Return on Investment and Cost-Effectiveness of Harm Reduction Programme in Malaysia

This report is part of the World Bank's technical assistance to Malaysia under Malaysia AIDS Support II project (P133134). The report was conducted under the overall guidance and supervision of Dr. Sutayut Osornprasop (Task Manager) and David Wilson (Programme Director) of the World Bank and Professor Dr. Adeeba Kamarulzaman of University of Malaya,

Herlianna Naning
Cliff Kerr
Adeeba Kamarulzaman
Maznah Dahlui
Chiu-Wan Ng
David P Wilson

Table of Contents

List of Tables 3
List of Figures 4
Acknowledgements 5
Abbreviations 6
EXECUTIVE SUMMARY 8
Objective 8
Population Model Methods 9
Economic analysis methods 9
Results 10
Conclusion 11
1. Introduction 12
2. Background 13
3. Study objectives 20
4. Methodology 21
5. Results 24
5.1 Estimates of impact on disease burden 24
5.2 Estimates of quality of life effects 28
5.3 Estimates of direct health care cost savings 29
5.3 Estimating the cost-effectiveness of harm reduction programme 32
5.4 Return on investments of the harm reduction programme 34
6. Discussion 35
7. Conclusion 42
APPENDIX A Epidemic Mathematical Transmission Model 43
APPENDIX B Literature search to obtain model input parameters 50
APPENDIX C1 Demographic and Prevalence Parameters 52
APPENDIX C2 Testing and Treatment Parameters 58
APPENDIX C3 Drug Behaviour Parameters 64
APPENDIX C4 Health utility weights by disease categories 70
APPENDIX C5 Economic Parameters 71
APPENDIX D Estimations of direct health care costs for HIV+ PWIDs 76
APPENDIX E Expenditures of NSP and MMT 81

List of Tables

Table 1. Average Number of Needles and Syringes Distributed per PWID per year, 2006-2011 18

Table 2. Estimates of past and future new HIV infections, infections averted and HIV prevalence with and without harm reduction programme, Malaysia, 2006 - 2050 25

Table 3. Estimates of past and future HIV mortality and HIV prevalence with and without harm reduction programme, Malaysia, 2006 - 2050 27

Table 4. Estimates of QALYs gained with MMT and NSP programmes, 2006 – 2050..... 29

Table 5. Health care costs for inpatient and outpatient HIV care borne by the GOM, 2010 31

Table 6. Estimates of cost savings from harm reduction programme, 2006 - 2050 32

Table 7. Government expenditures for MMT and NSP programmes, 2006 - 2011 32

Table 8. Government expenditures for MMT and NSP programmes, 2006 - 2050 33

Table 9. Estimates of return on investment with MMT and NSP programmes, 2006 – 2050 35

Table D1 Unit costs for laboratory tests and consultation fees..... 76

Table D2 Estimation of inpatient costs for HIV+ PWIDs at Sungai Buloh Hospital in 2010 80

List of Figures

Figure 1. New HIV Infections by Mode of Transmission, 2001-2012 14

Figure 2. Expansion in MMT sites, Malaysia 2006-2011 16

Figure 3. Expansion in NSP sites, Malaysia 2006-2011 17

Figure 4. Public expenditures for the MMT and NSP programmes, Malaysia, 2008-2011 .. 19

Acknowledgements

We would like to express our deep gratitude and appreciation to the Disease Control Division, Ministry of Health, Malaysia for their continuous support and contributions to this study especially toDr Chong Chee Kheong, Director of Disease Control Division; Dr Sha'ari Ngadiman, Head of AIDS/STD Section, Disease Control Division and Dr Fazidah Yusman, Senior Principal Assistant Director, AIDS/STD Section, Disease Control Division. We also would to thank the clinical specialist team at Sg Buloh Hospital, Datuk Dr Christopher Lee, Dr Suresh Kumar and Dr Benedict Lim for their valuable input and professional insights into this study. We also acknowledge the support provided by Dr Sangeeth Kaur, Assistant Medical Director, Treatment and Rehabilitation Department, National Anti-Drugs Agency for the valuable information on the HIV programmes conducted at the drug rehabilitation institutions, Richard Gray, Lei Zhang and Josephine Reyes of Kirby Institute for their technical inputs during the Malaysian team's technical visit to the Kirby, Institute, University of New South Wales. Our deepest gratitude to the World Bank for funding this research, in particular to Dr. Sutayut Osornprasop for his guidance and valuable support for this study and for his leading the technical review that helped improve the quality and rigor of this study. We would also like to thank the following World Bank team members for their contribution:- David Wilson, Toomas Palu, Lars Sondergaard, Xiaolu Bi, Noppakwan Inthapan, Nicole Fraser-Hurt, Dan Hogan, Frederico Gil Sander, Markus Haacker, Emiko Masaki, Pandu Harimurti and Marelize Gorgens.

Abbreviations

AIDS	Acquired immune deficiency syndrome
ART	Antiretroviral therapy
BSS	Behavioural Surveillance Survey
CERIA	Centre of Excellence for Research in AIDS
CPI	Consumer Price Indice
DALY	Disability-adjusted Life Year
DIC	Drop-in Centre
DU	Drug User
DRC	Drug Rehabilitation Centre
GDP	Gross Domestic Product
GFATM	Global Fund for AIDS, TB and Malaria
GP	General Practitioner
GOM	Government of Malaysia
HIV	Human immunodeficiency virus
IBBS	Integrated bio-behavioural Surveillance
ICER	Incremental cost-effectiveness ratio
MAC	Malaysian AIDS Council
MOH	Ministry of Health
MMT	Methadone Maintenance Therapy
MSM	Men who have sex with men
NADA	National Anti-Drug Agency
NGO	Non-government organisation
NSP	Needle Syringe Programme
PWID	People who inject drugs
PLHIV	People living with HIV/AIDS

QALY	Quality-adjusted Life Year
ROI	Return on investments
SBH	Sungai Buloh Hospital
UNAIDS	United Nations Programme on HIV/AIDS
UNODC	United Nations Office on Drugs and Crime
UNRTF	United Nations Regional Task Force

EXECUTIVE SUMMARY

Malaysia has recorded a cumulative total of over 98,000 persons infected with HIV by the end of 2012. The number of recorded cases of HIV infection in Malaysia is highest among people who inject drugs (PWID) which constitutes 67 per cent of the total cumulative cases. In the effort to mitigate the HIV transmission among PWID, the government of Malaysia initiated harm reduction programme comprising the Needle Syringe Programme (NSP) and Methadone Maintenance Therapy (MMT) in 2006. Since its inception as a National Pilot Project in 2006, the funding for the programmes has gradually been increased to increase the coverage of these programmes. During the phase of the harm reduction programme, the NSP was carried out by non-governmental organisations affiliated with the Malaysian AIDS Council whilst the MMT was provided by medical practitioners in the public and private health sectors. Since then the MMT programme has been expanded into the non-health sector and is being implemented by the prisons and the National Anti-Drug Agencies (NADA). By the end of 2011, the Malaysian government has invested a total of RM69.3 million for harm reduction programme. Despite the official recognition that the harm reduction programme may have been successful in reducing HIV transmission, concerns have been raised that public funding for these activities may not be sustainable in the long run and sources of alternative funding is desired. Thus, an assessment of the economic impact and cost-effectiveness of this programme is very much needed.

Objective: This project aimed to assess whether the harm reduction programme in Malaysia, which consists of NSP and MMT programmes amongst PWID, have been cost-effective from the *perspective of the government* by estimating savings in direct health care cost to the government resulting from infections that were averted as a result of the NSP and MMT programmes. The following estimates were included in the estimate of savings in direct health care costs; estimate the cost-effectiveness of the NSP and MMT programmes in terms of costs for the provision of programmes net of health care cost savings for each quality-adjusted-life years (QALYs) gained; estimate the return on investment (ROI) from NSP and MMT programmes where ROI refers to total health care costs saved from averted infections in comparison to total programme costs. The cost-

effectiveness and ROI of these programmes were evaluated over 3 time periods, from 2006 to current year 2013, a short 10-year future projection from 2013 to 2023, as well as projections from 2006 to 2050 to capture the long-term costs and benefits of the programmes.

Population Model Methods: An epidemiological mathematical model developed by a team of investigators at the Kirby Institute, University of New South Wales, Australia, was adopted to simulate the impact of MMT and NSP on the transmission of HIV among PWIDs in Malaysia. The model required input of HIV prevalence, behavioural and demographic data for PWID in Malaysia. The required information was obtained through an extensive review of published literature as well as other data sources from government agencies and non-government organisations (NGOs) involved in the provision of MMT and NSP services. The model simulates the number of PWID who become infected with HIV over time and the extent of disease progression among those infected in the presence and absence of harm reduction programme in the country. The model also tracks the number of people who were initiated on first-line antiretroviral therapy (ART), the rate of treatment failure and progression to second- and subsequent-lines of ART.

Economic analysis methods: The epidemic model results were used to assess the cost-effectiveness of the programmes. The cost of harm reduction programme and ART were obtained directly from the Ministry of Health (MOH). A separate costing exercise was carried out to derive the costs of inpatient and outpatient treatment for PWIDs living with HIV. All costs and benefits were reported for the base year 2013. The relevant years' Consumer Price Indices (CPIs) were used to adjust for inflation. A three per cent discount rate was applied for future costs and benefits. The economic analysis of outcome of interest are including direct health care cost saved, QALYs gained, incremental cost effective ratio (ICER) and ROI. The analysis was estimated for combined NSP and MMT programmes as well as independently for NSP and MMT.

Results

Combined MMT and NSP: Over a period of 2006 to 2013, the combined MMT and NSP programmes were found to be cost-effective. The programmes implemented to date will have long term epidemiological and economic benefits.

Outcomes	2006-2013	2013-2023	2006-2050
Number of infections averted	12,653	23,241	103,717
Healthcare cost saved (mil)	RM47.06	RM209.53	RM909.47
QALYs gained	51,565	393,526	2,164,809
ICER (RM/QALYs gained)	2,456	1,611	1,482
ROI	RM0.51	RM1.07	RM1.13

NSP only: It was found that implementing NSP alone would be cost-effective and cost-saving within all the observed time frames.

Outcomes	2006-2013	2013-2023	2006-2050
Number of infections averted	12,191	22,257	101,081
Healthcare cost saved (mil)	RM45.53	RM200.88	RM881.76
QALYs gained	28,591	316,852	316,852
ICER (RM/QALYs gained)	Cost-effective	Cost-effective	Cost-effective
ROI	RM1.35	RM3.18	RM3.35

MMT only: During the 2006-2013 periods, the MMT programme alone is cost-effective but not cost saving. Projection of expected future epidemiological and economic benefits show MMT programmes would improve in their cost-effectiveness ratios but not become cost saving. It is worth noting that only HIV-related benefits and costs were included in these analyses. MMT is primarily implemented for reduction of drug use and the many other social benefits that result. These benefits are not included in the analyses. Therefore, the overall cost-effectiveness of the NSP and MMT programmes

represent a significant under-estimate of the overall cost-effectiveness of the harm reduction programme.

Outcomes	2006-2013	2013-2023	2006-2050
Number of infections averted	1,597	6,787	38,092
Healthcare cost saved (mil)	RM3.85	RM41.56	RM265.11
QALYs gained	22,996	123,422	901,351
ICER (RM/QALYs gained)	2,354	723	308
ROI	RM0.07	RM0.31	RM0.49

Conclusion: The study provides strong evidence that even with the present moderately low coverage, MMT and NSP programmes are an effective and cost-effective strategy for averting HIV infections in Malaysia.

1. Introduction

Cases of human immunodeficiency virus (HIV) infections were first detected in Malaysia in 1986 (Ministry of Health, 2012). Since then, the number of new HIV cases has been increasing steadily to a peak of 6,978 new cases detected in 2002 then declining to 3,438 new cases in 2012. By the end of 2012, the country recorded a cumulative total of 98,279 persons diagnosed with HIV infection, 19,047 of them with Acquired Immunodeficiency Syndrome (AIDS) and 15,688 HIV/AIDS related deaths. Despite the declining number of new infections, the challenge of controlling the spread of HIV is far from over and the HIV disease burden remains high among several key populations, namely female sex workers, transgenders, men who have sex with men (MSM) and people who inject drugs (PWID). Of these, the number of HIV cases has been highest among PWID where it has been estimated that 67.2 per cent of the cumulative reported HIV cases from 1986 to 2012 (or 66,046 out of the total of 98,279 cases) are made up of PWID (Ministry of Health, 2012). Due to the high numbers of PWIDs among those with HIV, Malaysia has been described as experiencing a severe HIV epidemic due to drug use similar to countries such as Russia, China, Ukraine and Vietnam (Wolfe et al., 2010).

In response to the escalating epidemic, the Government of Malaysia (GOM) agreed the implementation of NSP and MMT programmes against much public opposition which viewed these programmes as being against the Islamic religion and would encourage more people to use drugs. Beginning with a one year pilot programme, the harm reduction has been expanded with considerable resources being allocated for its implementation which has come almost exclusively from the public purse. It was reported that almost 40 per cent of the 2006-2010 budget allocation of RM500 million for HIV/AIDS prevention activities was set aside for harm reduction activities (Ministry of Health, 2010b). In common with many other countries, there are multiple competing interests on public funds in Malaysia. Although there has been some official recognition that the harm reduction programme may have been successful in reducing HIV transmission, the government has also raised concerns that public funding for these activities may not be sustainable in the long run and that alternative funding sources for these activities need to be obtained (Ministry of Health, 2012). Since 2012, mainly funding for such activities has also been supplemented by international agencies including the Global

Fund for AIDS, TB and Malaria (GFATM) and the International HIV/AIDS Alliance although the GOM remains the single largest funding source (Ministry of Health, 2012).

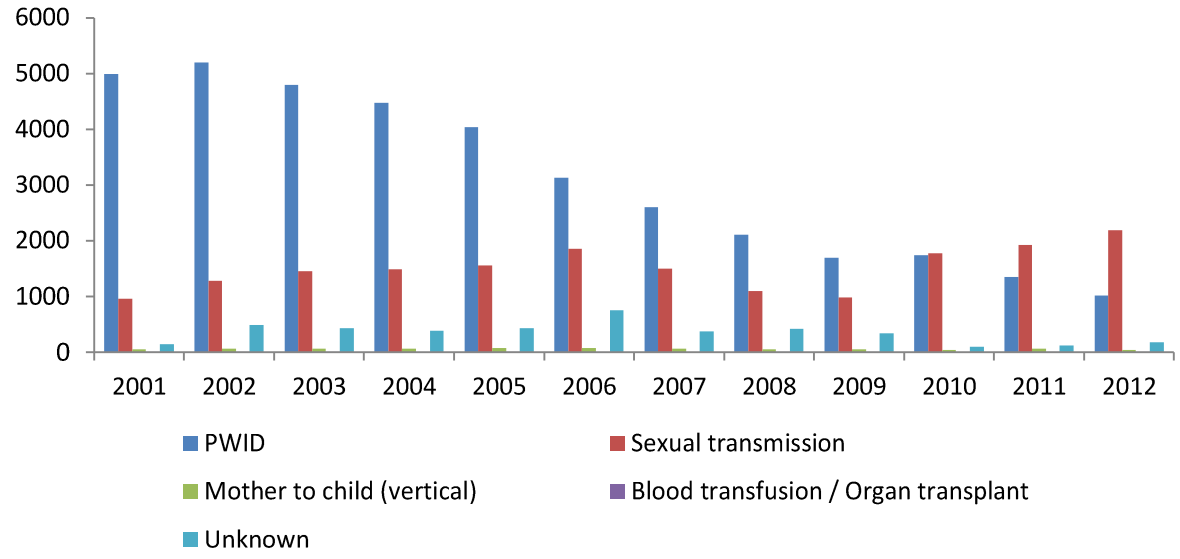
This economic evaluation of the harm reduction programme is primarily aimed at evaluating the level to which NSP and MMT as implemented in Malaysia have been effective in averting HIV infections and whether these programmes have also resulted in cost savings to the government. Similar evaluations have been performed in several developed countries and in different programme settings which have all indicated that the programmes were cost-effective and cost-saving (Gold et al., 1997, Laufer, 2001, Cabases and Sanchez, 2003, Commonwealth Department of Health and Ageing 2002, Barnett, 1999, Razzaghi et al., 2005, McCarty et al., 2010). Such economic appraisal however has yet to be performed in Malaysia. Evidence produced would be useful to inform policy debate concerning future allocations of public funds for HIV/AIDS prevention activities.

2. Background

The HIV epidemic in Malaysia has thus far been mainly concentrated in four key affected populations with the prevalence amongst the general population estimated at less than one per cent. Results from the 2012 Integrated Bio-Behavioural Surveillance Survey (IBBS) conducted by the MOH in multiple selected sites throughout the country reported HIV prevalence rates of 4.2 per cent among female sex workers, 5.7 per cent among transgenders, 12.6 per cent among MSM and 18.9 per cent among PWIDs (Ministry of Health, 2013). An earlier IBBS, which was carried out in 2009 in sites around the Klang Valley, which are areas around the capital city of Kuala Lumpur, examined the HIV prevalence among the transgenders (9.3 per cent), FSWs (10.5 per cent) and PWID (22.1 per cent) (Ministry of Health and Malaysian AIDS Council, 2009). While PWID remain the largest group of people living with HIV (PLHIV), over the last several years there has been a gradual shift in the predominant mode of HIV transmission in the country. In 1990, there was one sexual transmission for every nine infections attributed to injecting drug use (Ministry of Health, 2012). Twenty years later in 2010, equal numbers of new HIV cases are reported from injecting drug use and sexual

transmission. In 2011, the trend has been reversed altogether with six sexual transmissions reported for every four from injecting drug use (Figure 1).

Figure 1. New HIV Infections by Mode of Transmission, 2001-2012



Source: Ministry of Health, 2012

Harm reduction in the context of HIV prevention in Malaysia basically refers to two programmes, the Methadone Maintenance Therapy (MMT) programme and the Needle Syringe Exchange Programme (NSP). The MMT programme is an opioid substitution therapy using methadone and is aimed at preventing HIV transmission by reducing injection drug use and the sharing of contaminated injecting equipment. Thus, the MMT programme reduces high-risk practices among PWID and the likelihood of sero-conversion due to its role in reducing injection frequency. Most studies in Malaysia have shown that heroin is the most commonly used drug amongst PWID in Malaysia. The IBBS study conducted in 2009 in the Klang Valley found that approximately 87 per cent of PWIDs in noted to use heroin[1] (Ministry of Health and Malaysian AIDS Council, 2009). An earlier Behavioural Surveillance Survey (BSS) study in 2004 among PWID in three states across the

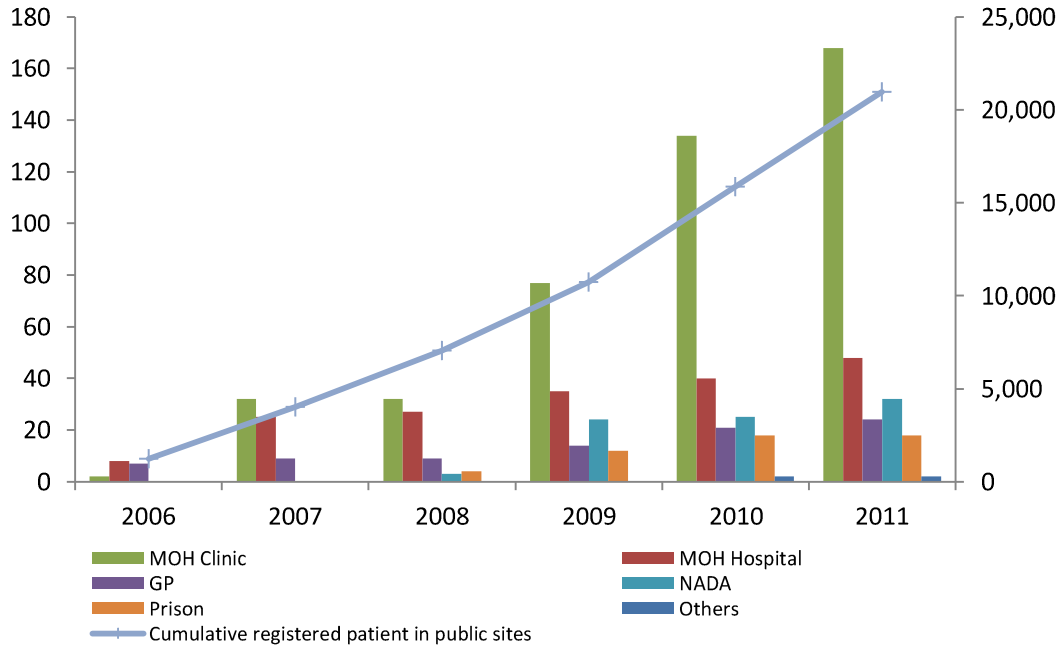
[1] Other drugs used are non-opiates such as diazepam, amphetamines and Subutex.

peninsular Malaysia reported similar finding that majority PWID used heroin (Ministry of Health and WHO, 2004)

The MMT programme in Malaysia provides a working example of public-private partnership in health right from its beginnings in 2006 when methadone was made available from only 17 sites (10 public health facilities and seven private clinics). There has since been a rapid expansion of the programme such that by 2011, 20,955 persons had registered to receive free services from 268 public sector MMT sites, including MOH facilities, prisons and National Anti-Drug Agency (NADA) service centres, and another 23,573 persons paid for services obtained from a network of 24 private general practitioner (GP) clinics[2]. The public sector MMT providers are mainly made up of MOH health care facilities, followed by prisons and NADA (Figure 2). From 2007 to 2011, the number of clients receiving services in all public sector MMT service providers had more than quadrupled. In general, the services provided under the MMT programme by public providers, namely the MOH, prisons and NADA are similar and include provision of methadone, Voluntary Counselling and Testing (VCT) and referral to HIV clinics for treatment. In the case of MOH and NADA, programme clients are also offered referrals for job opportunities whilst private GPs generally only provide methadone with little or no other support services.

[2] Data and information obtained directly from the Disease Control and Prevention Division of the MOH.

Figure 2. Expansion in MMT sites, Malaysia 2006-2011



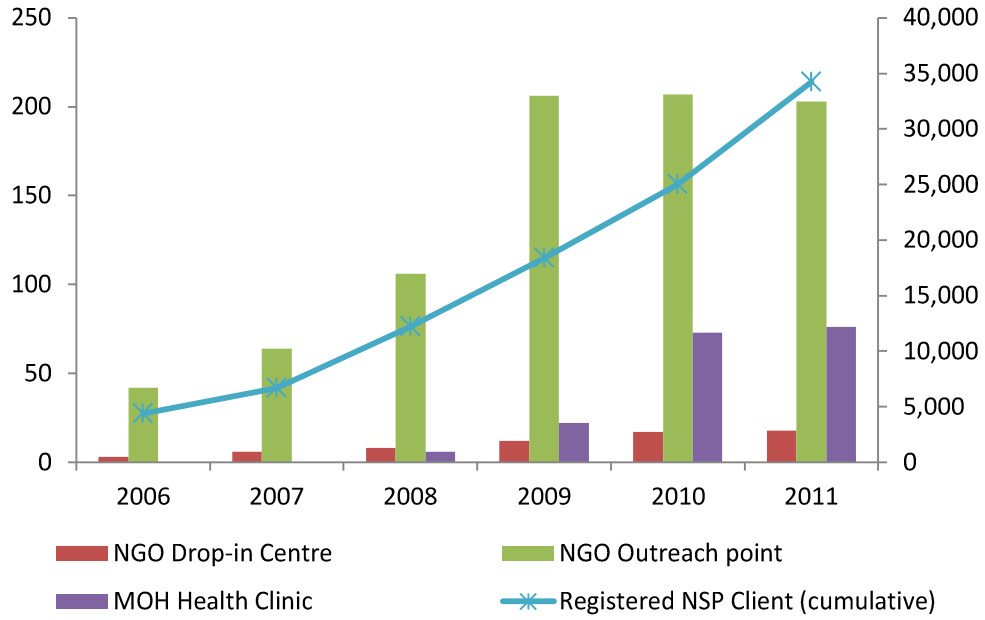
Source: Data obtained directly from from the Disease Control and Prevention Division of the MOH

On the other hand, the NSP is aimed at the provision of clean needles and syringes to PWIDs in order to reduce cross HIV infections among PWIDs through sharing of contaminated needles and other injecting equipment. Delivery of the NSP programme was through a direct partnership with NGOs, namely the Malaysian AIDS Council and her partner organisations. The NSP programme started in 2006 with only three NGOs which operated three drop-in centres (DICs) and 42 outreach points and which collectively provided services to a total of 4,357 PWIDs. In 2008 NSP services were implemented in six MOH clinics as well. By 2011, 34,244 PWIDs had registered to receive NSP services from 18 NGOs (operating 18 DICs and 203 outreach points) and 76 MOH clinics[3] (Figure 3). In general, all NSP clients receive packages consisting of sterile needle and syringes and other safe injecting paraphernalia such as alcohol swabs and cotton balls. In addition to these, clients are also provided with risk reduction counselling such as safer injection techniques and hygiene issues, and

[3] Data and information obtained directly from the Disease Control and Prevention Division of the MOH.

referrals to MMT services, welfare and legal services, VCT and other health care services when warranted.

Figure 3. Expansion in NSP sites, Malaysia 2006-2011



Source: Data obtained directly from from the Disease Control and Prevention Division of the MOH

In 2011, an average of 429 needles and syringes had been distributed to every PWID who registered with the NSP programme or 24 needles and syringes for every PWID in the country (Table 1). In comparison, it has been estimated that PWIDs in other countries in Southeast Asia received between 7 to 68 needles and syringes per year (Mathers et al., 2010).

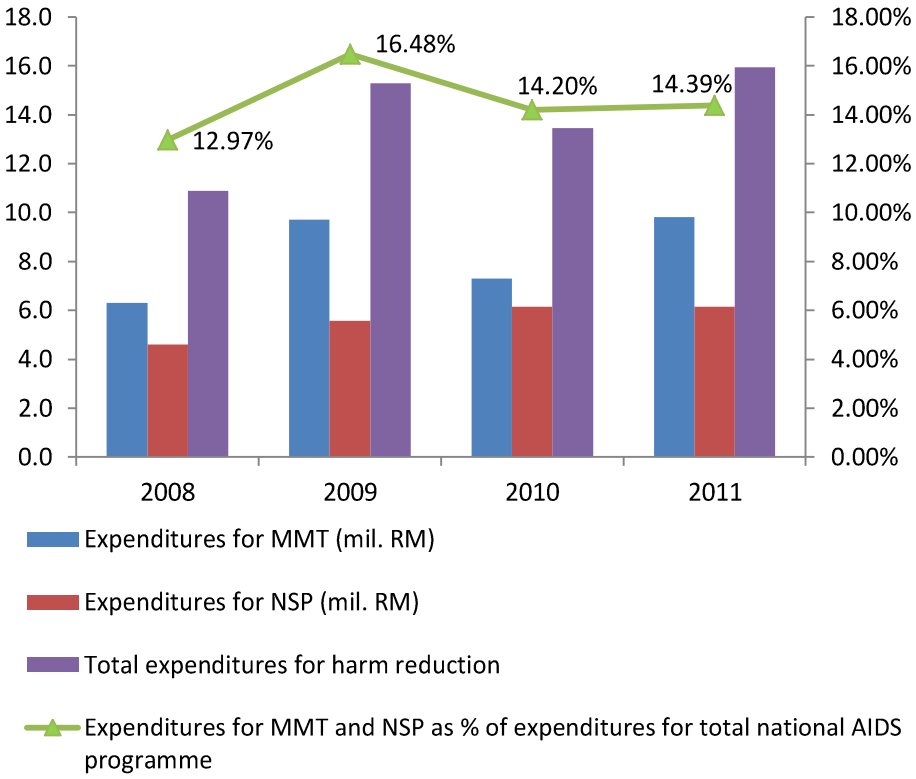
Table 1. Average Number of Needles and Syringes Distributed per PWID per year, 2006-2011

	2006	2007	2008	2009	2010	2011
Number of needles/syringes distributed[1]	536,309	1,158,500	1,903,174	2,497,261	2,897,379	3,966,369
Estimated PWID populations[2]	180,286	176,857	173,429	170,000	166,571	163,143
Average number of needles/syringe per PWID	3.0	6.6	11.0	14.7	17.4	24.3
Number of registered PWID[1]	4,357	2,301	5,572	6,147	6,622	9,245
Average number of needles/syringes per registered PWID	123.1	503.5	341.6	406.3	437.5	429.0

Sources:
1. Data obtained directly from MOH
2. Population of PWID is the estimate used in this study

With the sole exception of MMT services obtained from private clinics, the cost of providing MMT and NSP services had been predominantly borne by the GOM. In 2008, the financial support for the two harm reduction programme constituted 12.6 per cent of the total public expenditures for the national AIDS programme amounting to RM84.0 million (Ministry of Health, 2010b). As shown in Figure 4, the annual MOH expenditures for harm reduction activities made up between 13.0 per cent and 16.5 per cent of the annual total AIDS public expenditures. And to put everything into perspective, the national AIDS public expenditures made up 0.28 per cent of MOH's total expenditures in 2008 and 0.27 per cent in 2009 (Ministry of Health, 2010b).

Figure 4. Public expenditures for the MMT and NSP programmes, Malaysia, 2008-2011



Sources : Information from MOH and (Ministry of Health, 2010b, Ministry of Health, 2012)

Despite the government's commitment to harm reduction activities, the coverage of the programmes remained limited. In 2009, it was estimated that less than 12 per cent of the estimated 170,000 PWID, had access to NSP (Ministry of Health, 2010a). Among the reasons identified as being barriers to adequate expansion of services were insufficient funds, human resources and infrastructure (Ministry of Health, 2010a). Unlike many neighbouring countries such as Indonesia, Vietnam, Thailand and Cambodia which have received substantial international funds for HIV prevention and treatment programmes, international donor funding has not played a significant role in the financing of HIV/AIDS programmes or health care in general in Malaysia (Ministry of Health Malaysia, 2011). This is probably in line with international sentiments that Malaysia, being an upper middle income country would be in a better position than many other low and middle income countries to self-support the provision of health care services to its population. In 2009, the country spent

approximately 5.0 per cent of her GDP on health (Ministry of Health Malaysia, 2011). Public financing sources contributed slightly more than half of the total expenditures or 2.7 per cent of GDP. This amount is much less than that committed by many other countries of similar economic development and thus, it can be argued that Malaysia could afford to increase public funding for health care and in the context of this study, it can also be argued that the country can afford to increase public funding of harm reduction activities. In 2011, to supplement the domestic funds allocated to harm reduction, Malaysia was successful in obtaining funds from GFATM to supplement funding of its HIV prevention activities. In June 2011, the MOH received RM15 million for five years to increase NSP coverage and to strengthen intervention programmes for sex workers. As financial aid from the Global Fund is not intended for long-term support of country-level programmes, the GOM will need to re-examine its commitment to harm reduction activities by sustaining and impact expanding the funds that are allocated for HIV prevention and treatment programmes, in particular the harm reduction programme. In essence, this study is to provide evidence to inform policy decision making on this matter.

3. Study objectives

The main objectives of this study are to evaluate whether the harm reduction programme in Malaysia is cost-effective and also whether they provide return on investments to the government. The cost-effective evaluation is aimed at examining whether the harm reduction programme represent value for money from the viewpoint of society, i.e. the benefits obtained justify the money spent by the government. On the other hand, the ROI analysis examines whether these programmes provide cost-savings to the government, who is the main programme funder. As such, this economic evaluation has been conducted from the government perspective only. Cost of provision of MMT from private practitioners has not been included in the analysis.

Specifically, the study aims to:

i. evaluate the effectiveness of MMT and NSP in preventing transmissions of HIV among PWID in terms of number of HIV infections averted through harm reduction;

ii. estimate savings in direct health care cost to the government resulting from the averted infections;

iii. estimate the quality of life (QoL) gained from harm reductions programmes as measured using Quality-Adjusted Life Years (QALYs);

iv. estimate the cost-effectiveness of the MMT and NSP programmes in terms of costs for the provision of programmes net of health care cost savings for each QALY gained;

v. calculate the ROI from MMT and NSP programmes where ROI refers to total health care costs saved from averted infections in comparison to total programme costs; and

vi. provide recommendations for resource allocations for harm reduction activities in Malaysia.

4. Methodology

The study used an epidemiologic mathematical model of HIV transmission and disease progression, called the Projection and Evaluation Tool (Prevtool) developed by a team of investigators at the Kirby Institute, University of New South Wales, Australia to simulate the impact of MMT and NSP on the transmission of HIV among PWIDs in Malaysia. A description of Prevtool is provided in Appendix A. Briefly, the model simulates the number of PWID who become infected with HIV over time as well as the extent of disease progression among those infected in the presence and absence of harm reduction programme in the country. The model considers both direct transmission of HIV from sharing of contaminated injecting equipment as well as onward transmission from these infected PWID to others.

Clinical protocol in Malaysia prescribes differential levels of health care to PLHIV dependent on their CD4 counts. In this respect, the provision of health care to PLHIV differs in terms of frequency of outpatient consultations, tests performed and initiation of ART depending on the stage of disease. Thus, in order to estimate the expected demand for health care, Prevtool categorises PLHIV by CD4

count groupings. The model also tracks the number of people who were initiated on first-line ART, the rate of treatment failure and progression to second- and subsequent-lines of ART.

Use of the Prevtool model required input of epidemiological, behavioural, demographic and health care cost data for PWID in Malaysia. The required information was obtained through an extensive review of published literature as well as other data sources including government agencies and NGOs involved in the provision of MMT and NSP services (Appendix B). Appendices C1 to C5 list all model input parameters used in the study, their descriptions, values, data sources and assumptions. Although some risk behaviours may differ by gender, the model inputs had not been stratified by gender. This is not expected to have a large impact on the results of this analysis since more than 90 per cent of the PWIDs in Malaysia are males (Ministry of Health, 2009). A separate costing exercise was carried out to derive the annual direct health care costs of treating PWIDs living with HIV. Appendix D provides details of this costing study. Model outputs are provided as medians with 95 per cent confidence intervals.

One of the main aims of this study was to explore whether the MMT and NSP programmes as implemented in Malaysia were cost-effective or in other words whether these programmes represent value for money. This required the estimation of a measure, the incremental cost-effectiveness ratio (ICER) which compares programme costs to additional health gains from harm reduction activities. In order to conclude whether the programmes have been cost-effective, it would be necessary to compare the ICER values to a cost-effectiveness threshold which is generally understood to be the maximum societal willingness to pay for a unit of health gain either measured in life years gained, disability-adjusted life years (DALY) averted or QALYs gained (Eichler et al., 2004). As yet there is no such threshold which has been openly debated and accepted in Malaysia nor is there a global consensus on how high this threshold should be set. However, based on the report of the Commission on Macroeconomics and Health (World Health Organisation, 2001), the WHO has suggested that for developing countries, *"interventions costing less than three times GDP per capita for each DALY averted represent good value for money"* and further that, *"very cost-effective interventions as those*

which avert each additional DALY at a cost less than GDP per capita, and cost-effective interventions as those where each DALY averted costs between one and three times GDP per capita" (World Health Organisation, 2002).

In 2012, the per capita GDP for Malaysia was RM29,683 or nearly RM30,000 (approximately USD10,00) (Department of Statistics Malaysia, 2012). In this study, health gains have been measured in QALYs. Theoretically a DALY averted is not equivalent to a QALY gained, and therefore the WHO cost-effectiveness threshold cannot be directly translated to RM90,000 per QALY for Malaysia. However, Eichler et al (2004) compared DALY and QALY weights in a broad range of disease categories and concluded that the value of the WHO threshold of three times GDP in DALY would exceed equivalent values in QALY. Thus, this study applied the value of RM90,000 per QALY gained as the conservative threshold for evaluation of cost-effectiveness of harm reduction programme in Malaysia.

Prevtool was used to estimate the cost-effectiveness and ROI of the harm reduction programme in Malaysia from the start of the programmes in 2006 to current year 2013, a short 10-year future projection from 2013 to 2023, as well as projections from 2006 to 2050 to capture the long term costs and benefits of the programmes. For purposes of model calibration, parameters involving epidemiological and behavioural data used covered the period 2000 to 2013. However, the effectiveness of the programme was evaluated only after the harm reduction started in 2006. Future projections, from 2013, were made based on the assumption that the programme coverage remained at constant at 2013 levels but with changing programme costs in tandem with changes in target PWID population. Similarly, health care costs savings also changed with changes in estimated averted infections. All costs and benefits are reported for the base year 2013. Where necessary, adjustments were made for inflation using Consumer Price Indices (CPI) obtained from the Department of Statistics, Malaysia. A three per cent discount rate was applied for future costs and benefits.

5. Results

5.1 Estimates of impact on disease burden

From 2006 to 2013, it is estimated that 20,903 new HIV infections occurred after the implementation of the MMT and NSP programmes (Table 2). This is in contrast to the estimated 34,220 new infections for the period 2006 to 2013, had these programmes not been implemented. Thus the harm reduction programme averted approximately 12,653 new HIV infections. It is expected that continuing the harm reduction programme to 2023 at the current 2013 coverage level, MMT and NSP would avert an additional 23,241 new infections.

Table 2. Estimates of past and future new HIV infections, infections averted and HIV prevalence with and without harm reduction programme, Malaysia, 2006 - 2050

Harm Reduction Programme	2006 – 2013	2013 – 2023	2006-2050
A. Number of new infections			
None	34,220 (23,495 – 40,444)	27,118 (14,562 – 35,238)	134,345 (69,943 – 177,724)
Combined MMT and NSP	20,903 (15,826 – 25,460)	3,596 (2,023 – 4,334)	27,979 (18,901 – 32,550)
NSP alone	21,422 (16,116 – 26,014)	4,566 (2,526 – 5,551)	30,971 (20,163 – 35,728)
MMT alone	32,594 (22,577 – 38,589)	20,353 (10,846 – 26,220)	96,461 (50,450 – 127,982)
B. Number of infections averted			
None	NA	NA	NA
Combined MMT and NSP	12,653 (7,518 – 14,984)	23,241 (12,517 – 30,697)	103,717 (50,546 – 148,890)
NSP alone	12,191 (7,236 – 14,430)	22,257 (12,001 – 29,450)	101,081 (49,233 – 145,036)
MMT alone	1,597 (921 – 1,885)	6,787 (3,715 – 9,018)	38,092 (19,176 – 51,013)

Note: NA not applicable.

Numbers in parenthesis refer to the 95 per cent confidence intervals of estimates.

Table 3 shows the reduction in HIV prevalence among PWIDs in the various time periods evaluated. Under the situation in which both MMT and NSP had been implemented and assuming that the programme coverage of 2013 remains a constant, prevalence of HIV among the PWIDs is expected to be nine per cent in 2013, dropping to four per cent in 2023 and one per cent in 2050. In the absence of these programmes, the prevalence is estimated to be 14 per cent in 2013 and 16 per cent in 2023 and 2050. This reduction of HIV prevalence is mainly attributed to uptake of harm reduction among PWIDs and can be explained by both a reduction in incidence of HIV (Table 2) as well as reduction in mortality among PWIDs (Table 3). Reduction in mortality among PWID in the presence of MMT and NSP is assumed to be due to reduced numbers of infected PWIDs since other model parameters, including uptake of ART, have not been varied.

Model estimations suggest that the averted infections and concomitant reduction in HIV prevalence had been mainly due to the impact of the NSP rather than the MMT programme (Tables 2 and 3).

Table 3. Estimates of past and future HIV mortality and HIV prevalence with and without harm reduction programme, Malaysia, 2006 - 2050

Harm Reduction Programme	2006 – 2013	2013 – 2023	2006-2050
A. Cumulative HIV deaths			
None	33,204 (28,369 – 35,747)	20,585 (13,272 – 24,218)	114,523 (69,575 – 133,910)
Combined MMT and NSP	32,541 (27,454 – 34,770)	9,255 (7,155 – 11,409)	46,514 (39,142 – 52,804)
NSP alone	32,566 (27,470 – 34,809)	9,732 (7,416 – 11,908)	48,069 (40,373 – 55,106)
MMT alone	33,172 (28,296 – 35,691)	18,379 (12,199 – 21,969)	92,338 (59,650 – 107,161)
B. HIV prevalence[1]			
None	14 (12 – 17)	16 (11 – 20)	16 (9 – 22)
Combined MMT and NSP	9 (7 – 10)	4 (3 – 5)	1 (1 – 1)
NSP alone	9 (7 – 10)	4 (3 – 6)	1 (1 – 1)
MMT alone	13 (11 – 17)	13 (9 – 16)	9 (4 – 13)

Note: [1]Estimated prevalence at the end of the corresponding time period.

Numbers in parenthesis refer to the 95 per cent confidence intervals of estimates.

5.2 Estimates of quality of life effects

The harm reduction programme prevented PWIDs from being infected by HIV. For this group of people, the MMT and NSP programmes provide QoL benefits from two aspects. The most obvious is the prolongation of lives of those who would have been infected. The second is from the avoidance of morbidity and social consequences of HIV infection. These Qol effects of harm reduction have been measured using the quality-adjusted life years (QALYs) approach.

QALYs combines measurement of the benefits gained from prolongation of life for those who avoided infections as well as the benefits gained from reduction in physical and mental suffering for those who avoided living with the infection into a single measure. One QALY is equivalent to living one year in perfect health. Estimations of QALYs require QoL values for different stages of the HIV illness. QALYs gained would then be the estimated time in which persons had avoided living in each stage of the disease multiplied by the relevant QoL value for that disease stage. In this study, the cumulative length of time avoided in each disease stage was estimated using PrevTool. In this analysis, the QoL values applied to these estimates were obtained from a published meta-analysis of utility for HIV/AIDS and available relevant utility for HIV-related deaths (Tengs and Lin, 2002). Details of these QoL weights by disease states are provided in Appendix C4.

As opposed to the NSP programme in which QoL improvement is mainly due to avoidance of HIV infection, PWIDs who undergo MMT may also experience improvement in other social aspects of their lives such as reduction in recidivism, increase productivity at work and other psychosocial benefits (Huong et al., 2009, Razzaghi et al., 2005, Musa et al., 2012). The MMT programme participants enjoy greater social integration since they suffer less from side effects of drug addiction. This analysis has also factored in this aspect of QoL improvement for all participants of the MMT programme (Salomon et al., 2012).

It is estimated that the harm reduction programme have resulted in gains of approximately 51,565 QALYs in the period 2006 to 2013 with an eight-fold increase in benefits for the period 2013 to 2023

and a 40-fold increase for the period from 2006 to 2050 (Table 4). These large future gains in benefits are not unexpected since QoL impact on persons newly infected with HIV is expected to be small compared to the impact later in the life-course of infection when they develop co-morbidities or even AIDS. However, even after incorporating the QoL improvement of MMT due to the social aspects, the QALYs gained from MMT alone are lower than that for NSP.

Table 4. Estimates of QALYs gained with MMT and NSP programmes, 2006 – 2050

Harm Reduction Programme	**Number of QALYs gained**		
	2006 – 2013	**2013 – 2023**	**2006-2050**
Combined MMT and NSP	51,565	393,526	2,164,809
	(38,672 – 58,119)	(254,380 – 448,703)	(1,202,338 – 2,869,765)
NSP alone	28,591	316,852	1,819,945
	(20,682 – 35,989)	(193,935 – 369,626)	(952,618 – 2,550,684)
MMT alone	22,996	123,422	901,351
	(20,490 – 24,832)	(87,188 – 131,941)	(547,624 – 1,113,563)

Note. Estimates are medians with 95% confidence intervals provided in parentheses.

5.3 Estimates of direct health care cost savings

Health care services for PLHIV as well as ART drugs (first and second-line drugs) are primarily funded by the government. Harm reduction programme would thus provide for some cost-savings to the government since they prevent HIV transmission to some PWIDs who would then not require HIV-related health care services.

In Malaysia, PLHIV would be eligible for ART once their CD4 counts reach below 350 cells/mL. In 2010, the annual cost of providing first-line ART drugs[4] was RM 2,684 per person and if second-line drugs[5] were provided, the cost would have been RM13,643 per person[6] .

Most of the PWIDs who have been infected with HIV would seek care in public health facilities. The main public agency providing care to the PWIDs is the MOH. Other agencies such as the academic medical centres supplement services provided by the MOH. The care provided in all public facilities is highly subsidised by the GOM through use of funds from general taxation. Although all public health care facilities charge user fees for most of their services, these fees have been kept low[7]. Rohaizat (2004) estimated that the revenue collected from patients through user fees was far below the cost of care and contributed only about three per cent of the MOH's annual budget. The annual government subsidy for health care consumed by each infected PWID for the year 2010, which represents the cost of health care borne by the GOM, was estimated in a cost description exercise detailed in Appendix D. Since existing clinical protocols prescribes health care regimes by CD4 counts, cost estimates had been conducted separately for those persons with CD4 counts above 350 cells/mL and those whose cell counts were below this level. The estimated annual outpatient and inpatient care costs for infected PWIDs who sought treatment are summarised in Table 5.

[4] First line regimen consist of Stavudine, Lamivudine and Nevirapine, or Combivir and Efavirenz, or Combivir and Nevirapine.
[5] Second line drugs are Combivir in combination with Kaletra.
[6] Data and information obtained directly from the Disease Control and Prevention Division of the MOH.
[7] A patient needs to pay only RM1 (approximately USD1 for RM3) for an episode of outpatient care (inclusive of consultation, investigations and medications) at any MOH general outpatient clinic. Many services provided at these clinics are also free and these include childhood vaccination services. Fees for inpatient care in MOH hospitals are also controlled and set lower than cost. The daily ward charges in a MOH hospital range from RM80 a day for a single bedded air-conditioned room (First Class) to RM3 a day in a dormitory-like Third Class ward. Fees for surgical treatment depended on the complexity of procedures and ranges from RM3,000 for a 'Type A' procedure (e.g. renal transplant) for a First Class patient to RM10 for a 'Type F' procedure (e.g. circumcision) for a Third Class patient.

Table 5. Health care costs for inpatient and outpatient HIV care borne by the GOM, 2010

Category of CD4 counts	Annual per capita health care costs (RM)		
	Inpatient Care	**Outpatient Care**	**Total**
CD4<350 cells/mL	15,683	1,461	17,144
CD4≥350 cells/mL	NA[1]	974	974

Note: [1]NA – not applicable. It is assumed that only PLHIV with CD4 counts below 350 cells/mL would require inpatient care for HIV related conditions.

Combining the estimated number of infections averted with the health care costs incurred, Prevtool estimated that over the period of eight years from 2006 to 2013, MMT and NSP programmes resulted in cost savings of approximately RM 47.1 million (Table 6). In the next 10 years, the model estimated that a further RM 209.5 million would have been saved. The Prevtool is also used to estimate projection of cost saving if the programmes were to continue until 2050. It was estimated that MMT and NSP programmes would save approximately RM909.5 million, from 2006 to 2050 in health care costs. As is shown in the table, cost savings were mainly from the NSP programme.

Table 6. Estimates of cost savings from harm reduction programme, 2006 - 2050

Harm Reduction Programme	Total health care cost savings (mil. RM)		
	2006 – 2013	2013 – 2023	2006-2050
Combined MMT and NSP	47.06	209.53	909.47
	(30.53 – 58.50)	(114.10 – 248.26)	(441.71 – 1182.40)
NSP alone	45.53	200.88	881.76
	(29.51 – 56,60)	(109.44 – 238.00)	(427.50 – 1144.88)
MMT alone	3.85	41.56	265.12
	(2.39 – 4.69)	(22.83 – 50.47)	(130.72 – 343.08)

Note. Estimates are medians with 95% confidence intervals provided in parentheses. All estimates have been adjusted to base year 2013.

5.3 Estimating the cost-effectiveness of harm reduction programme

Table 7 provides details of actual government expenditures for the MMT and NSP programmes for the years 2006 to 2011 as provided by the MOH. In the case of MMT, these expenditures include costs for human resources, facility overheads and purchase of methadone for distribution in public facilities. In the case of NSP, the amounts are funds channelled to NGOs for delivery of services. Details of expenditure breakdown are provided in Appendix E.

Table 7. Government expenditures for MMT and NSP programmes, 2006 - 2011

Harm Reduction Programme	Estimates of Programme Cost* (mil. RM)					
	2006	2007	2008	2009	2010	2011
MMT	4.3	5.9	6.3	9.7	7.3	9.8
NSP	1.3	2.2	4.6	5.6	6.2	6.1
Total	**5.6**	**8.1**	**10.9**	**15.3**	**13.5**	**15.9**

Note* Nominal values.

Source: Disease Control and Prevention Division, MOH

Using available information, the model projected the expenditures for years 2012 and 2013. It is estimated that from 2006 to 2013, the total government investments for harm reduction totalled RM92.0 million, comprising of RM58.2 million for the MMT programme and RM33.8 million for the NSP programme (Table 7).

Table 8. Government expenditures for MMT and NSP programmes, 2006 - 2050

Harm Reduction Programme	Estimates of programme costs (mil. RM)		
	2006 – 2013	2013 – 2023	2006-2050
Combined MMT and NSP	91.98	195.34	801.97
NSP alone	33.81	63.20	263.18
MMT alone	58.17	63.20	538.79

Note. Estimates are medians with 95% confidence intervals provided in parentheses. All estimates have been adjusted to base year 2013.

These programme costs were then compared to the estimated QALYs gained from the MMT and NSP programmes (Table 4) and health care savings (Table 6). The incremental cost-effectiveness ratios (ICER) of these harm reduction programme were estimated in comparison to the baseline scenario in the absence of such programmes. The ICER values are that of costs for each programme net of health care savings per QALY gained from the programme. In the case of NSP programme alone, the health care costs savings exceeded programme costs for all the time periods examined and thus regardless of cost-effectiveness threshold used, NSP can be considered very cost-effective. In the case of the MMT programme implemented alone, the health care costs were higher than programme costs but ICER values for all the time periods showed that the MMT programme if implemented alone was also very cost-effective[8], i.e. below per capital GDP per QALY, with ICER values ranging from RM 2,354 per

[8]Below GDP per capita per QALY or RM30,000 per QALY.

QALY gained for the period 2006 to 2013, RM 723 per QALY gained for the period 2013 to 2023 and only RM 308 per QALY gained for the period 2006 to 2050.

Since the NSP programme was found to be more cost effective than the MMT programme, further analysis explored the policy option of the addition of the MMT programme to the existing NSP programme. The ICER values from the incremental addition of MMT to the NSP programmes range from RM2,465 per QALY (2006-2013), RM1,611 per QALY (2013-2023) to RM1,482 per QALY (2006-2053). Thus the combined MMT and NSP programmes have been found to be cost effective.

5.4 Return on investments of the harm reduction programme

Estimates of the ROI resulting from the harm reduction programme in Malaysia are provided in Table 9. These estimates have been derived from examination of government investments into the programmes and comparing these to the direct health care cost savings from averted HIV infections.

The analysis shows that from 2006 to 2013, the combined MMT and NSP programmes did not result in any net cost savings to the government; there was a return of only RM 0.51 in direct health care costs savings for every RM1.00 invested into the combined programmes. However, these programmes resulted in saving in the next 10 years when it is predicted that the returns in health care costs savings would increase to RM1.07 for every RM1.00 investment. Over the period 2006 to 2050, the returns are expected to increase to RM1.13 for every RM1.00 investment. As described earlier, the health care cost savings from NSP exceeded programme costs for all the time periods examined. This resulted in overall cost savings to the government as reflected in the ROI values exceeding RM 1.00 for every RM 1.00 invested in the programme. The opposite is true in the case of the MMT programme examined in isolation.

Table 9. Estimates of return on investment with MMT and NSP programmes, 2006 – 2050

Harm Reduction Programme	Estimates of return on investment		
	2006 – 2013	2013-2023	2006 – 2050
Combined MMT and NSP	0.51 (0.33 – 0.64)	1.07 (0.58 – 1.27)	1.13 (0.55 – 1.47)
NSP alone	1.35 (0.87 – 1.67)	3.18 (1.73 – 3.77)	3.35 (1.62 – 4.35)
MMT alone	0.07 (0.04 – 0.08)	0.31 (0.17 – 0.38)	0.49 (0.24 – 0.64)

Note. Estimates are medians with 95% confidence intervals provided in parentheses.

6. Discussion

This study is the first comprehensive economic evaluation of the MMT and NSP programmes in Malaysia and has produced several important findings which should inform policy discussions on continued GOM financial support for harm reduction activities in the country. From 2006 to 2013, the GOM has invested an estimated RM 92 million into harm reduction activities, provided either mainly by NGOs (as in the case of the NSP programme) or by public agencies including the MOH and NADA (as in the case of the MMT programme). Though, harm reduction in the context of HIV containment is undoubtedly an evidence-based prevention strategy, one of the often raised questions in policy circles concerns the level of effectiveness of the programme – to what extent has the harm reduction activities in Malaysia actually prevented transmission of HIV? This, perhaps, is the first important contribution of this study, that the effectiveness of MMT and NSP programmes as they have been implemented in the country has actually been quantified.

An estimated 21,000 new HIV infections occurred in the eight year period, from 2006 to 2013, after harm reduction activities commenced in Malaysia. In the absence of such activities, it is estimated that an additional 12,600 new infections would have occurred. In other words, the MMT and NSP programmes reduced the burden of new infections by about a third in the first eight years of implementation. What is more significant is that with the harm reduction programme in place, it is

expected that a further 23,000 new HIV cases would be prevented in the next ten years, reducing the expected burden of new HIV infections by a significant 87 per cent. Taking an even longer perspective, from 2006 to 2050, the combined MMT and NSP programmes are expected to reduce burden of new HIV infections by 79 per cent.

While these findings of averted infections are of value to inform policy discussions, it should also be pointed out that the benefits of the MMT and NSP programmes do not end with preventing occurrence of new HIV infections alone, especially if viewed from the perspective of the GOM. The current dual public-private healthcare sectors in Malaysia offer consumers a wide variety of choice with the private sector catering to public demand for medical therapies in comfortable, even luxurious surroundings, and without the need to wait for treatment. Private care is expensive, paid for mainly by direct out-of-pocket payments and, as such, utilised by those who can afford to pay. On the other hand, access to the low-priced and widely distributed public health services is available to all citizens of the country[9]. The GOM bears approximately 97 per cent of the cost of providing care in the public health sector. Due to socioeconomic reasons, most PWIDs infected with HIV would seek treatment in public facilities and thus would directly benefit from government funding for the care that they receive. Hence, the MMT and NSP programmes, in being able to prevent new cases of HIV would also serve as avenues to procure cost savings for the Government.

PWIDs who are also HIV infected require health care in many forms. They need regular medical consultations and laboratory investigations to gauge the progress of their illness. Those with opportunistic infections may require more intensive treatment in a hospital setting. In addition, persons whose CD4 counts fall below 350 cells/mm^3 would also need to be started on ART . If the PLHIV obtain services from the public providers, most if not all of the related health care costs would be borne by the government. By preventing HIV transmissions to 12,600 PWIDs, it is estimated that the harm reduction programme allowed the GOM to accrue savings from direct health care costs

[9]Non-citizens are permitted to use public services upon payment of fees which are set at a higher rate than for citizens.

amounting to RM 47 million over the period 2006 to 2013. Despite the provision of free ART by the GOM, not all who clinically qualify to receive ART drugs are receiving treatment - only a third of all who medically qualify to receive ART are receiving the drugs and less than 25 per cent of these are PWIDs. Due to disease progression for those not on ART, it is expected that they would require higher intensity health care over time which would translate to higher health care costs for the government. Thus, direct health care cost savings from averted infections in the initial eight year period are expected to increase over time. This, combined with cost savings from infections newly averted in the next ten years, is expected to result in higher health care cost savings to the government of RM 209 million over the 10-year period from 2013 to 2023.

During the period 2006 to 2013, the GOM invested a total of RM 92 million into harm reduction activities which resulted in health care cost savings from infections averted of about RM 47 million. It would then be logical to question whether these programmes represent 'value-for-money' or are cost-effective. To complicate the issue further, by examining each programme individually the study found that the NSP has out-performed the MMT programme in the sense that the MMT programme costs more but was able to avert less HIV infections than the NSP programme. Moreover, unlike the MMT programme, health care costs savings from the NSP programme actually exceeded its programme costs. From 2006 to 2013, the NSP cost the GOM a sum of RM 34 million but produced direct cost savings of RM 46 million - a return of RM1.35 in savings from every RM1.00 invested into the programme. In the following ten years, the NSP programme is expected to produce an even higher return in savings of RM 3.18 for every ringgit invested. These findings highlight the economic rationale for having a NSP programme. Thus, the study then focussed its attention to the question of whether the addition of MMT to complement NSP services is economically justified.

To answer this question, the study turned to another measure of programme effectiveness, QALYs, which have been used extensively in health care research to measure and compare effectiveness of various health care therapies. PWIDs, who are infected with HIV, are expected to experience a deterioration in QoL over time and will probably suffer premature mortality. The extent that both of

these conditions occur can be measured in QALYs - one QALY can be viewed as a year of life lived in perfect health. Since the number of HIV infections prevented by harm reduction has been quantified in this study, it was then also possible to estimate the QALYs gained from these programmes. These QALYs reflect the QoL and length of lives that were preserved for those fortunate enough not to be infected with HIV because of their participation in harm reduction activities. To determine if the combined MMT and NSP programmes had been cost effective, the incremental increase in net programme costs from NSP alone to a combined programme was compared to the incremental increase in QALYs gained to produce a metric known as ICER. In the first eight years of the combined MMT and NSP programme, the ICER value was RM 2,465 per QALY gained which is below the cost effectiveness threshold adopted in this study of RM 90,000 per QALY. Thus the combined MMT and NSP programme has been found to be cost-effective and can be considered a 'value-for-money' prevention strategy.

What does a cost-effective health strategy really mean? To label a health programme as being cost-effective is to say that after consideration of the benefits obtained from the programme, society in general considers the money invested in it well spent. However, unlike the United Kingdom which has an explicit threshold to gauge cost-effectiveness of medical therapies, Malaysia has yet to develop a culture of using results of economic evaluations before adoption of new medical therapies and thus has yet to develop an explicit threshold. Despite this, some informative indications can be obtained from examination of another health prevention programme that has been implemented in this country. In tabling the 2012 budget, the Prime Minister announced an allocation of RM 50 million to provide free human papilloma virus (HPV) vaccinations to 18 year old girls to supplement a similar programme for 13 year old schoolgirls started in 2010. The HPV vaccination programme was added to existing Pap smear screening services in an effort to reduce the incidence of cervical cancer, one of the most frequent cancers among women in Malaysia. The programme has since received wide public support. Ezat et al (2010) performed an economic evaluation comparing the combined HPV vaccination and Pap smear screening programmes to a baseline situation of just the screening programme alone. The estimated ICER value of the combined cervical cancer prevention programme

was found to be RM 35,347 per QALY gained, which is about 15 times the ICER value of the combined harm reduction programme evaluated in this study.

This study is one among many other recent studies (Ni et al., 2012, Zhang et al., 2011, Kwon et al., 2012, Tran et al., 2011, Wammes et al., 2012, Xing et al., 2012) which have demonstrated the effectiveness of MMT and NSP in preventing HIV transmission among PWIDs. The magnitude of programme benefit differs between studies as is only logical as number of infections averted would be dependent on HIV prevalence and programme coverage among other factors. In general, though different thresholds had been applied, these studies have also concluded that harm reduction was cost-effective in their respective country contexts. The Malaysian findings are in line with this general consensus. In addition, the benefits of the MMT and NSP programmes are expected to increase in the future. In the next ten years, these programmes not only become more cost-effective but also produce cost savings to the Government. From 2013 to 2023, the ICER value of the programme is expected to decrease to RM 1,611 per QALY gained but an equally important finding is that direct health care cost savings of RM 209 million would exceed programme costs of RM195 million producing a return of RM 1.07 per every ringgit invested by the GOM. Together these findings would argue for continuation of government financial support for harm reduction activities in Malaysia.

In addition to contributions towards informed policy discussion on GOM funding for harm reduction, this study has also revealed other policy relevant areas for future research. The analysis of future costs and benefits of harm reduction programme in Malaysia was based on the assumption that the coverage of these programmes remained at the 2013 levels. This was to directly address the important policy question of whether existing harm reduction activities had been cost-effective and produced cost savings. However, it is also acknowledged that additional important policy input could be obtained if scenarios with different coverage levels had been examined which could specifically address the question of whether GOM should invest in efforts to expand coverage of services. The current coverage of harm reduction programme in Malaysia remains limited, as low as less than 35 per cent of PWIDs have access to harm reductions as of 2011. It is possible that with increased

programme coverage and funding in the future, more infections could be averted resulting in higher savings in direct health care costs. A study in Indonesia has shown that expansion in MMT coverage from five to 40 per cent in West Java could be expected to reduce the number of infections among PWIDs by 18 per cent (Wammes et al., 2012).

The study was very much focused on costs and savings from the perspective of the GOM which contributed to the decision to compare GOM investments into harm reduction against direct health care cost savings for HIV infections. At the current time, there are limited publicly financed health care services for treatment of hepatitis C virus infections, the other medical condition of importance where disease transmission could be reduced with harm reduction (Commonwealth Department of Health and Ageing, 2002, National Centre in HIV Epidemiology Research, 2009, Kwon et al., 2012). Future research can thus be undertaken to include consideration of Hepatitis C and other socially important benefits of harm reduction such as early return to productive economic activities.

This study has also not looked into the private provider's role in reducing HIV transmission among PWID through their participation in delivering MMT services. The inclusion of private providers in the analysis may serve to provide a holistic policy guide on cost-effectiveness of the different modality, to address the current challenges of low coverage, accessibility and quality of services and integration between the different delivery modalities. This will be an interesting area to examine especially in the light of this study's finding that MMT programme provided cost-savings when implemented alongside NSP. At this juncture, it is only possible to speculate as to the reasons for this finding. The main public providers of MMT services are the MOH clinics. Services are provided alongside normal outpatient services with no significant increase in human resources and physical structures. The only conceivable increase in financial outlay is that for purchase of the opioid substitute, methadone. The price for 80mg of methadone is approximately US$63 in a month per patient[10]. This figure is much higher compared to studies in Vietnam (US$ 21) and China (US$13) which included the start-up costs of establishing dedicated MMT clinics (Tran et al., 2011, Xing et al.,

[10] Price obtained from http://www.pharmacy.gov.my/v2/en/apps/drug-price

2012). Thus, it is possible that the MMT public expenditures in Malaysia could have been overestimated and which has contributed to masking the cost-effectiveness of the programme. It is not within the scope of this study to examine the reason behind the low uptake of MMT in public clinics. One of the reasons could be the inadequate provision of staff and physical infrastructure to deliver MMT services in addition to the normal clinic outpatient services. This can be an area for examination in future studies.

The modelling approach adopted in this study also presented many challenges. Although the best available data were used in the model, in most instances behavioural and prevalence data came from non-representative surveys carried out among PWIDs at different times in Malaysia or inferred from similar studies conducted among PLHIV. Information was also obtained from administratively collected sources such as surveillance, case notifications and programme expenditures. While the quality of data generated through national data collection sources are improving, due to various reasons such as underreporting of cases, information from these sources may not reflect the true disease or financial burden of HIV in the country. In certain cases where data required are not available, recourse was made to expert opinions obtained from clinical experts. In such instances, opinions were sought from only the main infectious diseases experts treating PLHIV in the country. Data triangulation has been used to increase confidence in the use of the data. Due to constraints in resources, inpatient health care costs had been estimated from only one public health care facility, and used with the assumption that the costs are representative of the country. However, the choice of the facility was based on prior knowledge that this facility is the main public hospital providing care to HIV infected PWIDs in the country. In addition, uncertainties in all parameter estimates were incorporated in the analysis which provided point as well as ranges of possible estimates for each output.

7. Conclusion

This study has shown that the combined MMT and NSP programmes as implemented in Malaysia are cost-effective and are expected to produce net cost-savings to the government in the future. Evidence of cost-effectiveness and expected cost-savings support policy recommendation that both MMT and NSP programmes should be maintained as part of the key strategy to control HIV spread among PWIDs in Malaysia. Study findings that even with the present programme coverage, harm reduction activities are expected to become more cost-effective and cost-saving in the future suggest that policies towards programme expansion may demonstrate higher value for money.

APPENDIX A Epidemic Mathematical Transmission Model

To assess HIV epidemic trends, resource needs, the cost-effectiveness of past programmes, and the impact of potential future programmes, a detailed mathematical model of HIV transmission and disease progression, called the Projection and Evaluation Tool (Prevtool), was developed by researchers at the Kirby Institute, University of New South Wales, Australia (Kwon et al., 2012).

Prevtool is a flexible population-based HIV model. The basic disease progression implemented in the model is shown in Figure A1. This is the only aspect of model structure that is fixed, and specifies it as being an HIV model instead of a universal epidemic model.

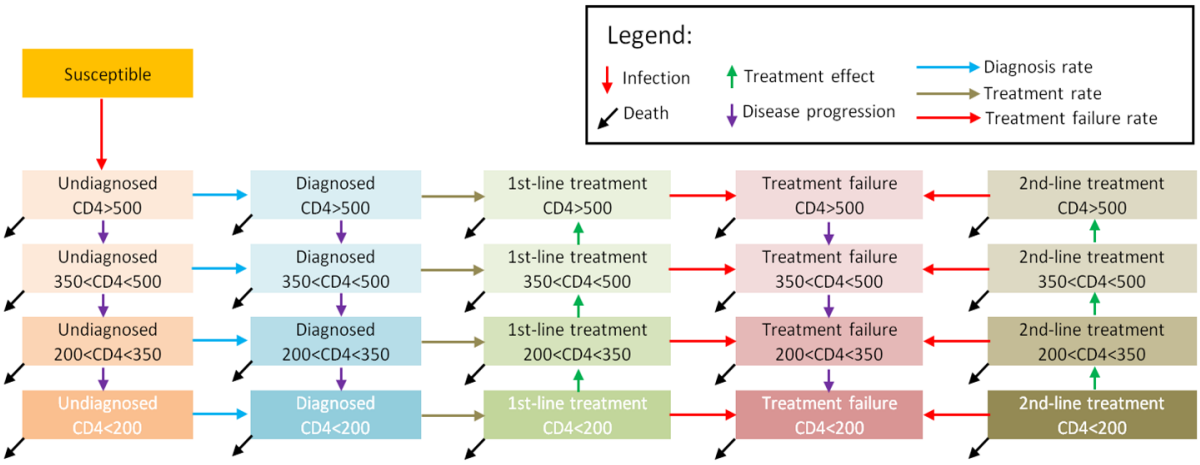


Fig. A1: Schematic diagram of model structure. Each compartment represents a single population group with the specified health state, while each arrow represents the movement of individuals between health states. All compartments except for *Susceptible* represent individuals infected with HIV. Death includes all causes of death.

The model uses a coupled system of ordinary differential equations to track the movement of people between health states. The overall population is partitioned in two ways: by group and by health state. Individuals are assigned to a given population based on their dominant risk. In this study the only population group examined was the PWIDs.

The rate at which uninfected PWIDs become infected is determined by the force-of-infection for that population. This depends on the number of risk events a PWID is exposed to in a given period of time and the infection probability of each event. Intravenous transmission risk depends on the number of injecting partners per person per year, frequency of injecting per year, frequency of sharing injecting equipment and percentage of shared syringes that are cleaned before re-use and the efficacy of cleaning.

Mathematically, the force-of-infection is given by: ( )

where is the force-of-infection, is the transmission probability of each event, and *n* is the effective number of at-risk events (thus *n* gives the average number interaction events with infected PWID where HIV transmission may occur). The value of the transmission probability is inversely related to CD4 count and may be modified by behavioral interventions. The number of events *n* not only incorporates the total number of events, but also other factors that moderate the possibility that these events are capable of transmitting infection.

In addition to the force-of-infection rate, in which PWIDs move from uninfected to infected states, there are seven other means by which PWIDs may move between health states. First, PWIDs may die, either due to the background death rate, due to injecting behavior, or due to HIV/AIDS (which depends on CD4 count). Second, in the absence of intervention, PWIDs progress from higher to lower CD4 counts. Third, PWIDs can move from undiagnosed to diagnosed states based on their HIV testing rate, which is a function of CD4 count (for example, people with AIDS symptoms have a higher testing rate) and population type (for example, PWIDs usually get tested more frequently than low-risk males). Fourth, diagnosed PWIDs may move onto treatment, at a rate which is dependent on CD4 count. Fifth, PWIDs may move from treatment to treatment failure, and sixth, from treatment failure onto second-line treatment. Finally, while on successful first- or second-line treatment, PWIDs may progress from lower to higher CD4 count.

The number of PWIDs in the compartment corresponding to undiagnosed PWIDs with a CD4 count between 200 and 350 cells/mL changes according to the following equation:

( )

where is the current population size of PWID with undiagnosed HIV and with a CD4 count between 350 and 500 cells/μL, is the PWID population size of the compartment with lower CD4 count (200-350 cells/μL), is the disease progression rate for the given CD4 count, is the death rate, and is the HIV testing rate. Each compartment (Figure A1, boxes) corresponds to a single differential equation in the model, and each rate (Figure. A1, arrows) corresponds to a single term in that equation.

Table A3: Input parameters of the model.

	Biological parameters	**Behavioral parameters**	**Epidemiological parameters**
Population parameters	Background death rate		Population sizes (TP)
HIV-related parameters	HIV health state progression rates (H) HIV-related death rates (H)		HIV prevalence (TP)
Injection-related parameters	Injecting HIV transmissibility* Syringe cleaning efficacy* Drug-related death rate	Number of injections* (T) Syringe sharing probability* (T) Syringe cleaning probability* Methadone treatment probability (T)	
Treatment parameters	ART efficacy* ART failure rates	HIV testing rates (TPH)	Number of people on ART (T)

Key: T = parameter value changes over time; P = parameter value depends on population group; H = parameter depends on health state; S = parameter depends on sexual partnership type; * = parameter is used to calculate the force-of-infection.

Most of the parameters in the model are related to calculating the force-of-infection; a list of model parameters is provided in Table A9. Empirical estimates for model parameter values can be interpreted in Bayesian terms as prior distributions. The model must then be calibrated, which is the process of finding posterior distributions of the model parameter values such that the model generates accurate prevalence estimates. Given the challenges inherent in quantifying all known constraints on the epidemic, initial calibration is performed manually, with oversight by and collaboration with in-country stakeholders where possible. This prior distribution is then used in a Monte Carlo Markov

chain (MCMC) algorithm, which uses both epidemiological and behavioral data to calculate the log-likelihood for a given set of model parameters.

Relationships between spending and risk behaviors

In this analysis, a logistic/sigmoid function is used to describe the relationships between a behavioral parameter affected by a HIV prevention programme and the level of spending on that programme. Using this function with assumed uncertainties bounds, logistic curve fits is obtained to available datasets for overall programme spending and associated behaviours. Indirect costs have no direct impact on HIV transmission parameters; but changes to HIV programmes may affect these costs to supply additional condoms, clean syringes, and methadone, for example. Using these relationships, any change in HIV programmes funding directly affects risk behaviors and changes to the HIV epidemic; an example of this is demonstrated in Figure. A2. The fitted logistic relationships will represent the change in behaviors with spending.

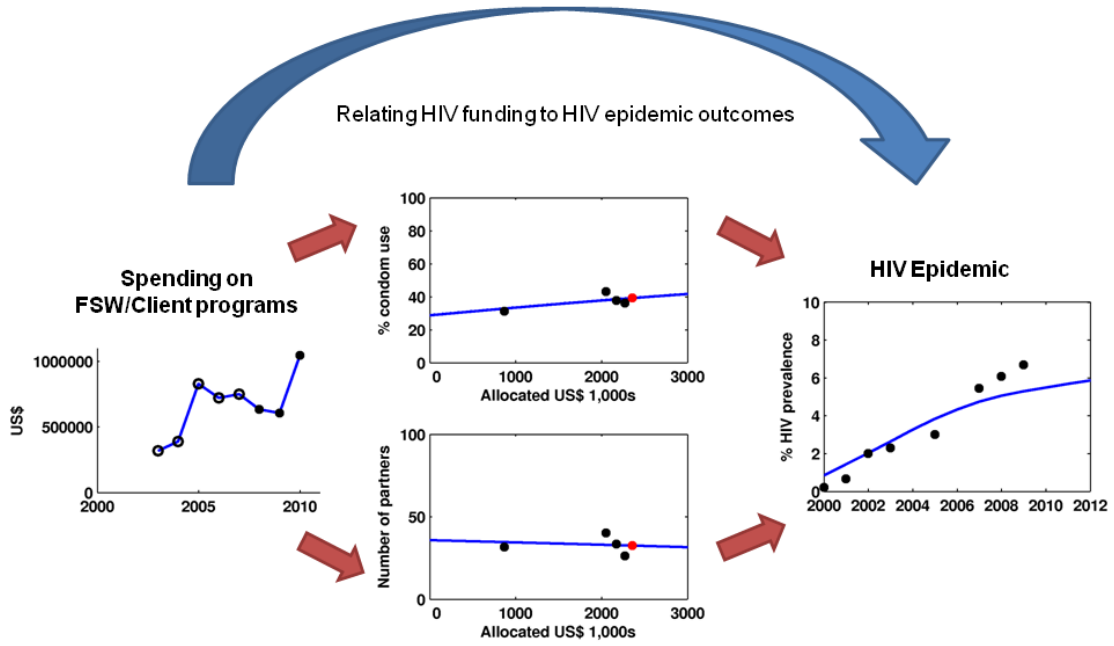


Figure A2: Example of the relationship between spending on FSW/client programmes and the HIV epidemic (numerical values are for illustrative purposes only).

Counterfactual scenarios

Prevtool calculates the cost-effectiveness of past HIV programmes by comparing the expected number of new infections and HIV/AIDS related deaths according to current and past conditions with the estimated numbers under counterfactual scenarios in the absence of funding for specific programs. Simulation of counterfactual scenarios using Prevtool is based on the assumed effect of the of NSP alone programmes, MMT alone programmes and combined NSP and MMT programmes. The calibrated simulations with the programmes in place represent the baseline scenario. Specific counterfactual scenarios used depend on the implementation and characteristics of HIV prevention programmes in each country and the data available. A logistic function was then fitted to behavioral parameters affected by prevention programmes.

Cost-effectiveness calculations for past evaluations

For each counterfactual scenario, the health benefits of a specific HIV intervention programmes is measured in terms of HIV infections averted as well as life years and QALYs gained or DALYs saved compared to the baseline scenario. Incremental cost-effectiveness ratios (ICERs) are calculated to estimate the cost-effectiveness of each programme. These are calculated based on the counterfactual scenarios and comparing the spending of each programme (discounted annually), as well as estimated annual healthcare costs incurred/saved (using unit health costs and utilities for each country obtained from data synthesis), with the estimated effectiveness of the programmes. Determining whether a past HIV programme is cost-effective is dependent on country-specific thresholds. Appropriate thresholds for each country will be determined after consultation with in-country stakeholders.

Return on investment calculations

Return on investment (ROI) analyses determines the future healthcare costs saved that are attributable to the past financial investment in HIV/AIDS programmes. For this analysis, two scenarios were considered: (1) the counterfactual scenarios without HIV/AIDS programmes and the (2) status quo (with HIV programmes). From these two scenarios, health care costs incurred among individuals infected with HIV (diagnosed, undiagnosed, and on treatment) is estimated. The ROI in a given year

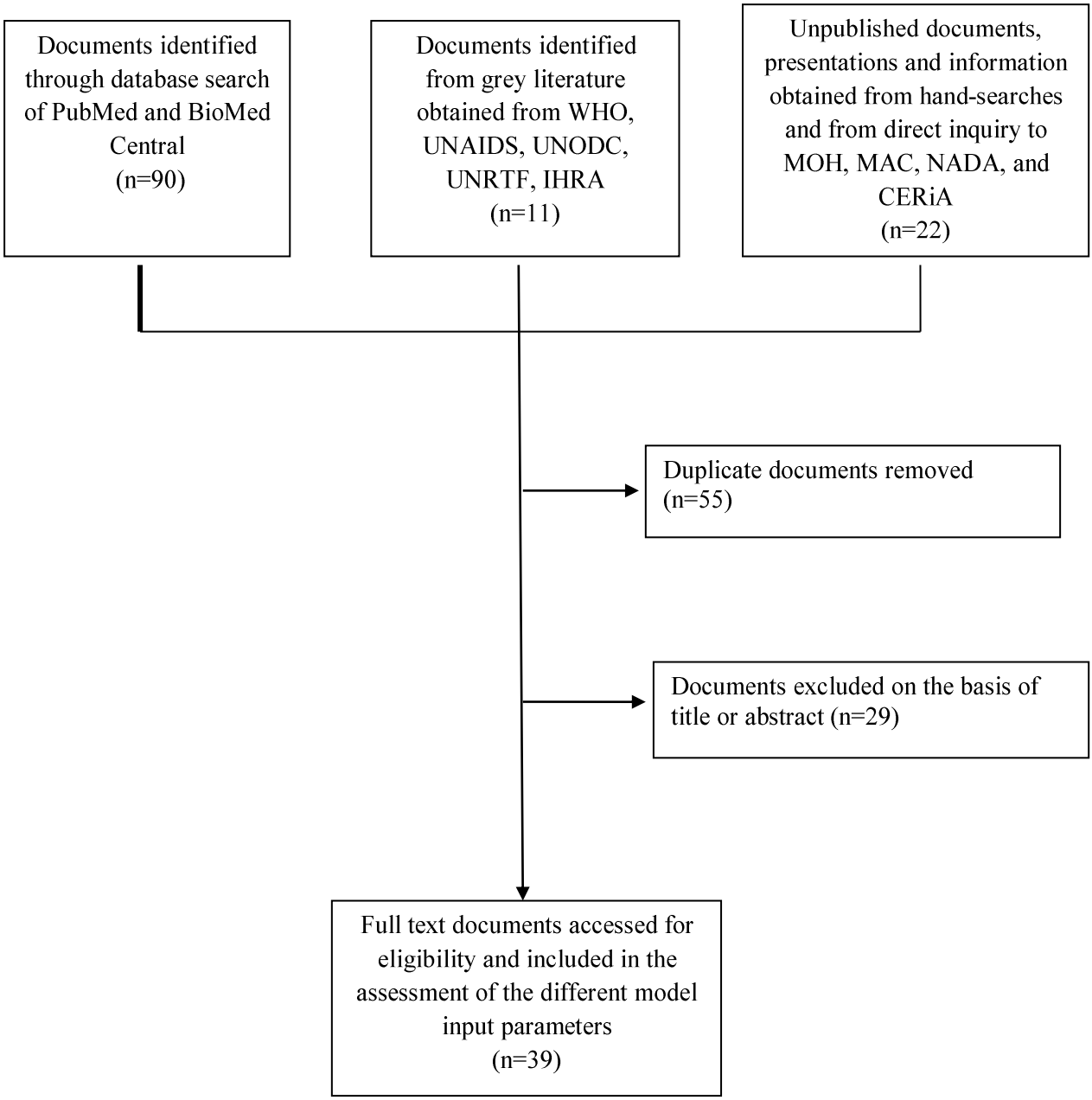
is equal to the total HIV health care costs saved (compared to the status quo scenario) divided by the total investment in a HIV/AIDS programme.

APPENDIX B Literature search to obtain model input parameters

Demographic, epidemiological, behavior and treatment data relevant to PWIDs in Malaysia were gathered through a review of published literature, grey literature, hand-searches and directed requests to MOH, Centre of Excellence for Research in AIDS (CERiA), National Anti-drug Agency (NADA) and Malaysian AIDS Council (MAC).

The initial search identified a total of 123 documents consisting of 90 documents from peer-reviewed journals, 11 published reports from international organisations including WHO, United Nations Programmes on HIV/AIDS (UNAIDS), United Nations Office on Drugs and Crime (UNODC), United Nations Regional Task Force (UNRTF) and International Harm Reduction Association (IHRA) and 22 other documents including reports, conference presentations, unpublished administrative data obtained from MOH, MAC, NADA and CERiA. Of the 123 documents, 55 duplicates were excluded while another 29 documents were excluded on the basis of irrelevant titles and abstracts (Figure B1). The full text of the remaining 39 documents were accessed and included in the assessment for the different model input parameters.

Figure B1 **Literature search**



APPENDIX C1 Demographic and Prevalence Parameters

1. Population size

Description of parameter:

Size estimate of PWID population

Values:

Year 2002	194,000 (133,000 – 255,000)
Year 2009	170,000 (117,000 – 223,000)

Source:

(Ministry of Health, 2004, Ministry of Health, 2009)

Assumptions:

The literature search identified 17 documents related to population size of PWIDs in Malaysia (Wodak, 2006, Mathers et al., 2008, Ministry of Health and Universiti Utara Malaysia, 2003, Ministry of Health, 2005, UNODC, 2009, The United Nations Regional Task Force on Injecting Drug Use and HIV/AIDS in Asia and the Pacific and Burnett Institute, 2010, WHO, 2010, IHRA, 2010, Reid et al., 2004, Aceijas et al., 2004, IHRA, 2008, WHO, 2011, Ministry of Health, 2010b, Ministry of Health, 2009, Ministry of Health, 2012, UNODC, 2010, Ministry of Health, 2004). Of these, 14 documents were eliminated because they contained only secondary citations which could not be traced for further verification. Included in this list were two international reviews of the burden of HIV among PWIDs which made mention of the Malaysian situation (Mathers et al., 2008, Aceijas et al., 2004). The remaining three documents were reviewed (Ministry of Health, 2004, Ministry of Health and Universiti Utara Malaysia, 2003, Ministry of Health, 2009).

- Based on information compiled from various sources including the National Drug Information System (NADI) database, interviews with key stakeholders including officials from local municipal council, NGOs and the Police, head of villages as well as drug users, the MOH in collaboration with researchers from the *Universiti Utara Malaysia* estimated that there were 117,955 PWIDs in 2002 (range from 104,486 to 135,506) (Ministry of Health and Universiti Utara Malaysia, 2003).
- However, in a separate estimation exercise, based mainly on data obtained from the HIV screening programme among drug users in 11 states, the MOH provided a higher estimate of the 2002 PWID population in the country – 194,000 (range from 133,000 to 255,000) (Ministry of Health, 2004).
- In 2009, the MOH convened a meeting between key stakeholders to review the HIV situation in the country. During this meeting, based mainly on a review of commonly used estimates, participants agreed that 170,000 represented a rough estimate for the PWID population in the country (Ministry of Health, 2009).

Based on these three estimates, the PWID population in the country could have increased or decreased in numbers from 2002 to 2009. However, numbers of drug users entering drug rehabilitation centres had been decreasing from 2005 to 2009 (Agensi Antidadah Kebangsaan Kementerian Dalam Negeri, 2009) and based on this, the model used PWID population data which showed a similarly decreasing trend - 194,000 in 2002 and 170,000 in 2009.

2. HIV Prevalence

Description of parameter:

Proportion of HIV cases among PWID population

Values:

Year 2001	16.4 per cent
Year 2002	16.7 per cent
Year 2003	16.3 per cent
Year 2004	17.7 per cent
Year 2005	17.2 per cent
Year 2006	15.3 per cent
Year 2007	8.7 per cent
Year 2008	10.6 per cent
Year 2009	9.3 per cent

Source:

(National Anti-Drugs Agency, 2010)

Assumptions:

The literature search identified ten documents related to HIV prevalence among PWIDs in Malaysia (Malaysian Aids Council and Ministry of Health Malaysia, 2009, Bazazi et al., 2011, Aceijas et al., 2004, Mathers et al., 2008, Ministry of Health, 2005, Ministry of Health, 2008, Ministry of Health, 2012, National Anti-Drugs Agency, 2010, Ministry of Health, 2013). Of these two documents (Aceijas et al., 2004, Mathers et al., 2008) were eliminated because they contained only secondary citations which could not be traced for further verification. The remaining eight documents were reviewed.

The review included four local studies conducted between 2007 and 2012 which provided some estimates of the HIV prevalence among PWIDs (Vicknasingam et al., 2009, Malaysian Aids Council and Ministry of Health Malaysia, 2009, Bazazi et al., 2011, Ministry of Health, 2013). However, the prevalence figures in these studies were not used in the model mainly because the coverage of the studies was limited and thus the results were not nationally representative.

- Vicknasingam et al (2009) surveyed 526 PWIDs from five towns found that HIV prevalence was 43.9 per cent. Respondents were recruited in locations where injecting drug use was known to be rampant and who were PWIDs not in treatment in Malaysia.
- The 2009 Integrated Bio-Behavioural Study conducted in six sites in the Klang Valley found that 22.1 per cent of the PWIDs surveyed were positive for HIV (Ministry of Health and Malaysian AIDS Council, 2009). Respondents were recruited using respondent driven sampling (RDS) method.
- Another RDS study in Klang Valley by Bezazi et al (2011) reported that the HIV prevalence to be 19.9 per cent among the 460 PWIDs surveyed .
- A preliminary result of the recent 2012 IBBS conducted by MOH found that HIV prevalence among PWIDs to be 18.9 per cent in 7 states (Ministry of Health, 2013). However, there was wide variation in prevalence rates between states ranging from as low as 5.3 per cent in Selangor to as high as 46.5 per cent in Kelantan. To date the IBBS results have not been finalised and thus have not been used in this study.

Some of the UNGASS Country Progress Reports prepared by the MOH also contained mention of the HIV prevalence rates among PWIDs (Ministry of Health, 2008, Ministry of Health, 2005, Ministry of Health, 2012). However these figures were not used in this study because they had been derived from varying sources

which could not be verified to be representative of the rates among PWIDs in the country.

- The UNGASS Monitoring the Declaration Commitment on HIV/AIDS Country Report December 2005 reported that the HIV prevalence rates among PWIDs was 20.1 per cent (Ministry of Health, 2005). The rates had been derived from information on HIV prevalence among drug users undergoing treatment in DRCs in 11 states. Some assumptions had to be made to extrapolate the prevalence rates among drug users to PWIDs. The authors applied a factor of 0.8/0.67 was based on prior knowledge that 67 per cent of drug users in DRCs were PWIDs and that 80 per cent of HIV infections among PWIDs was attributed through sharing needles. These assumptions could not be validated.
- Based on data from sentinel surveillance, the UNGASS Country Progress Report 2008 reported that the 2007 HIV prevalence among PWIDs was 11 per cent. However, the report provided no further details of the sentinel surveillance (Ministry of Health, 2008).
- The 2012 Global AIDS Response Country Progress Report indicated that HIV prevalence among PWIDs was 8.7 per cent based on screening programme in harm reduction sites and DRCs. The HIV test with rapid test kit programme was carried out only in MMT sites where PWIDs are at lower risk of HIV infection. Thus, the reported HIV prevalence in 2012 UNGASS may not reflect actual situation of HIV prevalence among PWIDs at the national level (Ministry of Health, 2012).

Due to lack of reliable direct estimates of HIV prevalence among all PWIDs in Malaysia, data on HIV prevalence used in this study was taken from HIV cases detected among high risk drug users admitted to DRC as reported by NADA (National Anti-Drugs Agency, 2010).

- NADA reported that the HIV cases detected among new entrants to DRCs showed a generally decreasing trend from 16.4 per cent in 2001 to 9.3 per cent in 2009 (National Anti-Drugs Agency, 2010).
- NADA instituted a compulsory HIV screening programme in which all new entrants are screened upon admission to DRC, after 6-months and 3-months prior to release. The agency operates 23 government DRCs located throughout Malaysia. Under the Act 283 Drug Dependants (Treatment and Rehabilitation) Act 1983, any police officer has the authority to arrest any person suspected to be drug dependent and if they are found positive for drugs, they would be sent to rehabilitation centres by court order (Law of Malaysia, 2006). Based on this, it could be assumed that the drug users admitted to DRCs are among the high risk drug users in the country.
- The data from NADA was preferred over the information from other sources because NADA data came from a consistent source, DRCs, which is reasonably representative of the country.

APPENDIX C2 Testing and Treatment Parameters

1. Testing rate per year

Description of parameter:

Average number of HIV tests conducted for each PWID annually

Values:

Year 2002	6.77 tests per 100 persons
Year 2009	7.83 tests per 100 persons

Source:

Adapted from (Agensi Antidadah Kebangsaan Kementerian Dalam Negeri, 2009, National Anti-Drugs Agency, 2010)

Assumption:

There was no available direct estimate of HIV testing rates among PWIDs in Malaysia. Data on HIV testing among drug users in DRCs were adapted for use in the study in the following manner:

- NADA reported that there were 6,658 occupants of rehabilitation centres in 2009 (Agensi Antidadah Kebangsaan Kementerian Dalam Negeri, 2009). It is the national policy that HIV testing be administered to all drug users upon registration into the programme, six-months after admission and three months prior end of programme. Assuming that all new entrants to the programme would have only two HIV tests in a year, the total number of tests would be 13,316 [6,658 x 2]. Averaged over the estimated number of PWIDs in the country (170,000 persons), the testing rate among PWIDs would be 7.83 times per 100 persons. This figure was applied for the year 2009.

- The HIV testing rate for 2002 was estimated in a similar manner. However, the occupancy rates of rehabilitation centres were not available for 2002. Thus, the estimation was based on the maximum capacity of the centres which was 6,570 (National Anti-Drugs Agency, 2010). The testing rate in the DRCs would be 6.77 times annually per 100 persons. This figure was applied for the year 2002.

2. Treatment rate per year

Description of parameter:

Proportion of ART eligible PWIDs initiated on treatment annually

Values:

Year 2010 16.8 per cent

Source:

Adapted from study in Kajang Prison and (Ministry of Health, 2010b, Kamarulzaman, 2009c)

Assumption:

There was no available direct estimate of HIV treatment rates among PWIDs in Malaysia. Data available from three sources (Ministry of Health, 2010b, Kamarulzaman, 2009c) were adapted for use in the study:

- Since 2010, patients would be considered eligible for ART treatment only when they reach the CD4 threshold of 350 cells/mm^3.
- In 2010, there were an estimated 14,002 persons on treatment (Ministry of Health, 2010b). Of these an estimated 3,501 or 25 per cent were PWIDs (Kamarulzaman, 2009c).

- Data obtained from a study in Kajang Prison reported that the 38 per cent of the HIV+ PWID prisoners had CD4 counts below 350 cells/mm^3 and thus eligible to receive ART treatment[11]. This rate was applied to the estimated 54,783 HIV positive PWIDs in 2010 (Ministry of Health, 2012) to give an estimated 20,818 persons who would be eligible for ART treatment.
- Thus an estimate of the proportion of PWIDs eligible to receive ART treatment who are on treatment would be 16.8 per cent (or 3,501/20,818).

3. Treatment failure

Description of parameter:

Proportion of PWIDs on first-line ART but not responding to treatment annually

Values:

40 per cent

Source:

(Kumar, 2012)

Assumption:

The literature search identified only one document related to treatment failure among PWIDs in Malaysia (Lubis et al., 2012). The study was conducted among HIV patients in a tertiary institution in Kuala Lumpur and found that only 64.5 per cent of the patients who initiated first-line ART treatment achieved viral load of less than 50

[11] The proportion of persons with CD4 counts <350 among HIV+ PID persons was obtained from a study conducted in Kajang Prison in 2012. Among 124 HIV+ PID prisoners, in which it was found that 38 per cent or 47 PIDs had CD4 counts below 350. The overall proportion of HIV+ persons with CD4 counts below 350 in Malaysia is 65 per cent (MOH UNGASS 2010). However, feedback from clinicians treating the bulk of HIV+ patients indicated that in general HIV+ PIDs appear to be younger and healthier than non PIDs and that the lower proportion of HIV+ PIDs with CD4 counts <350 in comparison with the general HIV+ population appear to support this notion. Kajang Prison is one of the main prisons to receive persons convicted of drug-related crimes in the country. In this estimate, it is thus assumed that the PIDs held in Kajang Prison are representative of PIDs around Malaysia.

copies/ml. However, the study participants contracted HIV through sexual means and not through intravenous drug use. Thus, the findings are not representative of the PWID population.

Due to lack of available direct estimate of HIV treatment failures among PWIDs in Malaysia, data was obtained from SBH. SBH is the main hospital involved in clinical management of HIV patients in the country. Routine data from SBH shows that treatment failure among PWIDs as 40 per cent in 2010 (Kumar, 2012).

4. Number of HIV diagnoses

Description of parameter:

Number of PWIDs tested HIV+ annually

Values:

Year 2000	3,815
Year 2001	4,724
Year 2002	5,176
Year 2003	4,796
Year 2004	4,478
Year 2005	4,038
Year 2006	3,127
Year 2007	2,601
Year 2008	2,113
Year 2009	1,699
Year 2010	1,737
Year 2011	1,348

Source:

(Ministry of Health, 2011)

Assumption:

The number of PWIDs diagnosed to be HIV+ was obtained directly from MOH (Ministry of Health, 2011).

5. Number of patients on first and second-line ART

Description of parameter:

Number of ART eligible PWIDs on treatment annually on first and second-line drugs

Values:

Year 2003	120
Year 2007	1,648
Year 2008	2,050
Year 2009	2,491

99 per cent of them were on first-line ART and the rest on second-line drugs.

Source:

Adapted from (Kamarulzaman, 2007, Kamarulzaman, 2009a, Ministry of Health, 2008, Ministry of Health, 2010b, Sg Buloh Hospital, 2011)

Assumption:

There was no available direct estimate of PWIDs on ART treatment. Data available from five sources (Kamarulzaman, 2007, Kamarulzaman, 2009a, Ministry of Health, 2008, Ministry of Health, 2010b, Sg Buloh Hospital, 2011) were adapted for use of this study.

- Kamarulzaman (2007, 2009b) reported that the proportions of PWIDs who received ART treatment increased from 7 per cent in 2003 to 25 per cent in 2008. The rapid increase was probably due to availability of generic drugs in 2004 and a scale-up in treatment coverage by the government (Ministry of Health, 2008). This study assumes that prior to 2004, the ART coverage among PWIDs remained constant at seven per cent and that after 2004, the coverage was 25 per cent.
- A report by Treat Asia estimated that of 9,500 PLHIV who need treatment, about 20 per cent were receiving treatment in 2004 (Treat Asia, 2004). The MOH reported 64,439 and 58,012 cumulative new HIV cases in 2003 and 2004 (Ministry of Health, 2011). Thus, the estimated number of PLHIV who need treatment in 2003 was 8,550.
- The MOH reported that a total of 6,590 and 9,962 PLHIVs were receiving treatment in 2007 and 2009 (Ministry of Health, 2008, Ministry of Health, 2010b). Separately, Kamarulzaman (2009) reported that an estimated 8,200 PLHIVs were receiving treatment in 2008.
- Thus, the estimate numbers of PWIDs on ART for the years 2003 to 2009 were:
  - 2003 1,710 x 7 per cent = 120
  - 2007 6,590 x 25 per cent =1,648
  - 2008 8,200 x 25 per cent = 2,050
  - 2009 9,962 x 25 per cent = 2,491

Information on proportions of PWIDs on first and second-line drugs was based on clinical data obtained from SBH, the main hospital providing treatment to PWIDs in the country. An estimated 99 per cent of the PWIDs treated were on first-line treatment[12].

[12] Data and information obtained directly from the clinicians attached to the SBH.

APPENDIX C3 Drug Behaviour Parameters

1. Average number of injections per year

Description of parameter:

Average number of injections per PWID annually

Values:

Year 2004	1140 injections
Year 2007	900 injections
Year 2009	936 injections

Source:

(Ministry of Health and Malaysian AIDS Council, 2009, CERiA, 2007, unpublished report, Ministry of Health and WHO, 2004)

Assumption:

The literature search identified five studies related to the average number of injections per PWID in a year (Ministry of Health and Malaysian AIDS Council, 2009, Bazazi et al., 2011, Azmel, 2011, CERiA, 2007, unpublished report, Ministry of Health and WHO, 2004). All documents were reviewed.

- In a study among PWIDs conducted by the MOH in 2004, it was found that on average each person injected 1,140 times in a year (Ministry of Health and WHO, 2004). The study had been carried out in three sites (Johor, Kelantan and Kuala Lumpur).
- A small study among 100 PWIDs conducted in Kuantan in 2007 found that each person injected an average of 900 times a year (CERiA, 2007, unpublished report).

- In 2009, the Integrated Bio-behavioural Surveillance conducted by the MAC in the Klang Valley reported that an PWID injected an average of 936 times per year (Ministry of Health and Malaysian AIDS Council, 2009).

2. Percentage shared injections

Description of parameter:

Proportion of total injections shared annually

Values:

Year 2004	22.0 per cent
Year 2006	16.8 per cent
Year 2007	12.9 per cent

Source:

Adapted from (Ministry of Health, 2007, Ministry of Health and WHO, 2004)

Assumption:

The literature search identified nine studies related to the practice of sharing of injections among PWIDs (Chawarski et al., 2005, Ministry of Health and Malaysian AIDS Council, 2009, Bazazi et al., 2011, Azmel, 2011, CERiA, 2007, unpublished report, Ministry of Health and WHO, 2004, Ministry of Health, 2007, Vicknasingam et al., 2009, Bachireddy et al., 2011). All documents were reviewed.

Between 2005 and 2011, there were six local studies which provided some estimates of the needle sharing behaviour (Chawarski et al., 2005, Ministry of Health and Malaysian AIDS Council, 2009, Bazazi et al., 2011, Azmel, 2011, CERiA, 2007,

unpublished report, Bachireddy et al., 2011). The findings were not nationally representative and were not used in the study.

- In 2005, a study by Chawarski et al (2005) found that 23.2 per cent of respondents in Muar shared needles in the 30 days prior to the study.
- In 2007, a study conducted by CERiA (2007) found that 54 per cent of respondents in Kuantan shared needles in the month prior to the study.
- In 2007, a study among HIV-infected male prisoners in Kota Bahru by Bachireddy et al (2010), found that 66 per cent of respondents shared needles in the 30 days prior to incarceration.
- In 2009, a study by MOH found that 14.6 per cent of 630 respondents surveyed in the Klang Valley shared needles in the recent injecting episode (Ministry of Health and Malaysian AIDS Council, 2009).
- Bazazi et al (2010) and Azmel et al (2011) in studies conducted in the Klang Valley reported that the rate of sharing injecting equipment in the month prior to their studies were 48 per cent and 37 per cent respectively.

From 2004 to 2007, there were another three relevant studies which had wider geographical coverage that the ones mentioned above (Ministry of Health, 2007, Vicknasingam et al., 2009, Ministry of Health and WHO, 2004).

- In 2004, a study by the MOH found that 74 per cent of PWIDs in three sites (Johor, Kelantan and Kuala Lumpur) shared needles in the month prior to the study (Ministry of Health and WHO, 2004).
- The MOH conducted a sequence of three studies to evaluate the pilot NSP programme implemented at three sites, Penang, Johor and KL. The second study conducted in 2007 reported that 43 per cent of the respondents had ever passed used equipment as opposed to 56 per cent in the first study conducted the year before in 2006 (Ministry of Health, 2007).

- In 2007, a study among PWIDs in five sites, namely Penang, Pahang, KL, Johor and Kelantan, found that 69 per cent of the 526 respondents had ever shared their injecting equipment (Vicknasingam et al., 2009). However this study was excluded as data from the post-study of pilot NSP would reflect the impact on sharing behaviour with the NSP in the setting.

However, the required input parameter for the model was not proportions of PWIDs who shared needles but rather proportion of total injections shared.

- In 2004, the MOH (2004) reported that the average number of injections in the month prior to the study among PWIDs in three sites (Johor, Kelantan and Kuala Lumpur) was 95 times while the average number of shared injections among those who reported sharing needles were 28 times. Thus, the proportion of total injections shared is estimated to be 30 per cent (28 times injections shared / 95 times injections).
- The above derived proportion of shared injections among PWIDs who shared injections were applied to findings of the earlier three studies (Ministry of Health, 2007, Ministry of Health and WHO, 2004) in the following manner:

  i. Year 2004 74 per cent x 30 per cent = 22.0 per cent

  ii. Year 2006 56 per cent x 30 per cent = 16.8 per cent

  iii. Year 2007 43 per cent x 30 per cent = 12.9 per cent

3. Percentage of reused syringes that are cleaned

Description of parameter:

Proportion of reused syringes that have been cleaned

Values:

Year 2004	77.6 per cent
Year 2009	93.8 per cent

Source:

(Ministry of Health and Malaysian AIDS Council, 2009, Ministry of Health and WHO, 2004)

Assumption:

The literature search identified two documents related to the practice of reused syringes that have been cleaned (Ministry of Health and Malaysian AIDS Council, 2009, Ministry of Health and WHO, 2004). All documents were reviewed.

- In 2004, a study by the MOH found that 77.6 per cent of PWIDs in three sites (Johor, Kelantan and Kuala Lumpur) cleaned their syringes before reusing them (Ministry of Health and WHO, 2004). However, most said they cleaned the syringes using water.
- In 2009, a study by MAC found that 93.8 per cent of the 630 respondents surveyed in Klang Valley reused their syringes that had been cleaned (Ministry of Health and Malaysian AIDS Council, 2009).

4. Percentage of PWIDs on Methadone

Description of parameter:

Proportion of PWIDs who are actively on the MMT programme

Values:

Year 2006	0.5 per cent
Year 2007	1.8 per cent
Year 2008	2.9 per cent
Year 2009	4.4 per cent
Year 2010	6.4 per cent
Year 2011	9.0 per cent

Source:

Disease Control and Prevention Division, MOH

Assumption:

Information of the number of PWIDs actively on methadone programme was obtained directly from the MOH.

APPENDIX C4 Health utility weights by disease categories

HIV Disease categories	Health Utility Weight
Uninfected PWID	0.75
Untreated HIV+ with CD4>500	0.779
Untreated HIV+ with 350<CD4<500	0.779
Untreated HIV+ with 200<CD4<350	0.779
Untreated HIV+ with CD4<200	0.453
Treated HIV+ with CD4>500	0.947
Treated HIV+ with 350<CD4<500	0.947
Treated HIV+ with 200<CD4<350	0.947
Treated HIV+ with CD4<200	0.947

APPENDIX C5 Economic Parameters

1. HIV testing

Description of parameter:

Cost of screening and confirmatory HIV test per person tested positive

Values:

Year 2010 RM114

Source:

(Ministry of Health, Order 2007)

Assumption:

It is assumed that each positive HIV diagnosis resulted from a screening test (Elisa Test) which costs RM26 per test and a confirmatory test (Western Blot Test, costing) which costs RM88 per test. The unit costs were obtained from the MOH's full paying patient fee schedule[13] which is assumed to be reflective of the full costs of each test (Ministry of Health, Order 2007). Thus the cost of HIV testing per person in 2010 was RM114.

2. Costs for First-line ART

Description of parameter:

Average annual cost of first-line ART treatment per eligible PWID

[13] The MOH implemented a full paying patient scheme in the Selayang and Putrajaya Hospitals where patients are expected to pay the full costs of care.

Values:

Year 2010 RM2,684

Source:

(Ministry of Health, 2011)

Assumption:

Information on the ART treatment costs were provided by the MOH. In 2010, the average annual cost per person was RM2,684 for those on the first-line regime. The first line therapy consists of a combination of

- Stavudine, Lamivudine and Nevirapine; or
- Combivir and Efavirenz; or
- Combivir and Nevirapine.

3. Costs for Second-line ART

Description of parameter:

Average annual cost of second-line ART treatment per eligible PWID

Values:

Year 2010 RM13,643

Source:

(Ministry of Health, 2011)

Assumption:

Information on the ART treatment costs were provided by the MOH. In 2010, the average annual cost per person was RM13,643 for those on the second line. The second line therapy is usually a combination of Combivir and Kaletra.

4. Health care costs for those with CD4 counts ≥350 cells/mm^3

Description of parameter:

Average annual health care costs per PWID with CD4≥350 cells/mm^3

Values:

Year 2010	RM487.00

Source:

Cost description study (Appendix E) and expert opinion

Assumption:

The cost description study (Appendix E) provided an estimate of the 2010 annual outpatient costs for each HIV person with CD4≥350 cells/mm^3 which was RM974. However, Prevtool required input of annual outpatient costs per HIV+ person averaged over the total population of PWIDs with CD4≥350 cells/mm^3 regardless whether they were on treatment or not. There is no direct information on the treatment coverage for HIV+ PWIDs with CD4≥350 cells/mm^3. In consultation with clinical experts, this study adopted a conservative assumption of treatment coverage of 50 per cent. Thus, the average outpatient cost for HIV+ PWIDS with CD4≥350 cells/mm^3 would be RM487 (RM974 x 50 per cent). Since it is assumed that HIV+ persons with CD4≥350 cells/mm^3 would not require inpatient services in relation to

their HIV status, this would also be an estimate of the total annual health care costs for such persons.

5. Health care costs for those with CD4 counts <350 cells/mm^3

Description of parameter:

Average annual health care costs per PWID with CD4<350 cells/mm^3, excluding costs for ART

Values:

Year 2010 RM2,882.84

Source:

Adapted from cost description study (Appendix E), study from Kajang Prison and (Kamarulzaman, 2009a, Ministry of Health, 2012)

Assumption:

i. Annual outpatient costs

The cost description study (Appendix E) provided an estimate of the 2010 annual outpatient costs for each HIV person with CD4< 350 which was RM1,461. However, this only applies to those who are on follow-up and who adhere to the recommended treatment schedule. Prevtool required input of annual outpatient costs per HIV+ person averaged over the total population of PWIDs with CD4 <350 cells/mm^3 regardless whether they were on treatment or not. This was derived in the following manner with the assumption that those on ART would be adhering to the treatment schedule:

- In 2010, it was estimated only 14,002 HIV positive persons were receiving ART treatment (Ministry of Health, 2012).

- Kamarulzaman, A (2009a) estimated that 25 per cent of PLHIV on treatment were PWIDs which gives an estimated of 3,501 (25 per cent x 14,002) PWIDs on treatment in 2010.
- In 2010, there were 54,783 HIV+ PWIDs (Ministry of Health, 2012).
- It is estimated that 38 per cent of the HIV+ PWIDs had CD4<350 cells/mm^3 which gives an estimated 20,818 (38 per cent x 54,783) persons in 2010[14] .
- A rough estimate of the proportion of HIV+ PWID with CD4<350 cells/mm^3 receiving treatment would then be 16.8 per cent (3,501 PWIDs on treatment / 20,818 PWIDs who were HIV+).
- Thus the average cost for outpatient services for a HIV+ PWID with CD4<350 would be RM245.67 (RM1,461 x 16.8 per cent).

ii. Annual inpatient costs

The cost description study (Appendix E) provided an estimate of the 2010 annual inpatient costs for each HIV+ person with CD4<350 cells/mm^3 which was RM15,683.29. However, not all HIV+ PWID with CD4<350 would have inpatient care. Assuming that only 16.8 per cent of them were receiving treatment as was adopted in the previous outpatient cost estimates, the average inpatient costs would be RM2,637.17 (RM15,683.29 x 16.8 per cent).

iii. Total annual health care costs

Thus the total annual health care costs for each HIV+ person with CD4<350 cells/mm^3 would be RM2,882.84 (RM245.64 + RM2,637.17).

[14] The proportion of persons with CD4 counts <350 among HIV+ PID persons was obtained from a small scale project in Kajang Prison. Among 124 HIV+ PID prisoners, in which it was found that 38 per cent or 47 PIDs had CD4 counts below 350. The overall proportion of HIV+ persons with CD4 counts below 350 in Malaysia is 65% (MOH UNGASS 2010). However, feedback from clinicians treating the bulk of HIV+ patients indicated that in general HIV+ PIDs appear to be younger and healthier than non PIDs and that the lower proportion of HIV+ PIDs with CD4 counts <350 in comparison with the general HIV+ population appear to support this notion. Moreover, the HIV+ PIDs in Kajang Prison, which is one of the main prisons to receive persons convicted of drug-related crimes in the country. In this estimate, it is thus assumed that the PIDs held in Kajang Prison are representative of PIDs around Malaysia.

APPENDIX D Estimations of direct health care costs for HIV+ PWIDs

This appendix details the estimation approach for direct health care cost parameter required for the Prevtool software. In deriving the estimates, costs for year 2010 have been used as this is the latest year for which complete information is available. The cost estimates are based on the clinical protocol for management of HIV+ persons in Malaysia which prescribes different treatment and follow up regimes for patients based on their CD4 counts.

1. Outpatient Costs

It is the current clinical practice for all HIV+ persons whose CD4≥350 cells/mm^3 to have routine outpatient visits twice a year while those with CD4<350 cells/mm^3 to have outpatient visits thrice a year[15]. Tests performed during each visit are the same and include tests for viral load, CD4, liver function, renal profile, full blood counts and blood glucose. Table D1 shows the unit cost of each test as well as the outpatient consultation fee based on the MOH's full paying patient fee schedule (Ministry of Health, Order 2007).

Table D1 Unit costs for laboratory tests and consultation fees

Item	RM
i. Consultation fee	85.00
ii. Viral load	88.00
iii. CD4 test	151.00
iv. Liver function test	63.00
v. Renal profile	50.00
vi. Full blood count	41.00
vii. Glucose/lipid	10.00
Total	**487.00**

Source: (Ministry of Health, Order 2007)

[15] Clinical feedback from experts in SBH

Thus the annual outpatient costs for each HIV+ with CD4≥350 cells/mm^3 would RM974.00 (RM487 x 2) and for HIV+ person with CD<350 cells/mm^3 would be RM1,461.00 (RM487 x 3).

2. Inpatient Costs

A study to collect the 2010 inpatient costs for HIV+ PWID patients was conducted at SBH which is the main hospital involved in clinical management of HIV patients in Malaysia. This study was facilitated by prior costing studies for general inpatient expenditures in the hospital as well as availability of a database on patients with infectious diseases admitted into the hospital. The clinical management of HIV patients in this hospital follows the clinical practice guidelines for HIV management in Malaysia. It is assumed that most HIV+ patients requiring hospital treatment would be admitted to public hospitals with resource use similar to that of SBH and thus the estimates obtained from this hospital would be representative of the inpatient costs for all HIV+ PWIDs in the country.

Table D2 provides a summary of the cost estimation process using data from the SBH. It is the practice of the hospital that all admissions for infectious diseases, including HIV, be admitted to Ward 4C. The hospital provided the monthly breakdown of patient fees for the year 2010 (Column A of Table D2). These fees had been highly subsidised by the government. It is estimated that the average subsidy rate for public health care services is 97 per cent (Yon, 2004). This figure was used to estimate the total government subsidy provided to patients in Ward 4C (Column B). The admission database provided the monthly breakdown of all admissions to the ward (Column C). It was not possible to obtain total number of admissions by HIV+ PWIDs directly from the database. This information had to be obtained from searching of patients' files. Due to time limitations, it was only possible to obtain the total number of admissions by HIV+ PWIDs for the months of March and September 2010 (Column D). This information allowed for estimation of the proportions of total admissions to the ward by HIV+ PWIDs (Column E). Examination of patient files also

revealed the number of unique HIV+ PWIDs individuals who had been admitted during those months (Column F). This information was then used in the estimates of inpatient costs for admitted HIV+ PWID as depicted below Table E2.

It is estimated that the annual inpatient costs for the year 2010 were RM15,683 for each HIV+ PWID.

Table D2 Estimation of inpatient costs for HIV+ PWIDs at Sungai Buloh Hospital in 2010

	Patient Fees[1] (RM)	**Total Government Subsidy[2] (RM)**	**No of admissions**	**No of admissions of HIV+ PWID**	**Proportion of admissions for HIV+ PWID**	**No of unique HIV+ PWID individuals**
	(A)	**(B) = (A)/3 x 97**	**(C)**	**(D)**	**(E) = (D) / (C)**	**(F)**
January	42,015	1,358,485				
February	39,656	1,282,214				
March	43,070	1,392,597	150	74	49 per cent	46
April	30,237	977,653				
May	52,253	1,689,514				
June	35,788	1,157,145				
July	38,177	1,234,390				
August	33,412	1,080,321				
September	30,884	998,583	144	76	53 per cent	38
October	36,719	1,187,248				
November	61,900	2,001,442				
December	34,711	1,122,322				
Total	**478,822**	**15,481,914**				
Average per month		**1,290,159 (B1)**			**51 per cent (E1)**	**42 (F1)**

Note:
[1]Patient fees are highly subsidised in the country.
[2]Estimated under assumption that subsidy rate is 97 per cent (Yon, 2004).

Thus the annual inpatient costs for each HIV+ PWID would be
= (B1 x E1)/F1
= (1,290,159 x 51 per cent)/42
= 15,683

APPENDIX E Expenditures of NSP and MMT

Methadone Maintenance Therapy

Year	Government-based clinic* (RM)
2006	4,300,000
2007	5,900,000.00
2008	6,300,000.00
2009	9,700,000.00
2010	7,300,000.00
2011	9,800,000.00
Total	**43,300,000.00**

*Inclusive human resources, facility overheads and purchase of methadone

Source: Disease Control and Prevention Division, MOH

Needle-Syringe Exchange Programme

Year	Government-based clinic* (RM)	NGO Sites* (RM)	Expenditure on needle and syringe (RM)
2006	0.00	1,307,000.00	201,115.88
2007	0.00	2,206,990.55	434,437.50
2008	16,800.00	4,576,574.32	700,768.50
2009	61,900.00	5,510,948.66	888,666.38
2010	81,000.00	6,077,721.73	1,052,338.88
2011	78,000.00	6,058,441.73	1,459,000.13
Total	**237,700.00**	**25,737,676.99**	**4,736,327.25**

* Inclusive of needle and syringe purchased

Source: Disease Control and Prevention Division, MOH

REFERENCES

ACEIJAS, C., STIMSON, G. V., HICKMAN, M., RHODES, T., UNITED NATIONS REFERENCE GROUP ON, H. I. V. A. P., CARE AMONG, I. D. U. I. D. & TRANSITIONAL, C. 2004. Global overview of injecting drug use and HIV infection among injecting drug users. *AIDS,* 18**,** 2295-303.

AGENSI ANTIDADAH KEBANGSAAN KEMENTERIAN DALAM NEGERI 2009. Maklumat Dadah 2009.

AZMEL, A. 2011. PREVALENCE OF HIV AND SYPHILIS INFECTION AMONGST NEEDLE SYRINGE EXCHANGE PROGRAMME ATTENDEES AT THE IKHLAS DROP-IN CENTRE, CHOW KIT, KUALA LUMPUR. *Powerpoint Presentation.*

BACHIREDDY, C., BAZAZI, A. R., KAVASERY, R., GOVINDASAMY, S., KAMARULZAMAN, A. & ALTICE, F. L. 2011. Attitudes toward opioid substitution therapy and pre-incarceration HIV transmission behaviors among HIV-infected prisoners in Malaysia: implications for secondary prevention. *Drug Alcohol Depend,* 116**,** 151-7.

BARNETT, P. G. 1999. The Cost Effectiveness of Methadone Maintenance as a Health Care Intervention.

BAZAZI, A., FU, J., WICKERSHAM, J., KAMARULZAMAN, A. & ALTICE, F. L. 2011. Structural Factors Contributing to HIV Risk, Morbidity and Treatment Engagement Among Active IDUs in Klang Valley, Malaysia. *Powerpoint Presentation.*

CABASES, J. M. & SANCHEZ, E. 2003. Costs and effectiveness of a syringe distribution and needle exchange program for HIV prevention in a regional setting. *Eur J Health Econ,* 4**,** 203-8.

CERIA 2007. Behavioural Surveillance Survey, Kuantan.

CHAWARSKI, M. C., MAZLAN, M. & SCHOTTENFELD, R. S. 2005. Heroin dependence and HIV infection in Malaysia.

COMMONWEALTH 2002. *Return on Investment in Needle and Syringe Programs in Australia*, Commonwealth Department of Health and Ageing.

COMMONWEALTH DEPARTMENT OF HEALTH AND AGEING 2002. Return on investment in needle and syringe programs in Australia.: Commonwealth Department of Health and Ageing.

DEPARTMENT OF STATISTICS MALAYSIA 2012. Malaysia Annual Gross Domestic Product 2005-2012.

EICHLER, H. G., KONG, S. X., GERTH, W. C., MAVROS, P. & JONSSON, B. 2004. Use of cost-effectiveness analysis in health-care resource allocation decision-making: how are cost-effectiveness thresholds expected to emerge? *Value Health,* 7**,** 518-28.

EZAT, W. P. & ALJUNID, S. 2010. Cost-effectiveness of HPV vaccination in the prevention of cervical cancer in Malaysia. *Asian Pac J Cancer Prev,* 11**,** 79-90.

GOLD, M., GAFNI, A., NELLIGAN, P. & MILLSON, P. 1997. Needle exchange programs: an economic evaluation of a local experience. *CMAJ,* 157**,** 255-62.

HUONG, A. G. W., GUAN, N. C., NORDIN, A. S. A., ADLAN, A. S. A. & HABIL, H. 2009. Quality of Life Assessment of Opioid Substance Abusers on Methadone Maintenance Therapy (MMT) in University Malaya Medical Centre. *ASEAN Journal of Psychiatry.*

IHRA 2008. Global State of Harm Reduction 2008. Mapping the respone to drug-related HIV and hepatitis C epidemic.

IHRA 2010. Region Update: Asia.

KAMARULZAMAN, A. 2007. *Challenges to scaling up antiretroviral treatment for injecting drug users in Asia* [Online]. Available: http://i-base.info/idu/320 [Accessed 12 April 2012].

KAMARULZAMAN, A. 2009a. Antiretroviral therapy in Malaysia: Identifying barrier to universal access. *HIV Theraphy,* 3**,** 9.

KAMARULZAMAN, A. 2009b. Impact of HIV prevention programs on drug users in Malaysia. *J Acquir Immune Defic Syndr,* 52 Suppl 1**,** S17-9.

KAMARULZAMAN, A. 2009c. Impact of HIV Prevention Programs on Drug Users in Malaysia. *Journal of Acquired Immune Deficiency Syndromes,* Volume 52**,** 17-19.

KUMAR, S. 2012. Access to Basic Health Care. *Powerpoint Presentation.*

KWON, J. A., ANDERSON, J., KERR, C. C., THEIN, H. H., ZHANG, L., IVERSEN, J., DORE, G. J., KALDOR, J. M., LAW, M. G., MAHER, L. & WILSON, D. P. 2012. Estimating the cost-effectiveness of needle-syringe programs in Australia. *AIDS,* 26**,** 2201-10.

LAUFER, F. N. 2001. Cost-effectiveness of syringe exchange as an HIV prevention strategy. *J Acquir Immune Defic Syndr.*

LAW OF MALAYSIA 2006. Act 283. Drug Dependents (Treatment and Rehabilitation) Act 1983.

LUBIS, R., BULGIBA, A., KAMARULZAMAN, A., HAIRI, N. N., DAHLUI, M. & PERAMALAH, D. 2012. Predictors of survival in Malaysian HIV infected patients on anti-retroviral therapy.

MALAYSIAN AIDS COUNCIL & MINISTRY OF HEALTH MALAYSIA 2009. Integrated Bio-Behavioral Surveillance 2009 Report. Kuala Lumpur: Malaysian Aids Council,.

MATHERS, B. M., DEGENHARDT, L., ALI, H., WIESSING, L., HICKMAN, M., MATTICK, R. P., MYERS, B., AMBEKAR, A., STRATHDEE, S. A., REFERENCE GROUP TO THE, U. N. O. H. I. V. & INJECTING DRUG, U. 2010. HIV prevention, treatment, and care services for people who inject drugs: a systematic review of global, regional, and national coverage. *Lancet,* 375**,** 1014-28.

MATHERS, B. M., DEGENHARDT, L., PHILLIPS, B., WIESSING, L., HICKMAN, M., STRATHDEE, S. A., WODAK, A., PANDA, S., TYNDALL, M., TOUFIK, A. & MATTICK, R. P. 2008. Global epidemiology of injecting drug use and HIV among people who inject drugs: a systematic review. *The Lancet,* 372**,** 1733-1745.

MCCARTY, D., PERRIN, N. A., GREEN, C. A., POLEN, M. R., LEO, M. C. & LYNCH, F. 2010. Methadone maintenance and the cost and utilization of health care among individuals dependent on opioids in a commercial health plan. *Drug Alcohol Depend,* 111**,** 235-40.

MINISTRY OF HEALTH 2004. CONSENSUS REPORT ON HIV AND AIDS EPIDEMIOLOGY IN 2004: MALAYSIA.

MINISTRY OF HEALTH 2005. Monitoring the Declaration of Commitment on HIV/AIDS. Country Report Malaysia.

MINISTRY OF HEALTH 2007. NSEP Final Progress Report.

MINISTRY OF HEALTH 2008. UNGASS COUNTRY PROGRESS REPORT. Malaysia. Reporting Period: January 2006 - December 2007.

MINISTRY OF HEALTH 2009. Estimation and Projection of the HIV Epidemic MALAYSIA 2009.

MINISTRY OF HEALTH 2010a. The Global Fund Proposal Form - Round 10. Country: Malaysia. Kuala Lumpur: Ministry of Health.

MINISTRY OF HEALTH 2010b. Malaysia 2010 UNGASS Country Progress Report. Reporting Period : January 2008 - December 2009. Ministry of Health.

MINISTRY OF HEALTH 2011. Data on Statistic HIV/AIDS Malaysia 1996-2011.

MINISTRY OF HEALTH 2012. Malaysia 2012 Global AIDS Response Country Progress Report. Reporting Period : January 2010 - December 2011.

MINISTRY OF HEALTH 2013. Seminar HIV Impact Assessment 21 February 2013. Injecting Drug User (IDU). Kuala Lumpur.

MINISTRY OF HEALTH Order 2007. Fees Act 1951, Fees (Medical) (Full Paying Patient)

MINISTRY OF HEALTH & MALAYSIAN AIDS COUNCIL 2009. Integrated Bio-behavioural Surveillance 2009 Report. Kuala Lumpur: Malaysian AIDS Council.

MINISTRY OF HEALTH & UNIVERSITI UTARA MALAYSIA 2003. Estimation of Drug Users and Injecting Drug Users in Malaysia. Kuala Lumpur: MOH

UUM.

MINISTRY OF HEALTH & WHO 2004. Summary findings of Behavioural Surveillance Surveys (BSS) in Malaysia.

MINISTRY OF HEALTH MALAYSIA 2011. Malaysia National Health Accounts. Health Expenditure Report Revised Time Series (1997 - 2008) & Health Expenditure Report (2009). Putrajaya: Ministry of Health, Malaysia.

MUSA, R., ABU BAKAR, A. Z. & ALI KHAN, U. 2012. Two-year outcomes of methadone maintenance therapy at a clinic in Malaysia. *Asia Pac J Public Health,* 24**,** 826-32.

NATIONAL ANTI-DRUGS AGENCY 2010. A Comprehensive HIV/AIDS Prevention and Treatment Programme in Drug Rehabilitation Centres in Malaysia.

NATIONAL CENTRE IN HIV EPIDEMIOLOGY RESEARCH 2009. Return on investment 2: Evaluating the cost-effectiveness of needle and syringe programs in Australia.: University of New South Wales.

NI, M. J., FU, L. P., CHEN, X. L., HU, X. Y. & WHEELER, K. 2012. Net financial benefits of averting HIV infections among people who inject drugs in Urumqi, Xinjiang, Peoples Republic of China (2005-2010). *BMC Public Health,* 12**,** 572.

RAZZAGHI, E. M., MOKRI, A. & VAZIRIAN, M. 2005. Effectiveness of methadone maintenance program in reducing illicit drug use and HIV related high-risk behavior: A multi-center study.

REID, G., KAMARULZAMAN, A. & SRAN, S. K. 2004. Rapid Situation Assessment of Malaysia. Kuala Lumpur: Burnett Institution

University of Malaya.

ROHAIZAT, Y. 2004. Financing Health Care in Malaysia: Safety Net for the Disadvantaged Groups including Pensioners, Elderly People, the Poor and the Disabled. *NCD Malaysia,* 3**,** 43-46.

SALOMON, J. A., VOS, T., HOGAN, D. R., GAGNON, M., NAGHAVI, M., MOKDAD, A., BEGUM, N., SHAH, R., KARYANA, M., KOSEN, S., FARJE, M. R., MONCADA, G., DUTTA, A., SAZAWAL, S., DYER, A., SEILER, J., ABOYANS, V., BAKER, L., BAXTER, A., BENJAMIN, E. J., BHALLA, K., ABDULHAK, A. B., BLYTH, F., BOURNE, R., BRAITHWAITE, T., BROOKS, P., BRUGHA, T. S., BRYAN-HANCOCK, C., BUCHBINDER, R., BURNEY, P., CALABRIA, B., CHEN, H., CHUGH, S. S., COOLEY, R., CRIQUI, M. H., CROSS, M., DABHADKAR, K. C., DAHODWALA, N., DAVIS, A., DEGENHARDT, L., DÍAZ-TORNÉ, C., DORSEY, E. R., DRISCOLL, T., EDMOND, K., ELBAZ, A., EZZATI, M., FEIGIN, V., FERRI, C. P., FLAXMAN, A. D., FLOOD, L., FRANSEN, M., FUSE, K., GABBE, B. J., GILLUM, R. F., HAAGSMA, J., HARRISON, J. E., HAVMOELLER, R., HAY, R. J., HEL-BAQUI, A., HOEK, H. W., HOFFMAN, H., HOGELAND, E., HOY, D., JARVIS, D., JONAS, J. B., KARTHIKEYAN, G., KNOWLTON, L. M., LATHLEAN, T., LEASHER, J. L., LIM, S. S., LIPSHULTZ, S. E., LOPEZ, A. D., LOZANO, R., LYONS, R., MALEKZADEH, R., MARCENES, W.,

MARCH, L., MARGOLIS, D. J., MCGILL, N., MCGRATH, J., MENSAH, G. A., MEYER, A.-C., MICHAUD, C., MORAN, A., MORI, R., MURDOCH, M. E., NALDI, L., NEWTON, C. R., NORMAN, R., OMER, S. B., OSBORNE, R., PEARCE, N., PEREZ-RUIZ, F., PERICO, N., PESUDOVS, K., PHILLIPS, D., POURMALEK, F., PRINCE, M., REHM, J. T., REMUZZI, G., et al. 2012. Common values in assessing health outcomes from disease and injury: disability weights measurement study for the Global Burden of Disease Study 2010. *The Lancet,* 380**,** 2129-2143.

SG BULOH HOSPITAL 2011. Cohort Data of IDUs on ARV Treatment in Sg Buloh Hospital, 2007-2011. *In:* SG BULOH HOSPITAL (ed.).

TENGS, T. O. & LIN, T. H. 2002. A meta-analysis of utility estimates for HIV/AIDS. *Med Decis Making,* 22**,** 475-81.

THE UNITED NATIONS REGIONAL TASK FORCE ON INJECTING DRUG USE AND HIV/AIDS IN ASIA AND THE PACIFIC & BURNETT INSTITUTE 2010. Harm reduction in Asia: progress towards universal access to harm reduction services among people who inject drugs.

TRAN, B. X., OHINMAA, A., DUONG, A. T., DO, N. T., NGUYEN, L. T., MILLS, S., HOUSTON, S. & JACOBS, P. 2011. Cost-effectiveness of methadone maintenance treatment for HIV-positive drug users in Vietnam. *AIDS Care*.

TREAT ASIA 2004. TREAT Asia Special Report: Expanded Availability of HIV/AIDS Drugs in Asia Creates Urgent Need for Trained Doctors.

UNODC 2009. Malaysia Country Advocacy Brief Injecting Drug Use and HIV.

UNODC 2010. Malaysia Country Advocacy Brief Injecting Drug Use and HIV.

VICKNASINGAM, B., NARAYANAN, S. & NAVARATNAM, V. 2009. The relative risk of HIV among IDUs not in treatment in Malaysia. *AIDS Care,* 21**,** 984-91.

WAMMES, J. J., SIREGAR, A. Y., HIDAYAT, T., RAYA, R. P., VAN CREVEL, R., VAN DER VEN, A. J. & BALTUSSEN, R. 2012. Cost-effectiveness of methadone maintenance therapy as HIV prevention in an Indonesian high-prevalence setting: a mathematical modeling study. *Int J Drug Policy,* 23**,** 358-64.

WHO 2010. A strategy to halt and reverse the HIV epidemic among people who inject drugs in Asia and the Pacific : 2010-2015.

WHO 2011. Good Practices in Asia. Scale-up of Harm Reduction in Malaysia. WHO.

WODAK, A. 2006. Review of Monitoring and Evaluation of Drug Substitution Treatment in Malaysia. A Report Commissioned by the World Health Organisation. Darlinghurst.

WOLFE, D., CARRIERI, M. P. & SHEPARD, D. 2010. Treatment and care for injecting drug users with HIV infection: a review of barriers and ways forward. *Lancet,* 376**,** 355-66.

WORLD HEALTH ORGANISATION 2001. Macroeconomics and health: investing in health for economic development. Report of the Commission on Macroeconomics and Health. Geneva: World Health Organisation.

WORLD HEALTH ORGANISATION 2002. World Health Report 2002. Reducing risks, promoting healthy life. Geneva: World Health Organisation.

XING, Y., SUN, J., CAO, W., LEE, L., GUO, H., LI, H. & DUAN, S. 2012. Economic evaluation of methadone maintenance treatment in HIV/AIDS control among injecting drug users in Dehong, China. *AIDS Care,* 24**,** 756-62.

YON, R. 2004. Financing health care in malaysia: Safety net for the disadvanged groups including pensioners, elderly people, the poor and the disabled.

ZHANG, L., YAP, L., XUN, Z., WU, Z. & WILSON, D. P. 2011. Needle and syringe programs in Yunnan, China yield health and financial return. *BMC Public Health,* 11**,** 250.