International Journal of Drug Policy 23 (2012) 358–364

Contents lists available at SciVerse ScienceDirect

International Journal of Drug Policy

journal homepage: www.elsevier.com/locate/drugpo

Research paper

Cost-effectiveness of methadone maintenance therapy as HIV prevention in an Indonesian high-prevalence setting: A mathematical modeling study

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ARTICLE INFO

Article history:
Received 11 January 2012
Received in revised form 14 June 2012
Accepted 22 June 2012

Keywords:
Cost-effectiveness
HIV
Methadone maintenance therapy
Indonesia

ABSTRACT

Background: Indonesia faces an HIV epidemic that is in rapid transition. Injecting drug users (IDUs) are among the most heavily affected risk populations, with estimated prevalence of HIV reaching 50% or more in most parts of the country. Although Indonesia started opening methadone clinics in 2003, coverage remains low.
Methods: We used the Asian Epidemic Model and Resource Needs Model to evaluate the long-term population-level preventive impact of expanding Methadone Maintenance Therapy (MMT) in West Java (43 million people). We compared intervention costs and the number of incident HIV cases in the intervention scenario with current practice to establish the cost per infection averted by expanding MMT. An extensive sensitivity analysis was performed on costs and epidemiological input, as well as on the cost-effectiveness calculation itself.
Results: Our analysis shows that expanding MMT from 5% coverage now to 40% coverage in 2019 would avert approximately 2400 HIV infections, at a cost of approximately US$7000 per HIV infection averted. Sensitivity analyses demonstrate that the use of alternative assumptions does not change the study conclusions.
Conclusion: Our analyses suggest that expanding MMT is cost-effective, and support government policies to make MMT widely available as an integrated component of HIV/AIDS control in West Java.

Introduction

Apart from sub-Saharan Africa, HIV epidemics are mainly concentrated among most-at-risk populations (WHO/UNAIDS, 2007). Injecting drug users (IDUs) constitute an important risk group, estimated at 15.9 million individuals globally, of whom 3 million are HIV-infected. The size of the IDU population and the prevalence of HIV in this population have increased in the past decade (Mathers et al., 2008).

Indonesia has significantly contributed to this increase. HIV increased considerably in Indonesia from the mid-1990s onwards, paralleling the rapid rise of opioid use. Indonesia currently faces an HIV epidemic in rapid transition: there has been a rapid rise in HIV incidence among IDUs, followed by a heterosexual epidemic among female sex workers (FSWs) and their clients, and subsequently among men having sex with men (MSM) (Des Jarlais et al., 2012). By 2007, approximately 50% of IDUs were infected (in Jakarta 55%, Bandung 43%, Medan 56%, and Surabaya 56%) (MOH-Indonesia, 2007; UNAIDS/WHO, 2008), contributing to at least 40% of new HIV infections. In 2015, it is expected that one million Indonesians will be HIV-infected and 350,000 will have died because of AIDS (NAC-Indonesia, 2008a,b).

Acknowledging the important role of injecting drug use, Indonesia adopted legislation in 2004 supporting harm reduction activities, including methadone maintenance therapy (MMT) (Mesquita et al., 2007). Despite ambitious policy targets, MMT coverage remains low, mainly because of its high costs, lack of capacity to expand continuously, and the recent tightening of drug laws (Chatterjee & Sharma, 2010; Sharma, Oppenheimer, Saidel, Loo, & Garg, 2009). In 2003, a pilot study in Jakarta showed that MMT significantly reduces injection frequency and IDU-associated

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0955-3959
http://dx.doi.org/10.1016/j.drugpo.2012.06.009

HIV risk behaviours (Lawrinson et al., 2008). However, many IDUs continue to inject, and therefore remain at risk of transmitting HIV or becoming infected themselves. This situation raises questions regarding the population-level preventive impact of MMT. Do intermediate behavioural outcomes also translate into final outcomes as infections averted at the populational level? In this sense, what are the long-term effects of MMT? van den Berg, Smit, Van Brussel, Coutinho, and Prins (2007) showed that full participation in harm reduction (both MMT and NSP) programs is associated with a reduced HIV transmission in the Netherlands (van den Berg et al., 2007), but it is questionable whether these results are also applicable to the Indonesian context. Moreover, the resource requirements for harm reduction in Asia in 2009 were estimated at $500 million and MMT accounted for a significant share of these resources (Bergenstrom et al., 2010). Therefore, careful assessment of both the costs and effects of prevention measures is warranted to further inform decisions about whether to expand MMT to higher coverage levels.

The research question in this paper is: from the societal perspective, what are the costs and effects of expanding MMT compared with current practice? This paper is the first to address the cost-effectiveness of MMT as an HIV prevention measure in a low-income setting. We chose a modeling design to study the effects of MMT on long-term HIV transmission at the populational level. We used the Asian Epidemic Model (AEM), a well validated and widely used HIV transmission model. Most importantly, the AEM comprises all relevant risk groups and allows behaviour to change over time (Brown & Peerapatanapokin, 2004; Saidel et al., 2003). We describe HIV transmission in the West Java province, explore the role of IDUs, and relate this role to cost-effectiveness analysis. West Java is Indonesia's most populous province (43 million people) and has one of the highest populations of HIV-infected individuals in Indonesia.

Methods

HIV transmission model

We used the AEM (Brown & Peerapatanapokin, 2004; Saidel et al., 2003) to simulate the epidemiology of HIV among the various risk groups in West Java. Our starting point of analysis was the AEM model as fitted for West Java by AIDsina and the East-West Centre, two local specialised institutes on HIV/AIDS epidemiology and modeling that developed the model and also calculated the national HIV/AIDS projections (NAC-Indonesia, 2008b). The parameters were varied to find the model fit as shown in Table 1, and risk behaviour was assumed constant after 2007.

The current practice scenario assumed a coverage of MMT of 1.5% in 2008 (Sharma et al., 2009), extrapolated to 5% in 2010 and remaining constant thereafter. The intervention scenario assumed a similar MMT coverage till the end of 2009 followed by a linear increase to 40% in 2019, following UNAIDS recommendations (Verster, Clark, Ball, & Donoghoe, 2007). In both scenarios, the impact of MMT was modeled through changes in the prevalence and frequency of unsafe injecting drug use (the frequency of injections and percentages of needle-sharing) and condom use among IDUs, derived from the intervention impact matrix of the Resource Needs Model (RNM) (Bollinger, Stover, & Sangrujee, 2007) (Table 2).

To estimate the impact of our intervention scenario, we ran current practice and intervention scenarios and compared the resulting annual numbers of new infections. We performed extensive one-way sensitivity analysis on all IDU-related parameters. Additionally, to cope with uncertainty in surveillance studies, we changed (±25%) functionally related clusters of both sexual and injecting behaviour parameters and single key parameters (based on our own data search). These scenarios were again fitted with observed HIV prevalences and used for alternative cost-effectiveness calculations.

Cost analysis

We also employed the RNM to estimate the cost of our intervention, and linked unit cost estimates to the number of people utilising MMT. Unit costs of MMT, from the societal perspective, were taken from Afriandi et al. (2010), which was also conducted in West Java. To summarise the findings of Afriandi et al. (2010), this study provides full details about the costs of MMT. MMT service delivery costs were estimated using a micro-costing approach. Data regarding service utilisation (such as attendance, methadone dosage, laboratory and other investigations, and referrals to medical services) were retrieved from the clinic's records from November 2006 to October 2007. Capital costs and other recurrent costs (such as personnel, training, and other resources used) were calculated on the basis of financial administrative data. Patient costs were estimated on the basis of a survey among 48 methadone clients. This survey included information about travel costs and travelling time, monthly income, and the average number of daily working hours. This information was combined with the average total time spent per client in the clinic. All capital costs (including training and workshops), personnel costs, methadone supply, and other supplies were included in the health care system perspective. The societal perspective also included patient costs.

The unit cost estimates ($6.70 and $2.63 per client visit for the societal and health care system, respectively, with a mean of 126 visits per client per year) were altered (±25%) in the sensitivity analysis. We ran sensitivity analysis including only costs from the health care system perspective.

Cost-effectiveness analysis

We compared costs and effects of the intervention scenarios to those of the current practice scenario. The incremental costs of the intervention scenarios were divided by their incremental effects to establish the incremental cost per HIV infection averted. We discounted both costs and effects at a 3% discount rate for both costs and effects; this value was altered to 1% and 5% for effects and costs, and to 0% for effects in our sensitivity analysis. The time horizon of this study was 10 years, and was changed to 20 years in the sensitivity analysis.

Results

The HIV epidemic in West Java and the role of injecting drug use

Our model simulations show a reasonably good fit with the observed prevalence of HIV among important risk groups (Fig. 1). Our current practice scenario predicts that in West Java, without any change in risk behaviours, the HIV prevalence in the overall adult population will not reach 0.3% before 2020. HIV prevalence among IDUs steadily approaches approximately 50% in the period from 2010 until 2020. Although HIV prevalence among FSWs is expected to grow considerably, the MSM prevalence only grows moderately (Fig. 1).

Intervention impact and cost-effectiveness

Fig. 2 depicts the expected impact of different MMT expansion programs on HIV prevalence among IDUs. When MMT is expanded to a coverage level of 40% in 2019, the number of IDUs receiving MMT will increase from approximately 500 in 2010 to approximately 4600 in 2019. The HIV prevalence among IDUs is expected

Table 1
Parameter baseline values, sensitivity ranges and references used in adapted Asian Epidemic Model for West Java Province.

Parameter	Baseline value	Reference
AEM fitting parameters		
Transmission probability		
Male to female (Pm_f)	0.00125	Fitting
Male to male (Pm_m)	0.01790	Fitting
Needle stick	0.03	Fitting
Ratio of male to female versus female to male transmission	3.80	Fitting
IDU network parameter (%)	80	Fitting
STI cofactor		
Female to male	16.00	Fitting
Male to female	20.00	Fitting
Male to male	1.00	Fitting
Circumcision factor	2.55	Fitting
Epidemic start year		
IDU	2002	Fitting
Heterosexual	1989	Fitting
MSM	1992	Fitting
Population sizes in West Java in 2006		
FSW	0.32%	NAC (2006)
FSW who are direct FSWs (%)	62.20	NAC (2006)
IDU	0.08%	NAC (2006)
MSM higher risk	0.13%	NAC (2006)
MSM lower risk	1.1%	NAC (2006)
MSW	0.02%	NAC (2006)
Clients of FSWs	1.7%	NAC (2006)
Males age 15+	14,596,400	BPS West Java
Females age 15+	14,152,600	BPS West Java
HIV prevalence (% in 2007, used for fitting)		
Direct FSW (%)	10.35	IBBS 2007
Indirect FSW (%)	3.29	IBBS 2007
IDU	43.00	IBBS 2007
MSM	2.00	IBBS 2007
General population	0.00	IBBS 2007
Hetero sexual behavior and STIs		
Direct female sex workers		
Direct to indirect FSW behavior movement each year (%)	1	Default value
Number of clients per day	1.7	IBBS 2007
Days worked per week	5.3	IBBS 2007
Condom use with clients (%)	62	IBBS 2007
Average duration of sex work (years)	2.5	IBBS 2007
STI prevalence (% Neisseria gonorrhea)	44	IBBS 2007
Indirect female sex workers		
Number of clients per day	0.86	IBBS 2007
Number of clients per day	5.5	IBBS 2007
Condom use with clients (%)	60	IBBS 2007
Average duration of sex work (years)	2.0	Local expert opinion[a]
STI prevalence (% Neisseria gonorrhea)	22	Local expert opinion
Clients of sex workers		
Males age 15–49 visiting sex workers (%)	1.7	NAC (2006)
Average duration of being a client (years)	11	Local expert opinion
Adult males circumcised (%)	87	DHS 2007
Male and female casual sex		
Males having casual sex in last year (%)	0.3	Local expert opinion
Females having casual sex in last year (%)	0.1	Local expert opinion
Condom use in casual sex (%)	21	IBBS 2007
Average number of casual contacts in last year (male)	1	Default value
Sex with spouses or regular partners		
Number of weekly sexual contacts with spouse/regular partner	1.4	Local expert opinion
Condom use with spouses or regular partners (%)	10	Local expert opinion
Adult population with STI (%)	0.5	Local expert opinion
IDU injecting and sexual behavior		
IDU mortality (% additional mortality per year)	1.0	Default value
IDU sharing (%)	32	IBBS 2007, percentage sharing needle last week
Injections shared, by those in sharing group (%)	70	IBBS 2007
Number of injections each day	0.74	IBBS 2007, the number of injections last week divided by 7.
Average duration of injecting (years)	8.0	IBBS 2007, a stable population is assumed. As 12% of IDUs started injecting drugs less than one year ago, the average duration is 1/12%.
Sharing to non-sharing movement in a year (%)	20	Local expert opinion

Table 1 (*Continued*)

Parameter	Baseline value	Reference
Visiting FSWs (%)	41	IBBS 2007, percentage visiting sex workers last year
Condom use with direct FSW (%)	54	IBBS 2007, condom use at last commercial sex
Condom use with indirect FSW (%)	54	IBBS 2007, condom use at last commercial sex
Condom use with spouse or regular partner (%)	34	IBBS 2007, condom use at last sex
Number of contacts with regular partners (per week)	1	Default value
Injecting sex workers (ISW)[b]		
Injecting behaviors – higher frequency injecting SWs		
Percent of higher frequency sex workers who inject	0.1	IBBS 2007
Percent of higher frequency ISW in high risk networks	0	Default value
Percent of higher frequency ISW sharing	0	Default value
Percent of all injections shared (Sharing hi frequency SW)	0	Default value
Number of daily injections for higher frequency ISW	0.7	IBBS 2007
Average duration of injecting for higher freq ISW (years)	2.5	IBBS 2007
Percent condom use with clients (hi frequency ISWs)	62	IBBS 2007
Injecting behaviors – lower frequency injecting SWs		
Percent of lower frequency sex workers who inject	0.1	IBBS 2007
Percent of lower frequency ISW in high risk networks	0	Default value
Percent of lower frequency ISW sharing	0	Default value
Percent of all injections shared (Sharing low frequency SW)	0	Default value
Number of daily injections for lower frequency ISW	0.7	IBBS 2007
Average duration of injecting for lower freq ISW (years)	2.5	IBBS 2007
Percent condom use with clients (low frequency ISWs)	60	IBBS 2007
MSM sexual behavior[c]		
Higher risk MSM (Hi MSM) sexual behavior		
Reporting anal sex last year (%)	93	Local expert opinion
Number anal sex contacts last week	0.5	Local expert opinion
Average duration of same-sex behavior (years)	12.7	Local expert opinion
Shift from Hi MSM to Lo MSM	25	Default value
MSM having sex with other female partners (%)	34	Local expert opinion
Condom use in anal sex with other hi MSM (%)	45	Local expert opinion
Prevalence hi MSM with anal STI (%)	21	Local expert opinion
Lower risk MSM (Lo MSM) sexual behavior		
Percent of Lo MSM reporting anal sex in last year	53	Local expert opinion
Number anal sex contacts last week (for MSM w/anal sex)	0.1	Local expert opinion
Average duration of same-sex behavior (years)	18.1	Local expert opinion
Percent of Lo MSM with other female partners	20	Local expert opinion
Percent condom use in anal sex with other Lo MSM	48	Local expert opinion
Percent Lo MSM with anal STI	5.4	Local expert opinion
MSM sexual behavior with commercial partners		
Percent of Hi MSM visiting male sex workers	13	Local expert opinion
Percent of Lo MSM visiting male sex workers	2	Local expert opinion
Ratio of frequency of visiting MSW (Lo MSM/Hi MSM)	0.1	Default value
Percent of Hi MSM visiting female sex workers	6	Local expert opinion
Percent of Lo MSM visiting female sex workers	0	Local expert opinion
Condom use in anal sex with male sex worker (%)	50	Local expert opinion
Condom use direct FSW (%)	62	IBBS 2007
Condom use indirect FSW (%)	60	IBBS 2007
Male sex workers (MSW)[c]		
MSW size and duration		
Average duration of male sex work (years)	6.3	Local expert opinion
Shifts from Hi MSM to MSW	1	Default value
Shifts from Lo MSM to MSW	1	Default value
Sexual behaviors and STI with clients		
Percent of MSW reporting anal sex with clients in last year	93	Local expert opinion
Number anal sex contacts last week (for MSW w/anal sex)	1.0	Local expert opinion
Percent MSW with anal STI	23	Local expert opinion
Female partners of MSW		
Percent MSW visiting female sex workers in last year	9	Local expert opinion
Percent MSW with other female partners in last year	43	Local expert opinion

IDU = injecting drug users, FSW = female sex workers, MSM = men having sex with men, STI = sexual transmitted infections.
Note: order and categorization of parameters are in line with presentation in Asian Epidemic Model.

[a] Local expert opinion was given by researchers from East West Center and AIDsina.

[b] The parameter values for Injecting sex workers are copied from both FSW and IDU parameter values.

[c] The IBBS 2007 report does not discriminate between MSM hi, MSM lo and MSW, but the raw IBBS data were used by local experts for parameter estimates.

to decrease to 40% in 2019. Compared with current practice, 2400 undiscounted HIV infections are expected to be averted by 2020, at an undiscounted cost of US$16 million. Of these averted infections, 56% would be among IDUs, 24% among FSWs, 11% among clients, 9% among lower risk populations, and just one averted infection would be among MSM. However, to put this into perspective, in the same period there would still be 95,600 HIV infections in the overall population. Expanding MMT to 40% is expected to reduce the number of infections among IDUs by 18%, while the effect on FSWs, clients, and MSM is expected to be negligible.

Table 2
MMT intervention impact matrix.[a]

	Non-condom use	Prevalence of injecting drug use	Frequency of injection	Prevalence of needle sharing
Low	−22%	−46%	−64%	−30%
Average	−32%	−47%	−79%	−63%
High	−42%	−53%	−88%	−89%

[a] *Source*: Bollinger et al. (2007).

Table 3
Results of sensitivity analysis on cost-effectiveness of MMT.

Parameter	ICER[a] current practice compared to no intervention		
	Lower end		Higher end
ICER[b]		6817	
Time horizon is increased to 20 years		3767	
Unit cost lower end = −25%, higher end = +25%	5113		8522
Unit costs taken from health care system perspective		2676	
Discount rate lower end = 1%, higher end = 5%	6661		6974
Discount rate for effects = 0%, costs 3%		5638	
IMPACT of intervention[c], lower end: low impact, higher end: high impact.	8551		5313
IMPACT of intervention – no effects on condom use		8654	
IMPACT of intervention – no effect on condom use, neither on prevalence of injecting drug use		11,813	
CEAs on alternative scenarios			
Alternative 1: PWID increased sexual risk behavior (all parameters +25% for risk behavior, −25% for protective behavior).		5580	
Alternative 2: PWID decreased sexual risk behavior (all parameters −25% for risk behavior, +25% for protective behavior).		8521	
Alternative 3: all injecting behaviors + 25% (except for additional mortality parameter).		6313	
Alternative 4: all injecting behaviors − 25% (except for additional mortality parameter).		7027	
Alternative 5: an enlarged (multiplied by 7) clients of sex workers population size and smaller (divided by 1.15) FSW population size.[d]		6699	
Alternative 6: increased (multiplied by 1.75) injection frequency.[e,f]		6775	
Alternative 7: enlarged (multiplied by 3.14) IDU population size.[e]		7913	

[a] ICER: incremental cost-effectiveness ratio: costs in US$ per infection averted.
[b] Assumptions in the CEA: time horizon is 10 years, an average impact of MMT is assumed (Table 1), discount rate both for costs and effects is 3%, unit costs are 848.41$ per IDU on MMT per year. Costs from 2010 until 2019 and effects from 2010 until 2019 were included.
[c] In Table 1 (methods), the different impacts are shown.
[d] To reduce the 'Number of sex acts per IDU with FSWs per year' and in this way testing the link between IDU and FSW and the effect on CEA. Reductions and multiplications follow alternative population size estimations.
[e] More dramatically than in alternative 3 and thereby testing the impact of this specific parameter on CEA.
[f] Using another indicator for injection frequency from IBBS 2007.

Table 3 shows that, in our baseline analysis, MMT costs approximately US$7000 per HIV infection averted. We performed extensive sensitivity analysis regarding the costs, epidemiological input, and the cost-effectiveness analysis calculation itself, and all incremental cost-effectiveness ratios (ICERs) fall within a factor two of US$7000 per HIV infection averted, with one exception. When adopting the health care system perspective, the ICER equals US$2676 per infection averted. When neither effects on condom use nor effects on the prevalence of injecting drug use were modeled, the ICER increased to almost US$12,000 per infection averted.

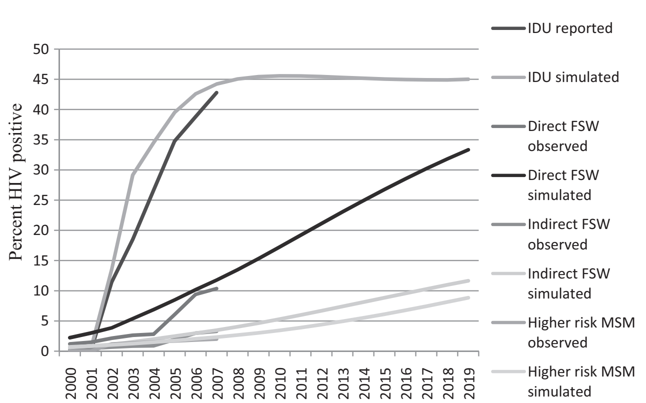

Fig. 1. Reported and simulated HIV prevalence among high risk groups in West Java, Indonesia. West Java projection for high risk groups (% older than 15 years, living with HIV) at current practice (5% coverage from 2010–2019) MMT.

Discussion

In this study, we analysed the cost-effectiveness of MMT and the role of injecting drug use in the West Javan HIV epidemic.

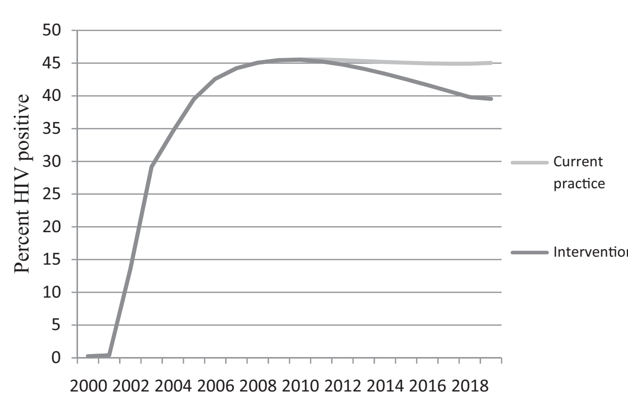

Fig. 2. Predicted HIV/AIDS prevalence among IDUs in West Java, current practice and intervention scenario.

Our analysis suggests that MMT costs approximately US$7000 per HIV infection averted, and we found this value to vary within a factor of two in the sensitivity analysis. The relevant question here is whether MMT in West Java is an economically attractive intervention, and would merit further investment from the Indonesian government to make the services widely available. The World Health Organisation, through its WHO-CHOICE program, defines interventions that cost less than the gross domestic product (GDP) per capita per disability-adjusted life year (DALY) averted as very cost-effective, and those with a ratio that falls between one and three times the GDP per capita as cost-effective (Torres, Baltussen, Hutubessy, Acharya, & Evans, 2003). Assuming that one averted HIV infection equates to approximately 26 averted DALYs (Tromp & Baltussen, in press), MMT would cost approximately US$269 per DALY averted. Given that Indonesia's GDP per capita is US$2858 (IMF, 2010), MMT can be considered very cost-effective. A comparison with other interventions is more difficult to make: MMT compares favorably to other HIV-preventive interventions, such as school-based education (Galarraga, Colchero, Wamai, & Bertozzi, 2009; Hogan, Baltussen, Hayashi, Lauer, & Salomon, 2005), but less so to a multifaceted harm reduction program (including Needle and Syringe Programs and others) in Bangladesh (Guinness et al., 2010). These studies have been conducted in different contexts and are therefore difficult to compare. However, our study results confirm findings from Ukraine, where expanding MMT was also found to be a cost-effective intervention (costing US$530 per quality-adjusted life year gained) (Alistar, Owens, & Brandeau, 2011).

Our results show that expanding MMT to 40% in 2019 will avert approximately 2400 HIV infections by 2020. Strikingly, only 56% of these infections will be prevented among IDUs. Two factors are of importance: the proportion of IDUs who share needles and the impact of IDUs on the epidemic as a whole. These two factors are discussed below in more detail.

In our one-way sensitivity analysis, we found '% of IDU sharing' to be the most important IDU-related parameter affecting the cost-effectiveness estimates. This parameter, together with movement in and out of this group, more or less determines the stable equilibrium of HIV prevalence among IDUs. Because IDUs inject frequently and HIV is transmitted very effectively via needles, almost all IDUs who share needles become infected and the rapid spread of HIV among IDUs is common (for an overview, see Saidel et al., 2003). This also implies that when the epidemic has reached equilibrium among IDUs, only those who start to share needles will be likely to acquire new infections. New needle sharers comprise a small proportion of a relatively stable cohort (in our study, the average duration of being an IDU was 8 years), especially when an intervention reduces the percentage of IDUs who share needles.

IDUs have played a significant role in the West Javan HIV epidemic, and may continue to do so in the future. The link between IDUs and FSWs is strong: in our West Java projection, 41% of IDUs reported visiting sex workers. Our West Java projection confirms the findings of Saidel et al. (2003) for a hypothetical population: despite high-risk behaviour by FSWs and their clients, their HIV prevalence remained low until the introduction of HIV among IDUs. HIV initially spread rapidly among IDUs, and provided a boost to the HIV epidemic among FSWs. Because of this strong link between IDUs and FSWs, many infections among FSWs and their clients would be averted when HIV incidence and prevalence among IDUs is reduced by MMT. Overall, our analysis suggests that the proportion of incident cases caused by injecting drug use is expected to decrease and to be replaced by infections caused by heterosexual transmission. This is an important insight, and indicates the limitations of interventions such as MMT: although they may offer value for money and are therefore worthwhile, they are only able to reduce incidence slightly (2.5% in our analysis).

Our analyses demonstrate a steady rise of HIV prevalence among MSM, yet at a relatively low level. More profound analysis of the HIV epidemic among MSM is beyond the scope of this article. Although our results appear soothing, given the MSM epidemics in Asia, HIV among MSM certainly requires further investigation, including cost-effectiveness analyses of interventions among MSM.

The present analysis has a number of limitations. First, our study was limited by the availability and quality of input parameters, especially size of population groups and MMT coverage rates. Also, we assumed that most behavioural parameters would remain constant after 2007, and neglected trends such as the increased consumption of methamphetamines, which may replace heroin use and for which MMT is not an effective treatment option. Yet our extensive sensitivity analyses showed that study conclusions are robust towards alternative assumptions on key variables, which also supports the extrapolation of our findings to epidemics other than the West Java epidemic.

Second, our analysis focused on MMT and its impact on IDUs. The evaluation of other interventions (such as the social marketing of condoms among IDUs) was beyond the scope of our study, and also impossible considering the absence of reliable cost information. Nor did we evaluate interventions targeting FSWs or MSM. We acknowledge FSWs and MSM as increasingly important risk groups (as reflected in our simulations), and we call for more research on HIV among FSWs and MSM in Indonesia, including cost-effectiveness analyses of interventions that target these risk groups.

Third, our estimates regarding the impact of MMT were based on international evidence, as summarised in the impact matrix of the RNM (Bollinger et al., 2007), and may not necessarily reflect reality in Indonesia. However, the assumed impact compares well with evidence from pilot studies of MMT at eight sites, including Jakarta (Lawrinson et al., 2008). In Jakarta, opiate use dropped from 2.5 ± 1.4 to 0.43 ± 1.2 daily occasions of use after three months, and to 0.51 ± 1.2 daily occasions of use after six months. Blood Borne Virus Transmission Risk Assessment Questionnaire injecting risk scores (which indicate unsafe injecting behaviour) dropped from 19.05 ± 17.9 to 5.23 ± 13.1 after three months and to 3.83 ± 9.3 after six months. Self-reported abstinence rates varied between 69 and 100% at six months. In addition, a recent international systematic review (Gowing, Farrell, Bornemann, Sullivan, & Ali, 2011) of the impact of MMT supports the RNM matrix. Because of the absence of any Indonesian data to support reductions in condom non-use and the prevalence of injecting drug use after the implementation of MMT, we ran a sensitivity analysis excluding these reductions and found that study conclusions did not change.

Fourth, the present analysis considers the role of current IDUs in HIV epidemics, but ignores the impact of recreational and former IDUs. While MMT is not indicated for these groups, they may play a role in the HIV epidemic in West Java; both populations may be important bridges to transfer HIV infections originating from injecting drug use to the general population through sexual transmission. In a recent survey from Indonesia, 44% of IDUs were classified as former IDUs, of whom 66% were HIV-seropositive (Iskandar et al., 2010).

Fifth, our analysis is somewhat limited in scope because we did not consider antiretroviral treatment of IDUs. Treatment incurs costs and reduces the transmission of HIV; however, because only a small minority of all IDUs receives treatment, we do not expect treatment outcomes to change our study conclusions. Furthermore, our analysis did not value reductions in addiction-related crimes and risk behaviours, regular contact of IDUs with medical services, reestablishment of social and societal functioning, or collateral health effects. These aspects are difficult to measure and are seldom included in cost-effectiveness analyses.

Sixth, we present the cost-effectiveness of one intervention only, and use international cost-effectiveness thresholds to classify the interventions as very cost-effective. Ideally, all possible interventions to control HIV/AIDS in West Java should be ranked on the basis of their cost-effectiveness, and investments should be geared towards the most cost-effective interventions until the budget is exhausted.

Seventh, our analysis shows that an expansion of MMT is warranted, but it does not tell us how the expansion should be performed. IDUs are a stigmatised group, and harm reduction programs often lack political support or face legislative problems. A lack of national capacity to expand harm reduction programs, including issues of funding, has been observed throughout South-east Asia (Sharma et al., 2009). Expanding MMT to 40% would require full commitment from the entire public health system (staff commitment, infrastructure, materials) and political and legislative support. Therefore, to successfully expand MMT, careful consideration and continuous attention to the political and organisational challenges are needed.

In sum, our analyses suggest that MMT is a cost-effective HIV prevention measure, and support government policies to make MMT services widely available as an integrated component of HIV/AIDS control in West Java.

Acknowledgements

Data for this study were collected with support from a grant from the European Commission (SANTE/2005/105-033) to the IMPACT program. We are grateful to all IMPACT staff in Bandung for their support. More specifically, Rozar Prawiranegara, Dindin Komarudin, and Lucas Pinxten have been of great support and facilitated optimal working conditions.

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