Background Report: Cost-effectiveness of Injecting Drug User Interventions to prevent HIV in Nepal

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Title: Cost-effectiveness of Injecting Drug User interventions to prevent HIV in Kathmandu, Nepal

Background: At this point in time, the HIV epidemic in Nepal is still concentrated among high-risk groups, including injecting drug users (IDUs). Nepal has approximately 20,000 IDUs, with at least 5,000 living in the capital, Kathmandu. HIV prevalence among IDUs in Kathmandu is extremely high. In 2003 – the reference year of this analysis – that rate was 68%.

Objectives: This paper has two objectives. The first is to examine the robustness of two different epidemiological models; these models were used to determine the impact of IDU interventions in Nepal when interventions are scaled-up to reach 60% of IDUs, as recommended by UNAIDS. The second objective is to disseminate the outcome of two cost-effectiveness analyses of IDU interventions in Nepal. These analyses used identical data sets to determine the cost-effectiveness ratios under various scenarios of intervention coverage.

Methodology: The Rapid Costing Approach (RCA) was used to generate total costs, as well as unit costs, over five years, under different scaling-up assumptions. Prices from 2003 were employed as a constant. Sentinel and behavioural surveys of the most at-risk populations undertaken in 2003 provided information on behaviour change among the IDU population in Kathmandu. The data was input into a dynamic mathematical model known as IDU 2.4. The Asian Epidemic Model (AEM) was used as an alternative effectiveness model by changing key parameters of behavioural input for IDUs. The same data sets were used for both models. The cost information is based on a cost analysis carried out in 2002, including financial and economic costs from the perspective of the provider.

Results: The results were striking and provided strong support for aggressively scaling-up interventions. Both models showed that 60% coverage will prevent more HIV infections in a single year than 20% coverage will prevent over ten years. Unit costs of IDU interventions were in the range of US$ 62–88 per IDU per year. The range took into account variations in capacity utilisation of 70–100%. The IDU 2.4 model showed cost-effectiveness ratios in the range of US$ 64–47 per HIV infection averted over five years. The range reflected different levels of intervention (20–60% coverage) and a discount rate, or the rate of HIV infections averted, of 3%. The most important variable identified in the cost-effectiveness analysis was needle-sharing behaviour.

Discussion: The discussion focused on three main issues: 1) the validity of the cost and epidemiological/behavioural data; 2) the applicability of the models for planning purposes; and 3) the robustness of the models to generate measures of effectiveness.

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Background Report:
Cost-effectiveness of Injecting Drug User Interventions to prevent HIV in Nepal

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Foreword and Acknowledgements

This paper is an outcome of collaboration between the Asian Development Bank (ADB) and UNAIDS to promote the use of economic analysis in support of evidence-informed policy to prevent the spread of HIV in Asia and the Pacific. The paper is one of two cost-effectiveness analyses on IDU interventions developed under the ADB HIV-AIDS evidence-based advocacy agenda. The other covers IDU interventions in Karachi, Pakistan (Alban et al, 2007a - unpublished). The information generated from both is supplemented by a literature survey on cost studies, effectiveness studies, and cost-effectiveness studies of IDU interventions in Asia and the Pacific, which forms part of the Review of IDU Interventions to prevent HIV in Asia (Alban et al, 2007b- unpublished).

This collective work on costs and cost-effectiveness of IDU interventions was first presented at the ICAAP in Colombo, August 2007.

The authors wish to thank the ADB and the UNAIDS Regional Office, Bangkok for support and encouragement to finalise this work. Special thanks go to ADB Practice Leader, Health, Jacques Jeugmans, and to UNAIDS Regional Programme Advisor, Swarup Sarkar. Invaluable and continuous support came from ADB Advisor Ian Anderson, who followed the work closely and offered comments and advice as the report progressed.

Background

The HIV situation in Nepal is categorised as a concentrated epidemic. This is because the HIV prevalence estimate for the general population is below 1%, but is as high as 53% nationwide among some groups identified as most at-risk, for example, IDUs. The first cases of AIDS were reported in Nepal in 1988. The epidemic that emerged has largely been the result of transmission through injecting drug use and unprotected sexual contact (UNGASS, 2006). Among the approximately 20,000 IDUs in Nepal, HIV prevalence varies by location. The highest prevalence rates are located in the Kathmandu Valley, which is the focus of this analysis. The first needle exchange programme in a developing country was established in Kathmandu in 1991. However, in 2003 – the reference year for this study – HIV prevalence among IDUs in Kathmandu had reached 68%. And in 2005, HIV prevalence among IDUs in Kathmandu was estimated at 70% (Open Society, 2006). The number of IDUs in Kathmandu is between 5–6,000, according to national estimates (HMG of Nepal National Centre for AIDS and STD Control, 2004), though one NGO – The Centre for Harm Reduction – estimates at least three times that number (Burrows, 2001). In our calculations, we have used the lowest estimate of 5,000 IDUs.

As many as 95% of IDUs in Nepal are male. They live in social and economic isolation with no system to provide appropriate assistance, including access to clean needles and syringes. As a consequence, national and international NGOs substitute the social systems that governments and other institutions in poor countries are unable to provide. The latest UNGASS report for

Nepal (2006) estimated that harm reduction interventions aimed at all IDUs were reaching only 8.4% of the target group. However, in 2005 harm reduction interventions reached 2,000 of the 5,000 IDUs in Kathmandu (UNGASS, 2006). As the reference year for our analysis is 2003, we estimate that 1,000, or 20% of the total IDU population in Kathmandu, were covered with harm reduction interventions at that point in time. Interventions included needle and syringe exchange programmes, condom provision and the distribution of risk-reduction information.

Nepal is among the poorest countries in the world. It ranks number 138 of 177 in the Human Development Index and has a GDP per capita of US$ 1,970 (International US$/Purchasing Power Parity US$). Financing the response against HIV and AIDS in Nepal has come though partnerships with bi-lateral donors and NGOs. The challenges facing the Government of Nepal in scaling-up prevention and treatment interventions are huge. A crucial element for success will be knowing the cost implications of different scale-up scenarios and information on ”best buys”.

This cost-effectiveness analysis of IDU interventions in Kathmandu is part of the background material being produced for the AIDS Commission in Asia and disseminated through ADB and UNAIDS. The analysis serves as a background document for the review of HIV interventions for IDUs in Asia targeted at decision-makers within the region (Alban *et al*, 2007b – in press).

It uses one original data set from a costing carried out in 2002, and epidemiological and behavioural data from a range of sources entered into two different models in order to estimate intervention impact under various scenarios.

Nepal has been selected as a case study for two reasons. Firstly, it has good quality cost data information that is easily converted into 2003 prices, and behavioural surveillance data from 2003. Secondly, Nepal was one of four countries in the region where an alpha version of the Asian Effectiveness Model (AEM) (Brown and Peerapatanapokin 2004, Brown T 2005) was available at the time of the analysis (June/July 2007) The availability of the AEM and the HIVTools model for IDU interventions allowed for a comparison of two separate effectiveness models to estimate intervention impact. A similar study has been conducted with data from Pakistan (Alban *et al,* 2007a – in press).

Objectives of the Study

1) To examine the robustness of two different epidemiological models to determine the impact of IDU interventions in Nepal when scaling-up intervention coverage to 60% as recommended by UNAIDS (this work is ongoing);
2) To disseminate the outcome of cost-effectiveness analyses of IDU interventions in Kathmandu, Nepal, by using data sets to determine the cost-effectiveness ratios under various scenarios of intervention coverage; and
3) To discuss the use of the information generated by the cost-effectiveness analysis.

Methodology

The analysis is based on secondary data only. Cost estimates were based on the Rapid Costing Approach (RCA) using data from a cost analysis of IDU interventions in Kathmandu carried out in 2002 (Alban & Hahn, 2002). The estimation of costs uses the ingredients approach as recommended by UNAIDS Costing Guidelines (UNAIDS, 2000). The RCA is used as the tool (spreadsheet model) for generating costs and calculating the cost-effectiveness ratios in a systematic manner. We chose only to estimate the costs of the provider(s) since the perspective of the analysis is to inform the process of scaling-up HIV interventions. By choosing the provider perspective we excluded the cost of the client to access services and the opportunity costs of the IDUs' and former IDUs' training to become peer educators, such as their time spent on training and their transport expenses. Other costs forgone by the analysis include possible costs to dependents and relatives. Ideally, these costs should be included, but no evidence was available about them.

To estimate the impact of IDU interventions we used HIVTools, IDU Version 2.4 (Watts, Vickerman & Chibisa, 2006) provided by the London School of Hygiene and Tropical Medicine. The model uses HIV infections averted as an outcome measure. This tool was employed for two particular reasons: the model has been used in the other three available cost-effectiveness analyses of IDU interventions to prevent HIV in Bangladesh (Guinness *et al,* 2006), Belarus (Kumaranayake *et al,* 2004), and Ukraine (Vickerman *et al*, 2006); and it was made available.

We used a scenario design based on no intervention and achieving three levels of coverage of interventions: actual level (20%), 30%, and 60% coverage of IDU services to prevent HIV. We limit ourselves from including cost savings associated with treatment for HIV averted, and cost savings associated with averted productivity losses because no reliable information was available.

Cost data

The Nepal costing covers a comprehensive range of HIV services provided in 2002, using RCA (Alban & Hahn, 2002) developed for this purpose. The approach builds on the Costing Guidelines developed by UNAIDS (2000). It includes the costs of producing a specific service, in this case the provision of harm reduction services for IDUs in Kathmandu. The findings and approach used in Nepal are described in the Costing Guidelines for the Asia/Pacific region (UNAIDS & ADB 2004).

The RCA assists in developing unit costs for relevant HIV interventions in a national context. Unit costs are optimal for planning purposes, including scaling-up. The measure for unit cost of IDU interventions is: costs per IDU intervention per year.

The overall costing principle in the RCA approach is incremental cost[1]. An incremental cost analysis includes only the costs of adding or implementing extra services to existing services; for example, the cost of scaling-up from one coverage level to another. When appropriate a full 'economic cost' approach was used. Economic cost includes known financial costs and expenditures incurred such as wages for personnel, and commodities such as needles, syringes and condoms. However, the economic cost approach also takes into account the fact that while volunteers and donated goods, such as computers, may not have a direct financial cost to the organisation concerned, they still involve the use of resources – labour and equipment in this case – that could have been used productively elsewhere. The economic cost approach captures a wider and more accurate picture of all resources used. The perspective of the costing is that of 'the provider' (public and private healthcare, Ministry of Justice; NGOs). Only the costs of providers such as government and NGOs are considered. Expenses incurred by clients, such as transport, user fees and time spent on training, were excluded. The RCA approach uses local data including available budgeting, accounting material, and local prices (made available from various programmes as appropriate).

[1] For more on full and incremental costs, refer to Chapter 2.3 in UNAIDS Costing Guidelines (UNAIDS 2000).

We estimated the coverage of IDU interventions in Kathmandu at 20% in 2003. We wanted to analyse the outcome – measured in HIV infections averted – by scaling-up IDU interventions to 30% and 60% coverage. The assumption was that over time the utilisation of capacity will improve from an estimated 70% to 100% when coverage reaches 60%. All results are presented in 2003 prices. Benefits over time (HIV infections averted) are discounted to 2003 level.

Estimation of effectiveness

Two models were used to determine the effectiveness of IDU interventions: HIVTools, IDU 2.4[2] and the Asian Epidemic Model (AEM[3]) applied to the Nepali context[4].

The effectiveness analysis based on HIVTools was carried out using a deterministic epidemiological model, IDU 2.4, to estimate the impact of the intervention on HIV transmission among IDUs and their sexual partners. IDU 2.4 requires a range of epidemiological, behavioural, demographic and intervention-specific input to model patterns of HIV transmission with and without the intervention. On this basis, the model can estimate the number of averted HIV infections that may be ascribed to the intervention.

The required epidemiological data were gathered from various sources. The key documents were behavioural surveys compiled by *Family Health International,* which has a large presence in the field of HIV/AIDS prevention in Nepal. Also, publications from the Ministry of Health served as sources of data (DHS, National Estimates), as did NGO reports of IDU interventions (Centre for Harm Reduction, Peak 1995). Where specific data from Nepal was unavailable, data from neighbouring countries such as India, Bangladesh and Pakistan or model default values were used as appropriate (Azim et al, Alban et al 2007b Williams etal 2006). The majority of input data were available from Nepali sources, though they did not in all cases relate specifically to IDUs in the Kathmandu Valley. Behavioural data mainly stemmed from the years 2001–2003.

A baseline set of input parameter estimates was selected. Due to the vagueness of several estimates, we conducted an uncertainty analysis by varying, in turn, each parameter estimate while keeping all other inputs constant. Each input estimate was altered according to alternative values from literature sources. The impact on the number of averted HIV infections after ten years of intervention was then determined.

Tim Brown at the East West Center provided the AEM for Nepal, and the use of the model was discussed during a meeting organised by UNAIDS in June 2007. The AEM was primarily not developed for conducting cost-effectiveness analyses of IDU interventions. However, the model comprises highly relevant parameters that can be changed in 'before' and 'after' scenarios, to determine the HIV infections averted over a given time span. The estimates entered in before and after scenarios are given in Appendix 2.

The AEM includes several specific parameters of IDU behaviour. We modified three:

- Percentage of IDUs sharing needles (92% before; 35% after intervention)
- Percentage of all injections shared by those in the sharing group (24.7% before; 16.5% after)
- The average duration of injecting drug use (8.3 years in both before and after scenarios)

[2] For more on this model, please see Foss *et al,* 2006.
[3] For more on this model, please see Brown and Peerapatanapokin, 2004.
[4] Data requirements and input for these two models are in Appendices 1 and 2 respectively.

Modification of the default values was performed in order to align AEM input with that used in the HIVTools model on these three key parameters. For example, *the percentage of IDUs sharing* (AEM) was calculated as the sum of *the proportion of IDUs with low and high levels of needle sharing* (HIVTools) before and after the intervention. *The percentage of all injections shared* (AEM) was calculated as described in Appendix 2, and *the duration of injecting drug use* (AEM) was calculated by taking the inverse of the *proportion of IDUs injecting less than one year* (HIVTools). Furthermore, the total number of IDUs in Nepal was changed from 22,700 (the default figure in 2003) to 3,000 (60% coverage of IDU population in Kathmandu in 2003).

Results of cost analysis

Cost estimates are based on experiences sustained by an NGO operating in Kathmandu that provides a mix of outreach services by trained peer educators, and drop-in-centres. The services included needle exchange, condom distribution, STI service referrals to public primary healthcare facilities, and information, education and communication (IEC) services. The services provided included a significant amount of training of peer educators (approximately 3.5% of total costs) and substantial resources were utilised for supervision of peer educators (14%). However, the major cost components were needles and syringes, which consumed more than one third of total costs. Drop-in centre and outreach service staff were assigned in a ratio of 1:5 to outreach services. Programme management was 15% of the total cost of US$ 61,800, or Nepali Rupees 4.8million (2003 prices). The result was a unit cost of US$ 88 or NRps 6,900 at 70% capacity, and US$ 62 or NRps 4,800 at full capacity.

Table 1. Costs of IDU intervention programme per year at 100% and 70% capacity, Nepal (2003 prices)

Unit cost per year, 100% capacity			
Cost component	**US$**	**NRps**	**%**
Behaviour Change			
Peer Educators (incl. Training)	8,740	681,732	14
Outreach/DIC	2,018	157,373	3
Outreach Worker/SV	10,495	818,582	17
IEC/Events	1,049	81,850	2
Commodities & Services			
Syringes/Needles	21,865	1,705,467	35
Condoms	3,744	292,032	6
PHC	235	18,333	0
Enabling Environment	1,049	81,850	2
Programme Management	9,418	734,623	15
Investments	269.4	21,010	0
M+E (5%)	2,931	228,596	5
TOTAL	**61,813**	4,821,448	100
UNIT	**62**		

Unit cost per year, 70% capacity			
Cost component	**US$**	**NRps**	**%**
Behaviour Change			
Peer Educators (incl. Training)	8,740	681,732	14
Outreach/DIC	2,018	157,373	3
Outreach Worker/SV	10,495	818,582	17
IEC/Events	1,049	81,850	2
Commodities & Services			
Syringes/Needles	21,865	1,705,467	35
Condoms	3,744	292,032	6
PHC	226	17,628	0
Enabling Environment	1,049	81,850	2
Programme Management	9,418	734,623	15
Investments	269.4	21,010	0
M+E (5%)	2,931	228,596	5
TOTAL	**61,804**	4,820,743	100
UNIT	**88**		

Source: Calculations based on Alban & Hahn, 2002

The unit costs were assumed to decrease over time when the programme managed to increase utilisation of capacity (from 70% to 100% over five years).

The costs of needles and syringes cannot be overlooked. They consume 35% of all resources. Spending on syringes and needles was US$ 21,800 (Rps 1.7million) per year at a coverage level of 20%. This assumes an average of 1,000 IDUs reached on daily basis. The unit cost for each syringe or needle was NRps 3 or US$ 0.04 in 2003 prices. On average each IDU utilised 2 pieces per day plus 20% being wasted.

Effectiveness results

To determine the effect of scaling-up, the HIVTools model was run under the assumption of an initial HIV prevalence among IDUs of 68%, and ten-year intervention coverage of 20%, 30% and 60%. Intervention effectiveness was measured in terms of averted HIV infections among IDUs and their sexual partners.

The impact of the different levels of coverage was striking: an intervention covering only 20% of IDUs averts fewer HIV infections in ten years than an intervention covering 60% does in a single year.

The difference in HIV infections averted after ten years is roughly proportionate to the change in coverage. In other words, it increases by a factor of three going from 20% to 60% coverage.

Of an initial baseline of 5,000 IDUs and a stable in-migration of 12% per year into the IDU population, 6,075 HIV infections among IDUs and their sexual partners could be averted after a nine-year intervention with coverage of 60%. This corresponds to a 17% point difference in HIV prevalence among IDUs with (68%) and without (85%) the intervention (Box 1).

Box 1. Kathmandu, IDUs, HIV prevalence at different levels of intervention coverage

Years of intervention	No intervention	20% coverage	30% coverage	60% coverage
1	86%	84%	83%	81%
3	88%	85%	83%	80%
5	87%	83%	81%	76%
7	86%	81%	79%	72%
9	85%	79%	76%	68%

From a baseline value of 68%, and without intervention, HIV prevalence increases steeply during the first year to 86%. With intervention covering 60% of IDUs, that figure becomes 81%. Prevalence continues to rise over the next two to three years, albeit more slowly, before a gradual decline commences. It is only with intervention coverage of 60% after ten years that HIV prevalence after is brought below the initial baseline value. The differences in effectiveness for different levels of coverage are illustrated in Figure 1 (prevalence) and Figure 2 (HIV averted).

Figure 1. HIV prevalence among IDUs over ten years – different coverage scenarios

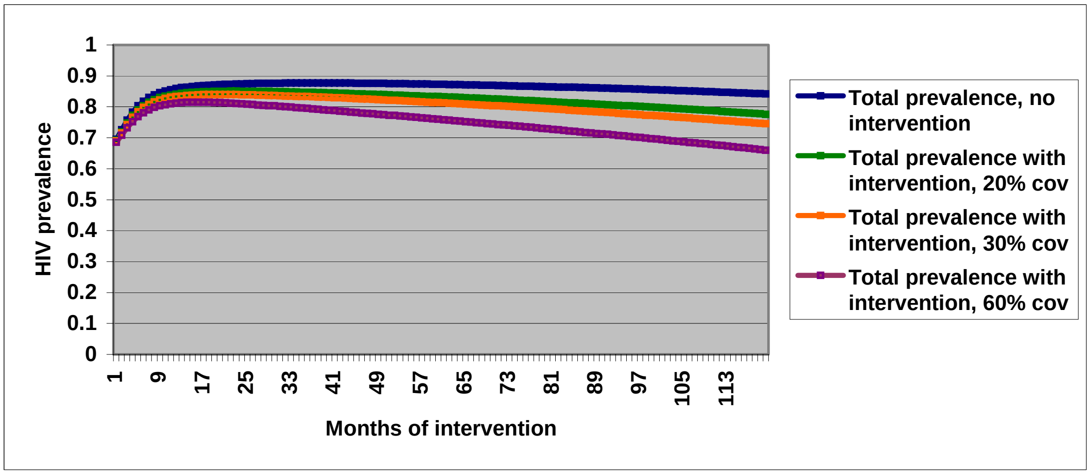
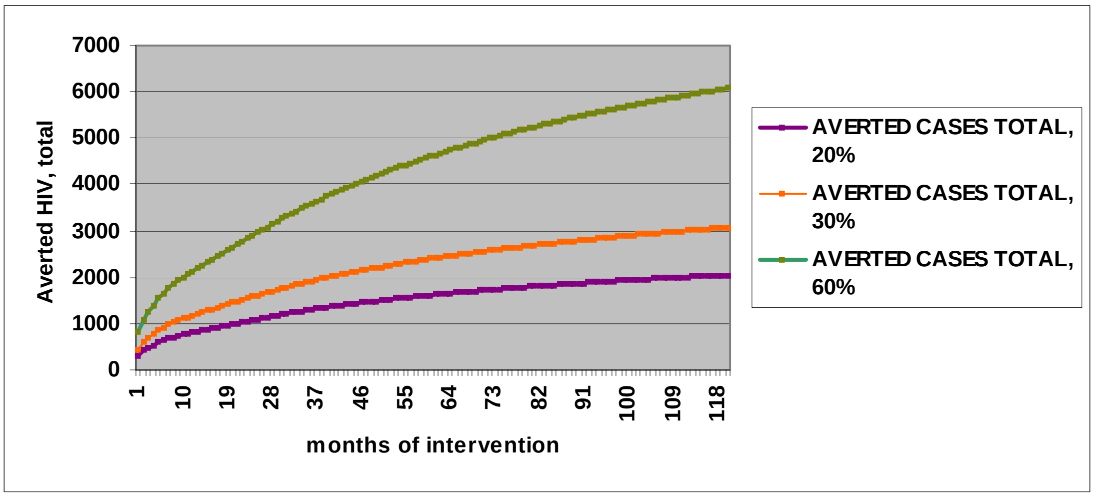


Figure 2. HIV infections averted over ten years – different coverage scenarios



Uncertainty analysis of effectiveness evaluation

To determine where uncertainty in input estimates had the greatest impact on outcome, we varied each input estimate in turn. Aside from level of coverage and initial size of IDU population, the most influential parameters were HIV transmission probability per needle-sharing act, proportion of IDUs injecting less than one year (in-migration), overdose related mortality, distribution of IDUs on number of sexual partners per month (none/low/high), the adjustment factor for differences in male and female reporting of IDU sexual partners, and the distribution of IDUs across levels of needle sharing behaviour, with and without intervention. The overall result at 60% coverage and accumulated numbers of HIV averted over ten years (undiscounted) is 6,075 (2,209-6,885) (Table 2).

Table 2. Uncertainty Analysis, Selected Parameters

	Baseline estimate	HIV averted	Relative change
Duration between HIV infection and severe morbidity (months)	**96**	**6,075**	
Low-end estimate	84	5,786	-4.80%
High-end estimate	120	6,525	7.40%
Probability of transmission per needle-sharing act	**0,00489**	**6,075**	
Low-end estimate	0,00324	5,530	-9.00%
High-end estimate	0,0069	6,203	2.10%
Proportion of new IDUs	**12%**	**6,075**	
Low-end estimate	10%	5,591	-8.00%
High-end estimate	14%	6,543	7.70%
Overdose-related mortality (per 1,000)	**5**	**6,075**	
Medium estimate	20	6,430	5.80%
High-end estimate	40	6,885	13.30%
Proportion of IDUs across level of sexual partners/month (none/low/high)	**0.28 / 0.33 / 0.39**	**6,075**	
Worst case scenario	0.25 / 0.32 / 0.43	5,535	-8.90%
Best case scenario	0.31 / 0.34 / 0.35	6,591	8.50%
Adjustment factor (male/female reporting of IDU sex partners)	**0.3**	**6,075**	
High-end estimate	0.5	5,197	-14.50%
Proportion of IDUs across levels of needle-sharing after intervention (none/low/high)	**0.65 / 0.2 / 0.15**	**6,075**	
Worst case scenario	0.22 / 0.54 / 0.24	2,209	-63.60%
Best case scenario	0.72 / 0.26 / 0.02	6,690	10.10%

Changes in needle-sharing behaviour had the greatest impact on averting HIV infections. The different scenarios for levels of needle-sharing have been calculated based on findings in the literature. A comparison between studies from Bangladesh, Belarus and Ukraine was conducted and forms the basis of estimations of levels of needle-sharing.

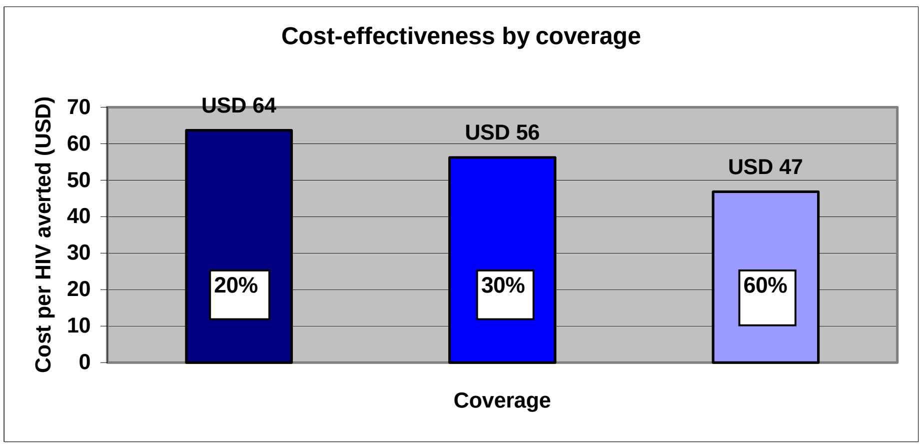
Foss and colleagues in their study from Bangladesh found that high viraemia multiplicative co-factor substantially influenced outcome (Foss *et al,* 2006). We did not identify high viraemia as an important determinant of the result in the case of Nepal, thus it is not included in the result of the uncertainty analysis (Table 2). Neither did we find a substantial effect of different levels of condom-use, or female-to-male probability of HIV transmission per sex act as reported by Vickerman *et al* (2006). No other studies have reported the adjustment factor for male/female reporting of IDU sex partners having an impact on outcome.

Cost-effectiveness results

The cost-effectiveness ratio was defined as the change in cost over the change in effectiveness relative to having no intervention. The effectiveness measure in both models was HIV infections averted. To explore the change in cost-effectiveness across years of intervention, we used the total average annual cost (2003 prices), while discounting effects (HIV averted) at a rate of 3% annually. The cost-effectiveness ratios were calculated as the (provider) cost per averted HIV infection using coverage of 20%, 30% and 60%. We assumed that utilisation of capacity would increase with coverage: at 20% coverage we assumed 70% capacity utilisation, at 30% coverage we assumed utilisation of an 80% capacity, and at 60% coverage we assumed a 100% capacity utilisation.

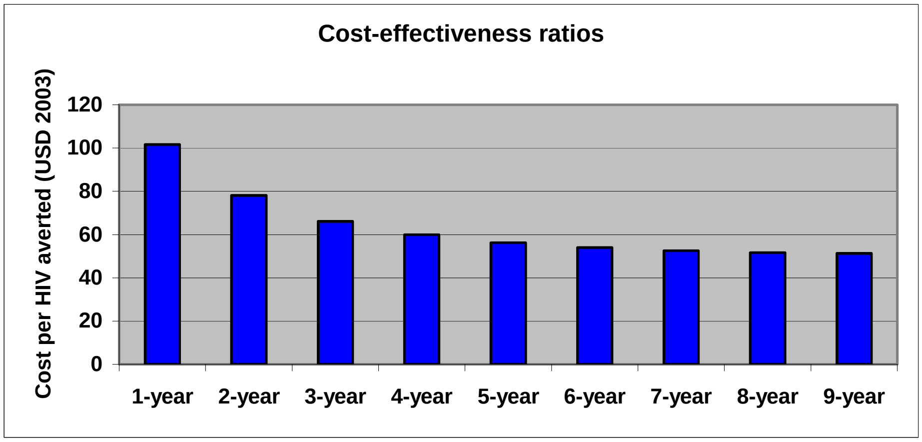
The cost-effectiveness ratios improved by coverage from US$ 64 per HIV averted to US$ 47 at 60% coverage (Figure 3). However, some of the improvement in the cost-effectiveness ratio is caused by assuming that utilisation of capacity increases with coverage, making the unit cost decrease over time. If we assume constant utilisation of capacity at 70%, the cost-effectiveness ratio would increase approximately 42% (US$ 67) at 60% coverage (3% discount rate). The results generated are contradictory to the findings of the cost-effectiveness ratios in the case of IDU intervention in Karachi, Pakistan (Alban *et al,* 2007a – in press). In the case of Karachi, the cost per HIV averted increased with coverage in spite of assuming decreasing unit costs. The key explanation is embedded in the higher level of cumulative HIV averted over the years in the case of Kathmandu, which has a much higher HIV prevalence rate of 68% as compared to 26% in Karachi.

Figure 3. Cumulative cost-effectiveness ratios by coverage over 5 years (3% discount rate)



In order to see how the cumulative cost-effectiveness ratios perform across years of interventions, we analysed the data over nine years at a constant 30% coverage and at a 3% discount rate (Figure 4). The cost-effectiveness ratios improve over the years, although at a much slower pace at the end of the period. The cost-effectiveness ratio after one year is US$ 102; after five years it has improved to only US$ 56 per HIV infection averted, almost half. After nine years the cost-effectiveness ratio is US$ 51. This development (slope of the curve) is similar to the case of Karachi (Alban *et al,* 2007a in press).

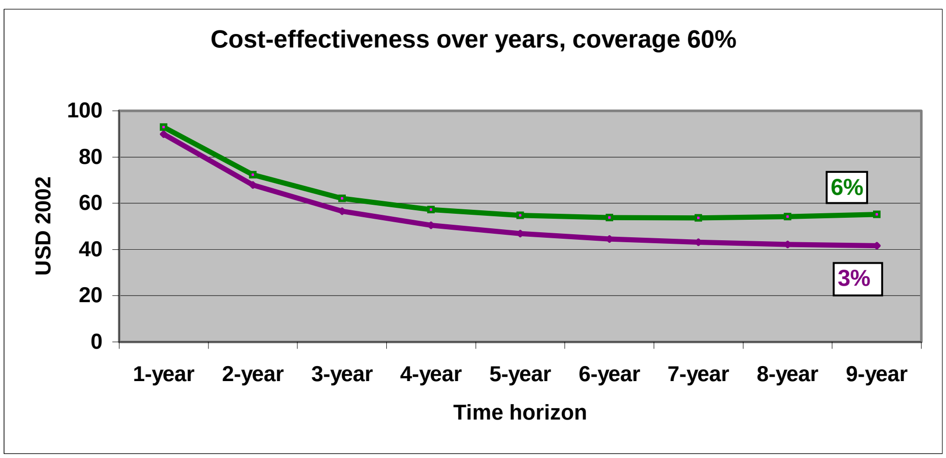
Figure 4. Cumulative cost-effectiveness ratios over 9 years (3% discount rate)



To examine the sensitivity of the discount rate, additional calculations using a 6% discount rate were made. Figure 5 shows the results for an intervention covering 60% of the target population with full capacity utilisation.

The cost-effectiveness ratio decreases over time from US$ 90 (2003 prices) for the first year of intervention to US$ 42 after nine years using a 3% annual discount rate. When effects are discounted at a higher rate (6%), the difference in cost-effectiveness ratio amounts to US$ 13 per HIV averted after nine years of intervention.

Figure 5. Cost-effectiveness over time, 60% coverage (3% and 6% discount of benefits)



Discussion

The analysis demonstrates that HIV interventions for IDUs are very cost-effective both at low (20%) and high (60%) coverage levels. However, low coverage rates cannot bring down the HIV prevalence at the same speed as high coverage. The extrapolation of HIV prevalence rates at different coverage levels shows significant difference in HIV prevalence rates over five years at 60% coverage, as compared to present coverage and 30% coverage. This difference is key to understanding how successful an IDU HIV prevention programme is in controlling the epidemic. In the case of scaling-up IDU interventions *the cost-effectiveness analysis is limited to focus on* *cost over the outcome* (which is favourable); however, the analysis does not provide information on the broader effect of the interventions unless several scenarios on coverage are brought into the decision-making arena. Although the cost-effectiveness ratios for all scenarios provide favourable results, decision-makers should be warned that *not all cost-effectiveness results are equally desirable*. In the case of IDU interventions, only those scenarios that markedly decrease HIV prevalence will eventually lead to reversing the epidemic. This is best achieved at 60% coverage (Box 1).

Reviewing the costs of HIV interventions in Asia shows variations in unit costs in US$ terms in the range of US$ 69–157 (2006 prices) per IDU per year for a mix of drop-in centre and outreach services (Alban *et al*, 2007b- in press). In this analysis the unit cost of IDU intervention services is estimated in the low range of US$ 62–88 (2003 prices) under various assumptions. We discuss a number of explanatory factors determining the unit costs of IDU services:

The costs vary depending on the approach. In this case we included a mix of drop-in centres and outreach services. This mix is the recommendation from UNAIDS and used by most HIV interventions for IDUs. From Karachi, we know that the unit cost between outreach services using motorbikes and drop-in centres, and a mobile van varies 26% (Alban *et al,* 2007a).

Another determining parameter is how the services are being provided. For example, one site might have no doctors attached but refer to primary healthcare services (like this one in Kathmandu), while another in Karachi might have several doctors to attend to treatment of STIs and other illnesses. The cost of IDU services also varies with utilisation of capacity, as underscored by this study approach.

Further, the reference year of the analysis matters, especially when using incremental costs, as we do. When services are being implemented a substantial amount of money goes into investments in training; some organisations depreciate training over five years, while others relate the costs to the year it arises. When comparing costs across sites the number of years in operation might assist in explaining differences in unit costs.

Finally, the unit cost is calculated based on the number of clients being served, the denominator of the equation. Some NGOs running IDU services use the number of registered IDUs, while others use the recommended denominator: IDUs reached per day (IDUs need 2–3 clean needles per day). By using the number of registered IDUs as a measure of clients served, unit costs decrease but the impact of the services becomes uncertain. Using an incorrect denominator influences both the unit cost (that will be undervalued) and the impact on services (that will be overvalued).

Cost-effectiveness analysis operates within three scenarios:

1. Initial 20% coverage, and 70% capacity utilisation.
2. Coverage at 30%, and 80% capacity utilisation.
3. Coverage at 60%, and 100% capacity utilisation.

It is uncertain if these scenarios are realistic. Previous studies suggest that utilisation of capacity increases over time (Guinness *et al,* 2006). The findings of Guinness *et al* (2005) indicate that the cost curve might be U-shaped over time. In their study on Female Sex Worker interventions to prevent HIV in India, the researchers found that the average cost varies with scale. They conclude that scale-specific cost information will improve planning for scaling-up HIV prevention interventions.

The remuneration of peer educators in our analysis might only reflect financial cost (the actual pay to the peer educators) and not economic cost (the income the peer educators could have earned from other similar work). Many peer educators are former drug users and their payment may not reflect the market price of their work; it ranges between being voluntary and low pay. The cost of peer educators is US$ 104 per year, but the economic costs might be several times higher. Peer educators are all part-time workers and it has not been possible to get exact information on how many hours the peer educators work per week. If peer educators each work 10 hours per week and would be paid the same salary as outreach workers of US$ 2,000 per year, the economic cost of peer educators' remuneration might be undervalued by a factor of between 3 and 5. This would increase the total cost to approximately US$ 83,000 and the unit cost to US$ 118 at 70% utilisation of capacity. In that scenario the cost of peer educators would become the component consuming most resources. The implications for the cost-effectiveness ratio would be marked: the cost-effectiveness ratio would increase from US$ 45 to US$ 63–90 after five years at 60% coverage and 70–100% utilisation of capacity.

We conclude that the results presented – be it unit cost of IDU services or cost-effectiveness ratios – are unique to the circumstances in Kathmandu, Nepal. The approach taken (what is being delivered and how) very much determines costs, impacts on effectiveness and eventually cost-effectiveness of the interventions. The overall impact of the interventions depends on a multitude of parameters, including epidemiological and behavioural parameters. They are seldom applicable from site to site and across countries. In the case of Nepal, we have demonstrated that the most important variable is changes in needle-sharing behaviour. A comparison across sites could use this parameter as a starting point. What we can learn from this cost-effectiveness analysis is what determines costs, and which effectiveness parameters impact most on what can be achieved by scaling-up IDU interventions.

Scaling up to 60% coverage is expected to occur gradually over time. The models do not allow for changing levels of coverage across years and it was only possible to work with one scenario at a time. If a more dynamic scenario were to be attained, reflecting a gradual scaling-up of coverage, several consecutive models would need to be conducted: first using present coverage and present utilisation of capacity (scenario 1) to obtain the first round of results (HIV averted) for one to two years. Then the results from the first run of the model would be entered for a second model run with increased coverage and perhaps utilisation of capacity. This should be repeated until a coverage level of 60% is reached.

We used available models to estimate effectiveness, and assessed their use for planning and *decision-making* when deciding on strategies for scale-up and priority setting. In the process, a number of lessons were learnt:

<u>HIVTools; IDU 2.4</u>

- The IDU 2.4 model requires input data of a very specific nature that are not easily obtainable, if at all, in national sentinel surveillance and behavioural studies, or from other sources such as the DHS (Demographic and Health Survey). We searched through all available data, yet for many of the parameters we had to rely on qualified guesses or estimate a best fit (see comments in Appendix 1). Although a range of studies is available for Nepal, in general, present routine data collection does not match the specific requirements of the HIVTools model.
- The model is not transparent. Though it is built on parameters that are generally known to impact intervention effectiveness, it is unclear how the input parameters are inter-related. The uncertainty analysis gives some insight into the relative importance of parameters, but how and whether changes in one estimate influence the weight of

another estimate remains uncertain. Of note, input parameters that we expected to be driving the model, such as the number of sexual partners and condom-use, seemed to make only a very slight impact on outcome in the uncertainty analysis.
A higher degree of model transparency and clarification of model dynamics is required if the model is to be used as a tool for planners and decision-makers in resource allocation.

From a more *technical perspective* we made the following observations:

- Once the parameters have been identified (or estimated) and entered into the model, the model quickly calculates effectiveness up to ten years. The model includes standard epidemiological outcome: prevalence, incidence and HIV averted. However, output is presented in a format which is not compatible with frequently used data processing software. This means that using and modifying results data to generate and modify graphs and tables – other than those provided by the model software itself – necessitates saving output data as a txt.-file and copying it into Excel spreadsheets or other software.
- It is not possible to save a model with completed input parameters. As a consequence, data has to be entered fresh each time the model is run. This makes work with different scenarios and uncertainly analyses time consuming.

We conclude that changes need to be made in data collection. The information being gathered in sentinel and behavioural surveillance studies of the most at-risk groups in Nepal does not include the information needed for an optimal model to estimate the effectiveness of the interventions. If decision-makers want to include quality cost-effectiveness analyses of key HIV prevention interventions in their decision-making processes, it will be necessary to determine minimum information requirements and encourage researchers to take these into account in future national and site surveillance studies. For the model (HIVTools) to be used at the operational planning level, it will need some re-working and an updated, more user-friendly manual.

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Appendix 1. HIVTools; IDU 2.4
Kathmandu: Input data (baseline scenario)

Type of Model Input	Definition of Model Input	Input Estimate	Uncertainty Bounds	Data Source
Computational data	Timescale (months)	120		
	Step size	0.1		*Default*
Epidemiological data	HIV prevalence in IDU population	68%		*HMG Nepal 2004*
	STI duration male (months)	1		*Default*
	STI duration female (months)	1.5		*Default*
	Duration of high viraemia phase (months)	1.5		*Default*
	Duration between infection and severe morbidity (months)	96	(84–96–120)	*AEM*[i]
	Number of non-IDUs that IDUs mix with sexually			
	Females	10,000	(8,000–15,000)	Foss 2006
	Males	1,000	(800–1,500)	
	Initial HIV prevalence in non-IDUs (%)			
	Females	0.5		UNAIDS 2004
	Males	0.5		
	Initial STI prevalence (%)			
	Females	5	(5–10)	HMG Nepal 2002[ii]
	Males	5	(5–10)	
	% of HIV infected with high viraemia (%)			
	Females	10		*Default*
	Males	10		*Default*
Transmission	*Probability of HIV transmission per sex act*			
	Male-to-female	0.002	(0.0016–0.002)	*Default*[iii]
	Female-to-male	0.001	(0.00067–0.00087–0.001)	
	Probability of HIV transmission per needle-sharing act	0.00489	(0.00324–0.00489–0.0069)	Foss 2006[iv]

Appendix 1. HIVTools; IDU 2.4
Kathmandu: Input data (baseline scenario)

Type of Model Input	Definition of Model Input	Input Estimate		Uncertainty Bounds	Data Source
Transmission	Probability of STI transmission per sex act (both sexes)	0.35			*Default*
	Average STI co-factor per sex act	30		(12–20–30)	*Default*
	Multiplicative factor during high viraemia	10		(10–15)	*Default*[v]
	Condom efficacy per sex act	0.9		(0.8-0.9)	*Default*
	Bleach or cleaning efficacy per sharing act	0.15		(0.1–0.15–0.2–0.3)	*Foss 2006*[vi]
Size of IDU population and intervention coverage	*Proportion of IDUs injecting less than one year (%)*				
	Males	12		(10–12–14)	New Era 2003[vii]
	Females	12		(10–12–14)	
	Overdose/sepsis-related mortality rate (per 1000)				
	Males	5		(5–20–40)	Peak 2001[viii]
	Female	5		(5–20–40)	
	Initial size of IDU population				
	Male	5,000		(5,000–15,000)	HMG Nepal 2004[ix]
	Female	100		(100–250)	[x]
	Proportion reached by the intervention	60%		(20%–30%–60%)	
Fixed needle-sharing behaviour (definition)	*Low level of needle-sharing*	**Not reached**	**Reached**		
	Needle-sharing partners/month	1	1		[xi]
	Frequency of needle shares per person/month	7.6	4.6		[xii]
	High level of needle-sharing				
	Needle-sharing partners/month	3	3		Burrows 2001[xiii]
	Frequency of needle shares per person/month	12.7	7.6		Peak 1995
	Degree of like-with-like mixing	0.7		(0.4–0.7)	*Default*[xiv]
Fixed sexual behaviour	*Definition of low and high partners*	**Males**	**Females**		

Appendix 1. HIVTools; IDU 2.4

Kathmandu: Input data (baseline scenario)

Type of Model Input	Definition of Model Input		Input Estimate		Uncertainty Bounds	Data Source
	per month					
		Low	1	1		*assumption*
		High	3	18		MOH 2001, New Era 2003[xv]
Fixed sexual behaviour	*Definition of consistency of condom use for IDU partnerships*					
		None	0			
		Some	0.3			*Default*
		All	0.7			
	Average number of sex acts per month with					
		Low number of partners	10			NACP 2005
		High number of partners	5.5			NACP 2005
	Level of like-with-like mixing between males and females		0.7		(0.3–0.7)	*Default*[xvi]
Sexual activity of IDUs	*Distribution of male IDUs' level of sexual activity (partners/month)*		**Not reached**	**Reached**		
		None	0.28	0.28	(0.25–0.28–0,31)	Burrows 2001[xvii]
		Low	0.33	0.33	(0.32–0.33–0.34)	New Era 2003
		High	0.39	0.39	(0.43–0.39–0.35)	*residual*
Sexual activity of IDUs	*Distribution of female IDUs' level of sexual activity (partners/month)*		**Not reached**	**Reached**		
		None	0.1	0.1	(0.1–0.11)	*Assumption*[xviii]
		Low	0.7	0.7	(0.7–0.67)	*residual*
		High	0.2	0.2	(0.2–0.22)	Hellard (no date)
Proportion of IDUs' sexual partners that are IDUs	*Level of sexual activity (male)*		**Not reached**	**Reached**		
		Low	0.37	0.44		
		High	0.37	0.44		
	Level of sexual activity (female)					*Default*

Appendix 1. HIVTools; IDU 2.4
Kathmandu: Input data (baseline scenario)

Type of Model Input	Definition of Model Input		Input Estimate		Uncertainty Bounds	Data Source
		Low	0.37	0.44		
		High	0.37	0.44		
	Adjustment factor for male/female reporting	0.3			(0.3–0.5)	*Default*[xix]
Proportion of IDUs with different levels of needle-sharing	Average consistency of cleaning syringes		0.16	0.55	(0.16–0.2–0.25) -- (0.45–0.55–0.65)	*Default*[xx]
	Level of needle-sharing (male)					
		None	0.08	0.65	worst case scenario	
		Low	0.59	0.2	best case scenario	
		High	0.33	0.15		
	Level of needle-sharing (female)					*Default*[xxi]
		None	0.08	0.65		
		Low	0.59	0.2		
		High	0.33	0.15		
Condom use in the IDU population	Average consistency of condom use (low sexually active IDUs)		0.02	0.13	*reached:* (0.02–0.13–0.24)	*Hellard (no date)*[xxii]
	Distribution of condom use (high sexually active IDUs) male and female					
		None	0.65	0.34	worst case scenario	*Hellard (no date)*
		Half	0.1	0.31		*residual*
		All	0.25	0.35		New Era 2003

[i] Uncertainty bounds stem from Foss 2006 (84 months) and the default value of 120 months.

[ii] The National HIV/AIDS strategy 2001–2006 reports a female STD prevalence of 4.7%. The USAID Country Health Profile states that prevalence of active syphilis had decreased from 18.8% in 1999 to 9.5% in 2003. Foss 2006 applies the same percentage for males and females.
[iii] Williams 2006 (India) uses 0.0016 for male-to-female transmission probability and 0.00087 for female-to-male. AEM default is 0.00067 for female-to-male.
[iv] 0.00489 (Foss 2006); 0.0028 (AEM); 0.0069 (default). 0.0028 unaccepted by HIVTools – we therefore used the smallest allowed value (0.00324) as minimum uncertainty bound.
[v] Default is 10, while Foss 2006 uses 15, based on recent literature (2001–2002).
[vi] Foss 2006, using this value, describes needle cleaning in their study as poor. In Nepal, needle cleaning is likewise reported to be inadequate (CREHPA, 2002): http://www.fhi.org/NR/rdonlyres/e6ixlqatfv4aer2johfd7lkrkcvwowrqi5hpoe7tgeeyp3cdox4xtfielgbsojskzfciq6q3n427am/nepalsituationassessmentiduskath2002fsno.pdf
[vii] New Era (2003) reports that 12% of IDUs had been injecting for less than one year in Pokhara Valley. The same information is not available from Kathmandu, but the New Era 2001 report indicates that the distributions of duration of injecting drug use are similar in Pokhara and Kathmandu.
http://www.fhi.org/NR/rdonlyres/ej74twegrnqyzne6turwu7nusygnd2latdzeait6gpgs5uo4b5jik676zqszeiipi32twk2pfccbmp/nepalhivprevalenceiduskath2001fsno.pdf
[viii] Approximation based on the following data: Pokhara; 5–15,000 IDUs → 5–6 overdose deaths (OD); Hertandra; 100–150 IDUs → 2 OD; Nepalgunj; 100–800 IDUs → 0 OD; Damak; 200 IDUs → very few OD; Biratnagar; 5–7000 IDUs → 1 OD. Input is per 1000 IDUs, so an average of the above data was calculated: (0.5+20+0+4+0.02) / 5 ~ 5 (per 1,000 IDUs).
Taskforce on IDU and HIV Vulnerability (2000) reports: 'While there are not reliable data on drug-related overdose and mortality in Nepal, anecdotal reports suggest that the incidence of these events is high.' (p.151) Default value is 40.
[ix] The national estimate is 4–5000 based on systematic mapping, while NGO estimates are much higher (such as that of the Centre for Harm Reduction at 15,000 IDUs).
[x] The Centre for Harm Reduction states in its report that a focus group discussion with 4 female IDUs in 2001 reports 20 known female IDUs in the Kathmandu valley. Also, the report states that a women's program run at a drop-in centre had heard of 20–25 sites in Kathmandu where women were injecting drugs. Visiting these sites, staff found 25 female IDUs. Later, the staff identified a further 10 sites with 10–12 more women (i.e. total 37). The Centre for Harm Reduction writes: 'The stigma of being a woman IDU in Kathmandu Valley is extreme, so women IDUs may be much more carefully hidden than male IDUs.' The FHI 2001 report on *HIV&IDU in selected sites of the Terai, Nepal* estimates that less than 5% of IDUs in these areas are female.
[xi] New Era 2003 (Pokhara) states that 90% of IDUs did not share needles/ injected alone, thus a low level of sharing is likely to be with one partner on average.
[xii] Lacking data, the after-intervention figure from the high level of needle-sharing group is used as 'before intervention' (i.e. not reached). The same percentage reduction – 40% ((12.7–7.6)/12.7=0.4) is used to designate the 'after intervention' (i.e. reached) group in the low level of needle-sharing group.
[xiii] Burrows 2001, reports that IDUs shared equipment with 0–6 other people, with most sharing with 2–3 people. Tamang *et al*, 2002 similarly report that groups ranged from 8–15 members, with most IDUs sharing with 2–3 people.
[xiv] Foss 2006 uses 0.4.
[xv] Females with a high number of sexual partners are assumed to be involved in commercial sex work. New Era 2003 reports that the mean number of sex partners (paying and non-paying) in the past week was 4.6, and as such averaging 18 per month.
[xvi] Foss 2006 uses 0.3
[xvii] Both Foss 2006 and the model default values use the same input for those reached by the intervention and those not reached.
[xviii] It is assumed that very few female IDUs are completely sexually inactive.
[xix] Foss 2006 uses 0.5 (an assumption not based on data).
[xx] New Era 2003, Burrows 2001, Hellard *et al* (no date) and Tamang 2002 all state that needle-sharing is frequent. Needles are most often cleaned between users, but cleaning is inadequate using poor methods. Hellard *et al* (no date) suggest that harm reduction programs have been shown to have an effect on safe injecting behaviour but gives no estimate of this effect. Foss 2006 input for not-reached IDUs is 0.51, while 0.80 for reached.

[xxi] The best- and worst-case scenarios are based on either existing data from other studies or the values which generate a +/- 10% change in absolute difference between 'before' and 'after' intervention estimates, whichever method gave the most extreme end-points. Data available on request.

[xxii] The after intervention estimates ('reached') are – due to lack of data – based on the relative changes (RC) in condom use found in the Bangladesh model and the default values.

Bangladesh: RC = (reached – not reached)/not reached = (0.24–0.025)/0.025 = 8.6

Default: RC = (reached – not reached)/not reached = (0.45–0.2)/0.2 = 1.25

Using these RC-values with the Nepal data on average condom use consistency for IDUs with low sexual activity who are not reached by an intervention (0.015) gives a low-end estimate of 1.9% and a high-end estimate of 12.9% for those who *are* reached by an intervention.

[xxiii] The after intervention estimates ('reached') are – due to lack of data – based on the relative changes (RC) in condom use found in the Bangladesh model and the default values, using the 'none' and 'all' categories for estimations and calculating the 'half' category as the residual (up to 100%).

Bangladesh:	Not-reached	Reached	RC
None	0.76	0.25	-67%
All	0.17	0.41	141%
Default:	Not-reached	Reached	RC
None	0.71	0.37	-48%
All	0.14	0.51	265%

Appendix 2. AEM IDU application, Nepal

Calculations of the AEM parameters:
With intervention

N IDUs = 100

	Fraction sharing	*Sharing partners per month*	*Shares per partner*	*Number of IDUs in category*	*Total shares per month*	*Injections per month*	*Total injects per month*		
None	8%	0	0	8	0	75			
Low	59%	1	7.6	59	448	75	4,425		
High	33%	3	12.7	33	1,257	75	2,475		
				Fraction shared among sharers =		1706	shared injections		
						-------------	------------ ------------	=	24.7%
						6,900	total injections		

Without intervention

N IDUs = 100

	Fraction sharing	*Sharing partners per month*	*Shares per partner*	*Number of IDUs in category*	*Total shares per month*	*Injections per month*	*Total injects per month*		
None	65%	0	0	65	0	75			
Low	20%	1	4.6	20	92	75	1,500		
High	15%	3	7.6	15	342	75	1,125		
				Fraction shared among sharers =		434	shared injections		
						-------------	------------ ------------	=	16.5%
						2,625	total injections		

AEM, Katmandu, Nepal, IDUs
Parameters changed (marked)

With interventions

Injecting Drug Use Behaviour

Behavioural inputs to AEM for IDUs & injecting sex workers

Male IDUs

Injecting behaviours	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Percentage of adult males 15–49 years of age who inject	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Percentage in high risk networks	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
IDU mortality (additional mortality per year in percent)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Percentage of IDUs sharing	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%
Percentage of all injections shared (by those in sharing group)	16.5%	16.5%	16.5%	16.5%	16.5%	16.5%	16.5%	16.5%	16.5%	16.5%
Number of injections each day	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Average duration of injecting (years)	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
Sharing to non-sharing movement in a year	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%

Without interventions

Injecting Drug Use Behaviour

Behavioural inputs to AEM for IDUs & injecting sex workers

Male IDUs

Injecting behaviours	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Percentage of adult males 15–49 years of age who inject	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Percentage in high risk networks	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
IDU mortality (additional mortality per year in percent)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Percentage of IDUs sharing	92%	92%	92%	92%	92%	92%	92%	92%	92%	92%
Percentage of all injections shared (by those in sharing group)	24.7%	24.7%	24.7%	24.7%	24.7%	24.7%	24.7%	24.7%	24.7%	24.7%
Number of injections each day	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Average duration of injecting (years)	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
Sharing to non-sharing movement in a year	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%