------------------|---------------|-------|------|-----|------|-----|------|-----|
| 40 |) | | 8.2 | 4 | 76 | 5.86 | 54 | 4.89 | 45 | 2. | 3 | 21 | 7.82 | 72 |
| 2005-2006 IBBS (Table Assumed months | e 19, pag An (| e 55 [3]) – Giang | average r | number of Tho | regular cl Da | ients per y Nang | year Hai f | Phong | На | Noi | НС | СМС | | |
| engaged in sex work | | | | | | | | | | | | | | |
| m | n | n*m | n | n*m | n | n*m | n | n*m | n | n*m | n | n*m | _ | |
| 9.23 | 10.04 | 93 | 7.17 | 66 | 4.19 | 39 | 4.45 | 41 | 4.94 | 46 | 4.89 | 45 | | |



s6: The average number of non-commercial casual sexual partners per year for 2002 and 2005 is based on the average number of non-commercial sex partners in the past month reported in the Vietnam Data Triangulation Team and in the 2005-2006 IBBS (Table 19, page 55 [3]). As in s4 & s5 it is assumed that SSWs engaged in sex work about 40 weeks (~9 months) each year and are inactive during the remaining 12 weeks. Thus the number of non-commercial casual sexual partners per month (n) is multiplied by assumed months they are engaged in sex work (m) (equal to 9.23) to obtain the annual estimates below. There is no available data for An Giang and Dien Bien in 2002. Thus, an average (2.7) across other provinces is taken for these provinces. The 2000 data for Hai Phong gives the mean number of non-commercial sex partners in the past month as 4.89 which seems too high and is exactly the same as the mean number of regular clients in the past month. We assume that this could be an input error and have used the average value across other provinces of 2.7 instead. For 2005, the average across the other 7 provinces (equal to 5.2) is used for Dien Bien. There are no available data for 2000 for any province. The uncertainty range is assumed to be ± 25% of the given value.

| 2002 Vietnam Data Triangulation Team – average number of non-commercial casual sexual partners per year | | | | | | | | | | | | |
|----------------------------------------------------------------------------------------------------------------|----------|-----|---------|-----|---------|-----|-----------|-----|--------|-----|------|-----|
| Assumed months engaged in sex work | An Giang | | Can Tho | | Da Nang | | Hai Phong | | Ha Noi | | НСМС | |
| m | n | n*m | n | n*m | n | n*m | n | n*m | n | n*m | n | n*m |
| 9.23 | | | 0.45 | 4.2 | 0.59 | 5.5 | | | 0.44 | 4.1 | 0.53 | 4.9 |

| 2005-2006 IBBS (Table 19, page 55 [3]) – average number of non-commercial casual sexual partners per year | | | | | | | | | | | | |
|-----------------------------------------------------------------------------------------------------------|------|-------|-----|-----|------|------|-------|------|----|-----|-----|-----|
| Assumed months engaged in sex work | An (| Giang | Can | Tho | Da N | Nang | Hai P | hong | На | Noi | HCI | ИС |
| m | n | n*m | n | n*m | n | n*m | n | n*m | n | n*m | n | n*m |



s7: The average number of non-commercial regular sexual partners per year for all provinces is based on the proportion of SSWs who reported they were currently married in the 2000 BSS report (Table 4, page 15 [1]), 2002 Baseline Survey Report (Table 14, page 47 [2]) and 2005-2006 IBBS (Table 18, page 54 [3]), with an assumed range of ± 25% of the given value to account for uncertainty in the data. For 2009, monthly number of regular male partners (boyfriends/husband) of SSW is given by IBBS 2009, SSW Questionnaire Q403.3 [28], this number is assumed to be identical to the number of regular male partners of SSW per year.

*For 2000, the values used for An Giang and Dien Bien are taken from an average across all other provinces.

⁺For 2002, a weighted average between An Giang and Dien Bien is taken for all other provinces. For 2005 and 2009 the data for Dien Bien is taken from an average across all other provinces.



s8: As with KSWs, the assumed average number of sexual acts per regular client per year is 12 corresponding to one visit per month. The number of times a regular client visits a sex worker is highly uncertain as there are no available data. To take this high uncertainty into account we assume a range from 6-24 representing a visit frequency of 2 months to once every two weeks on average.

s9: The average number of sexual acts per regular partner per year for the general male and female populations is taken to be 87, as reported in the Global Sex Survey 2005 [26]. This value has an assumed uncertainty range of + 25%. For 2009, the monthly number of regular male partners (boyfriends/husband) of SSW is taken from data collected by IBBS 2009, SSW Questionnaire Q403.3 [28]; this number is assumed to be identical to the number of regular male partners of SSW per year.

s10 & s11: The proportions of condom use per act with one-time/casual clients and regular clients during last sex (or most recent sex) among SSWs are taken from the 2000 BSS report (Figure 4, page 27 [1]), 2002 Baseline Survey Report (Table 6, page 22 and Table 17, page 50 [2]), a table of behavioral surveillance data provided by the Vietnamese Data Triangulation Team, and 2005-2006 IBBS (Table 20, page 56 [3]). The reported condom use with both one-time/casual clients and regular clients during last sex was high, which may have affected due to social desirability bias. For 2009, the percentage of acts in which condoms are used between SSWs and one-time clients or regular clients is based on data of condom use at the last sexual act (IBBS 2009, SSW Questionnaire Q504 [28]).

*For 2000, the values used for An Giang and Dien Bien are taken from an average across all other provinces.

 \pm For 2005 and 2009, the values used for Dien Bien are taken from an average across all other provinces. The uncertainty ranges for these parameters are assumed to be \pm 25% of the given value.





s12: For 2000, the probability of condom use per act with non-commercial casual partners during last sex among SSWs is based on condom use at last sex with non-paying partner reported in 2000 BSS (Figure 4, page 27 [1]). The data for 2002 is derived from a table of behavioral surveillance data provided by the Vietnamese Data Triangulation Team. For 2005, this data is based on condom use with non-commercial sex partner during last sex among SSWs reported in the 2005-2006 IBBS (Table 20, page 56 [3]).

*For 2000, the values used for An Giang and Dien Bien are taken from an average across all other provinces.

⁺For 2002, the values used for An Giang are taken from an average across all other provinces. For 2005, the values used for Dien Bien are taken from an average across all other provinces. The uncertainty range for these values is assumed to be ± 25% of the given value.



s13: The percentage of acts in which condoms are used between SSWs and non-commercial regular partners is based on condom use at most recent sex with husband/boyfriends; this is reported for An Giang and Dien Bien (Lai Chau) in the 2002 Baseline Survey Report (Table 6, page 22 and Table 17, page 50 [2]). There are no available data for 2000 and 2005 and in other provinces. A weighted average (47%) between An Giang and Dien Bien has been taken for all other provinces for 2002, where n= sample size and p=proportion condom use in most recent sex with husband/boyfriends among SSWs. For 2009, the percentage of acts in which condoms are used between SSWs and regular male partners (boyfriend/husband) is taken as the values reported on condom use at the last sexual act (IBBS 2009, SSW Questionnaire Q702 [28]). Dien Bien values used in 2009 are estimated as the average across other provinces. The uncertainty range for these values is assumed to be ± 25% of the given value.

2002 Baseline Survey Report (Table 6, page 22 and Table 17, page 50 [2])

| | Condom use | e in mos | st recent | sex | with | | | |
|----------------------------------------------------|----------------|-----------------|-----------------------------|-----|------|----------|----------------|--------|
| | husband/boyfri | ends | | | | n | Proportion (p) | n*p |
| | An Giang | | | | | 383 | 0.486 | 186.1 |
| | Dien Bien | | | | | 37 | 0.25 | 9.3 |
| | Total | | | | | 420 | | 195.4 |
| | Weighted avera | age - total n*p | / total n | | | | | 0.47 |
| | L | | | | I | | I | 1 |
| | An Giang | | Can Tho | | | Da Nai | ng | Dien I |
| 100% ed | | 100% | | | 100% | | T 100' | Ж. |
| ₩ ₩ 10 10 10 10 10 10 10 10 10 10 10 10 10 1 | | 75% | | | 75% | | 75 | Ж.: |
| 5 0 | T | 500 | 1. The second second second | 30 | FOR | T | 1 | |



s14: For 2005, the reported value is based on ever injected drugs in the 2005-2006 IBBS (Table 22 page 57 [3]). The number for 2002 is based on the percentage of commercial sex workers who have ever injected drugs in the 2002 Baseline Survey Report (Table 15, page 48 [2]). The percentage of SSWs who injects drugs for 2000 is based on injecting drugs in the past six months reported in the 2000 BSS (Table 10, page 23 [1]),

and is available for only Ha Noi and HCMC.

*An average (18.6%) between these two provinces has been used for other provinces.

For 2002, this data is based on ever injected drugs reported in the 2002 Baseline Survey Report (Table 15, page 48 [2]).

For 2005, the data is based on SSWs who reported ever injected drugs in the 2005-2006 IBBS (Table 30, page 63 [3]).

‡The 2005 data for Dien Bien is an average of all other provinces, which is 10.9%.

The uncertainty ranges for these values are assumed to be \pm 25% of the given value.

s15: There are no data available on the percentage of SSWs who receive a test for HIV every year. However, there are data on the percentage of SSWs who have ever voluntarily tested for HIV in the 2005-2006 IBBS report (Table 23, page 58 [3]). We use this value as an upper bound on the proportion tested each year. It is assumed that SSWs are more likely to be tested than the general population due to their at risk behavior. Thus the testing rate for the general population is used as a lower bound.

* For Dien Bien the upper bound for the uncertainty range is assumed to be 25%.

hr1: Intervention data for the total number of condoms distributed and total number of syringes distributed in each province were collated as the sum over multiple sites hosted by the World Bank, US CDC and Family Health International. Available data cover the years 2006-2009.

Evaluation of harm reduction programs on HIV in Vietnam Table of province-independent parameters used in the VHM

| References | Values | Parameter description |
|--------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| | | Biological transmission parameters |
| [30-34] | 0.0002-0.015 | Transmission probability per unprotected act of receptive penile- vaginal sex (male-to-female) |
| [30-34] | Min: 0.0002 Max: M-to-F level | Transmission probability per unprotected act of insertive penile- vaginal sex (female-to-male) |
| [35] | 0.001-0.015 | Average transmission probability per unprotected act of penile-anal sex (male-to-male) |
| [36-43] | 0.004 - 0.009 | Transmission probability per injection with a contaminated syringe |
| [44-48] | 85-95% | Efficacy of condoms in preventing HIV transmission |
| [49-50] | 70-80% | Efficacy of syringe cleaning in preventing HIV transmission |
| | HIV di | sease progression and clinical parameters |
| [51] | 8-14 years | Average time for disease to progress through chronic stage to late/AIDS stage disease in the absence of antiretroviral therapy |
| [52] | 3-6% per year | Rate of treatment failure for those on antiretroviral therapy |
| Experimental | 2-2.8% per year | Background rate of leaving sexually mixing population |
| [53-57] | 1-2% per year | Death rate for untreated people in chronic stage of HIV infection |
| [58-60] | 30-75% per year | Death rate for untreated people in late/AIDS stage of HIV infection |
| [60] | 1-10% per year | Death rate for people on antiretroviral therapy |
| | | Other parameters |
| [61-62] | 2 | Average number of people who share injecting equipment per sharing event |
| Experimental variable | 0.5-2.5% | Average proportion of distributed units of injecting equipment that are not used (i.e. wasted) |