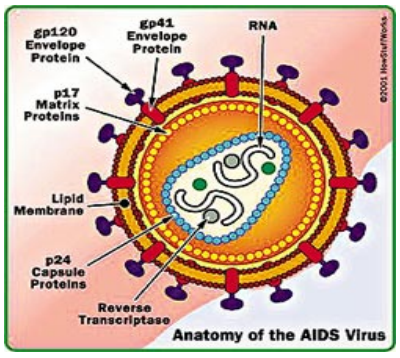
HITAP

A report on

Identifying information regarding effectiveness and cost-effectiveness

of policy and strategies reorientation to mitigate the impact of HIV/AIDS in Thailand



Funded by

The World Bank

A report on

Identifying information regarding effectiveness and cost-effectiveness of policy and strategies reorientation to mitigate the impact of HIV/AIDS in Thailand

By

Juntana Pattanaphesaj

Yot Teerawattananon

Chanida Leartpitakpong

Teera Sirisamutr

2008

Identifying information regarding effectiveness and cost-effectiveness of policy and strategies reorientation to mitigate the impact of HIV/AIDS in Thailand

Health Intervention and Technology Assessment Program (HITAP)
6th Floor, 6th Building, Department of Health
Ministry of Public Health
Tiwanon Road, Mueng, Nonthaburi
Thailand 11000
Tel : +662 590 4374 – 5
Fax : +662 590 4369
Website : http://www.hitap.net
E-mail : hitap@hitap.net

First published 2008
Document number : 09006-09-301-2551
ISBN : 978-611-11-0070-9

ACKNOWLEDGEMENTS

This study was conducted with funding from the World Bank. The Health Intervention and Technology Assessment Programme (HITAP) was supported by the Thai Health Promotion Foundation, the Health Systems Research Institute, and the Bureau of Policy and Strategy Ministry of Public Health. The findings and opinions in this report have not been endorsed by the above funding agencies and do not reflect the policy stance of these organizations.

The authors are also grateful to many individuals and organizations, from whom we have obtained valuable data and information for use in our report. We would like to express our gratitude to the experts who provided helpful comments and suggestions on the research proposal and early versions of preliminary report. The authors, however, are solely responsible for any errors and omissions in this report.

EXECUTIVE SUMMARY

This study aims to make a comprehensive list of interventions that are likely to be effective and cost-effective under the Thai setting and to identify information gaps at both the national and international levels concerning HIV prevention interventions. The review focused on the local evidence in Thailand using both published and unpublished (grey) literature. If the local data was not available, systematic searches of evidence from international databases were conducted. The authors classified and defined HIV prevention interventions using standard guidelines recommended by UNAIDS.

The findings demonstrated that male/female condoms, street outreach programmes, programmes for the prevention of mother-to-child HIV transmission, improvement of sexually transmitted infection treatment services and male circumcision were the only interventions to show strong evidence of reducing HIV infection among target populations. Although it was recommended in the document 'Disease Control Priorities in Developing Countries', there was a lack of significant evidence to prove that community-based education offered good value for money in the prevention of HIV infection, in either low or high HIV prevalence settings. This review found that there was potential for interventions that aim to mitigate barriers to prevention and minimize the negative social outcomes of HIV infection e.g. increased alcohol tax, financial and in-kind sustenance support.

We found very limited local evidence regarding the effectiveness of HIV interventions among the high risk populations in Thailand i.e. injecting drug users, MSM, female sex workers, and young people. This underlines the urgent need to prioritise health research resources to assess the effectiveness and cost-effectiveness of HIV interventions aimed at reducing HIV infection among high risk groups.

This review demonstrated several limitations in using effectiveness and cost-effectiveness evidence for policy decision making concerning HIV/AIDS. First, a lack of proper assessment about the effectiveness and/or cost-effectiveness outcomes of many interventions poses a significant challenge in making evidence-based health policy decisions and programme reorientation. Second, although good quality of evidence was observed for assessing intervention effectiveness, a major concern is the strength of evidence used to generate the cost-effectiveness information. Third, given

that we put more effort into identifying local information for HIV prevention, a majority of the studies included in the final analysis were identified from international databases rather than local sources, and may not be applicable in the Thai context.

LIST OF ABBREVIATIONS

AIDs	acquired immunodeficiency syndrome
ART	anti-retroviral therapy
AZT	azidothymidine or zidovudine
CD4	cluster of differentiation 4
CHOICE	CHOosing Interventions that are Cost Effective
CI	confidence interval
CPI	consumer price index
DALY	disability-adjusted life year
DCP2	Disease Control Priorities in Developing Countries, 2nd edition
DNA	deoxyribonucleic acid
ELISA	enzyme-linked immunosorbent assay
FDA	Food and Drug Administration
FSW	female sex workers
G pop	general people
GDP	gross domestic product
HAART	highly active anti-retroviral treatment
HCW	healthcare worker
HIV	human immunodeficiency virus
ICER	incremental cost-effectiveness ratio
IDU	injecting drug user
MSM	men who have sex with men
NA	not available
NAT	nucleic acid test
NVP	nevirapine
OR	odds ratio
PEP	post-exposure prophylaxis
PI	prison inmate
PICT	provider-initiated HIV counselling and testing
PMTCT	prevention of mother-to-child HIV transmission
PPP	purchasing power parity
Preg	pregnant women
QALY	quality-adjusted life year
RCTs	randomised controlled trials
RNA	ribonucleic acid
RR	relative risk
SDC	serodiscordant couples
STD	sexually transmitted disease
STI	sexually transmitted infection
UAI	unprotected anal intercourse
UK	The United Kingdom
UNAIDS	The United Nations Joint Programme on HIV/AIDS
US	The United States of America
VCT	voluntary counselling and testing
WHO	World Health Organization
Young	people aged 10-24 years old

CONTENTS

I. BACKGROUND

In Thailand in recent years, as in other developing countries, there has been an increasing impetus to justify resource allocation decisions in the health sector, especially after the introduction of the universal health insurance coverage policy in 2001 [1]. The term "evidence-based decision making" was, therefore, introduced to ensure that decisions about health and health care are based on the best available knowledge. To use such an approach it is necessary to appraise what constitutes evidence in relation to health-enhancing interventions. While the use of effectiveness information to justify health care resource allocation is still a common practice, decision makers, academics and health care professionals are becoming more interested in health economic evaluation which is designed to guide explicit health resource allocation decisions by comparing the marginal costs and consequences of alternative health care interventions [2].

The second edition of "Disease Control Priorities in Developing Countries" hereafter "DCP2", aims to support the initiative of the World Bank, in the late 1980s, concerning the search for informative evidence to provide systematic guidance to policy decision makers in developing settings through the use of cost-effective interventions for combating major health problems [3]. This information is very important because empirical evidence suggested that the low level of service utilisation about existing, proven effective and cost-effective interventions could save millions of lives in developing countries.

However, it is noteworthy that the prioritisation of strategies for dealing with sexually transmitted infections and HIV/AIDS, which are among the highest disease burdens in Thailand and many other developing countries, appeared in chapters 17 and 18 of the DCP2 respectively, and was done with several limitations [3]. Firstly, a lack of reliable evidence regarding the effectiveness and cost-effectiveness of many potential strategies was addressed throughout the chapters. This underlines the fact that many HIV/AIDS programmes have been done without close monitoring, or rarely incorporated the well-defined control or comparison groups necessary to identify the effect size of the intervention. In addition, the authors did not employ a comprehensive and systematic search for evidence, resulting in a number of published and unpublished literature being excluded.

Secondly, the book aims to provide policy recommendations across health care settings and this leads to concerns over the transferability of findings from one setting to another. For example, the limitations e.g. infrastructures, social and culture that are specific to the Thai health care system may not be well recognised. Lastly, there were no clear definitions or strategic plans for the implementation of such recommendations—several of the recommendations, e.g. school-based education or peer-based programmes, are too broad, and need to be fine tuned further before their implementation.

As a result, this project aims to elaborate on the achievement of DCP2 by offering precise information about the effectiveness and cost-effectiveness of HIV/AIDS interventions that are particularly specific to the Thai setting. This information will be crucial for guiding public investment to lessen both the short and long-term impacts of HIV/AIDS in Thailand.

In addition, in the context of universal access to antiretroviral therapy, evidence from National AIDS Spending Assessment indicates a decreasing proportion of expenditure on prevention interventions, which prompts policymakers to revitalize HIV prevention. In such a context, this paper contributes to the need to assess the effectiveness and cost-effectiveness of prevention intervention. When measured against the existing HIV programme interventions, gaps of prevention intervention will reorient the programme nature.

II. OBJECTIVES

1. To produce a comprehensive list of prevention interventions that are likely to be cost-effective under the Thai setting (the list will include both interventions that are currently available and not available in Thailand);
2. To identify information gaps at the national and international levels concerning the effectiveness and/or cost-effectiveness of HIV/AIDS prevention interventions in general and/or specific groups of population.

III. METHODOLOGY

A. CRITERIA FOR CONSIDERING STUDIES FOR THIS REVIEW

The primary criterion for selection of studies was that they report the effectiveness or cost-effectiveness of HIV prevention intervention(s). Nevertheless, the effectiveness of such interventions can be measured in a number of ways. Diagram 1 shows the concept of outcome hierarchies that emphasize the difference between 'proximal', 'intermediate' and 'distal' outcomes of HIV interventions. It can be seen that the scale immediate measures of effectiveness of HIV intervention are characterised by the change in knowledge, attitude, perception and skills of the individuals. In many HIV programmes, the changes were reported in terms of trust, caution and received assurances. Further along the continuum, these immediate changes can subsequently affect the determinants of health or health behaviours, for example, condom use, abstinence or fewer partners in the case of HIV/AIDS interventions. Finally, changes in incidence or morbidity or mortality should be evaluated as the final or ultimate goal of the programme.

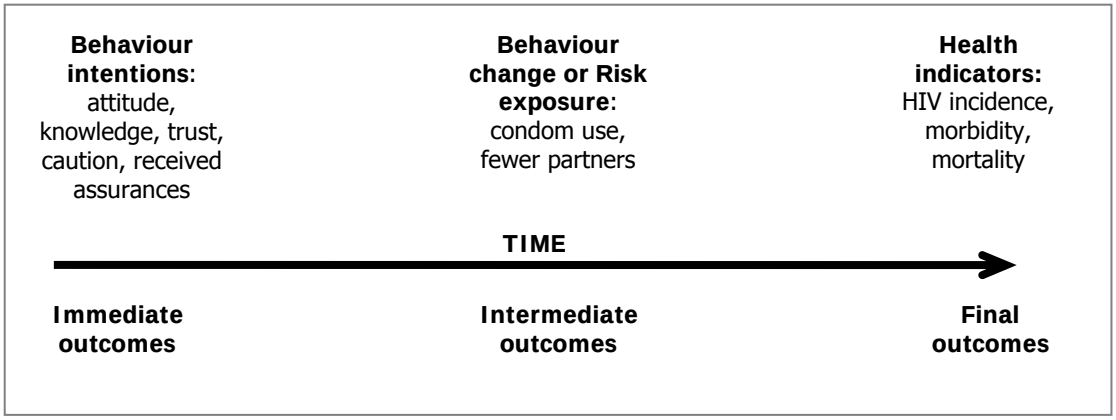


Diagram 1 Outcome measures for HIV prevention interventions [4]

Because it is not always the case that the changes in immediate outcomes lead to changes in intermediate and final outcomes, this study considered only the effectiveness of interventions in terms of the changes in HIV risk behaviour (intermediate outcomes) and HIV incidence (final outcomes). Furthermore, the review included only economic evaluation studies that presented the results in terms of cost per HIV infection averted, or cost per quality-adjusted life year (QALY) gained, or cost per disability-adjusted life year (DALY) gained.

B. SOURCES OF INFORMATION

It is important that the review gave a higher priority to studies conducted within a Thai setting because they better recognise the limitations of resources and infrastructures that are specific to the health care system in Thailand as well as the effectiveness of the many interventions which are determined by many context specific factors. The review of the Thai literature, therefore, included both published and unpublished (grey) literature such as research reports, Master's dissertations or Ph.D. theses, which are considered to be important in the Thai context. If the local data about the effectiveness or cost-effectiveness of interventions were available, then there was no further search of international evidence. For those interventions with no local evidence supported, a systematic search of evidence from international databases was then included. Box 1 provides detailed information of data sources used for the review.

Box 1 A list of databases that were used for reviewing the effectiveness and cost-effectiveness information of HIV/AIDS prevention

Domestic databases

- Thai HTA database (http://www.db.hitap.net/);
- Health Systems Research Institute database (http://www.hsri.or.th);
- Journal of Health Science (http://pubnet.moph.go.th);
- Thai thesis database (http://thesis.tiac.or.th);
- Thai Index Medicus (http://161.200.96.194);
- The Thailand Research Fund (http://www.trf.or.th);
- International Health Policy Programme (http://ihpp.thaigov.net);
- Research Library of National Research Council of Thailand (http://www.riclib.nrct.go.th);
- Raks Thai Foundation (RTF);
- Prevention of HIV/AIDS Among Migrant Workers in Thailand (PHAMIT);
- International Organization for Migration (IOM)

International databases

- Pubmed;
- Cochrane library

Because the Thai databases were quite small and we wished to include as many as possible in the studies for the review, we used only 'AIDS' OR 'HIV' as keywords for searching from Thai databases.

For international databases, various keywords and search strategies were used to identify the relevant papers. Table 1 reveals mesh terms, keywords and search strategies used for the PubMed database. For Cochrane, we used 'search by topic' by selecting 'HIV/AIDS'.

Table 1 Keywords and search strategies used for PubMed

Search1 : International evidence for cost-effectiveness analysis		**abstracts**
#7	#4 AND #6 Limits: Publication Date from 1997/01/01 to 2008/04/30, English	236
#6	#4 AND Review	444
#5	#4 Limits: Publication Date from 2005/01/01 to 2008/04/30, English	513
#4	#3 AND economics	3,660
#3	#1 AND #2 NOT Vertical Transmission	41,452
#2	Prevention and Control OR Primary Prevention OR Intervention Studies OR Early Intervention	722,080
#1	Acquired Immunodeficiency Syndrome OR HIV	220,908
Search2 : International evidence of effectiveness		
#8	#7 Limits: Publication Date from 1997/01/01 to 2008/04/30, English	102
#7	#5 AND Review	126
#6	#5 Limits: Publication Date from 2005/01/01 to 2008/04/30, English	373
#5	#4 NOT Vertical transmission	1,288
#4	#1 AND #2 AND #3	1,482
#3	Randomized Controlled Trial	302,239
#2	Prevention and Control OR Primary Prevention OR Intervention Studies OR Early Intervention	785,868
#1	Acquired Immunodeficiency Syndrome OR HIV	221,573
Search3 : International evidence by risk group		
#23	#22 Limits: Publication Date from 2005/01/01 to 2008/07/31, English	4
#22	#1 AND #2 AND #5 AND #21	5
#21	migrant worker	6,549
#20	#19 Limits: Publication Date from 2005/01/01 to 2008/07/31, English	50
#19	#1 AND #2 AND #5 AND #18	163
#18	iv drug user	10,036
#17	#16 Limits: Publication Date from 2005/01/01 to 2008/07/31, English	49
#16	#1 AND #2 AND #5 AND #15	130
#15	Male Homosexuality OR gay	19,013
#14	#13 Limits: Publication Date from 2005/01/01 to 2008/07/31, English	35
#13	#1 AND #2 AND #5 AND #12	107
#12	prostitution OR "sex workers"	5,017
#11	#10Limits: Publication Date from 2005/01/01 to 2008/07/31, English	8
#10	#1 AND #2 AND #5 AND #9	18
#9	discordant*	12,552
#8	#7 Limits: Publication Date from 2005/01/01 to 2008/07/31, English	22
#7	#1 AND #2 AND #5 AND #6	77
#6	breast feeding	23,834
#5	#3 OR # 4	688,368
#4	observation	161,732
#3	Randomized Controlled Trial	305,945
#2	Prevention and Control OR Primary Prevention OR Intervention Studies OR Early Intervention	903,379
#1	Acquired Immunodeficiency Syndrome OR HIV	225,001

C. TYPES OF STUDIES

For the purpose of this review, studies were identified as being one of the following design types:

1. Systematic reviews and meta-analysis of randomised controlled trials (RCTs)
2. Systematic reviews of case controls or cohort studies
3. Case control studies
4. Cohort studies

Please note that we deliberately excluded descriptive or qualitative reports from the review.

Because the above information is vulnerable to different degrees of bias, systematic review and meta-analysis of high quality RCTs are the most favourable data sources [2]. The advantages of using systematic reviews of clinical effects are twofold. First, a more precise estimate can be attained from combining the outcome data from a number of studies. Second, by using the results from studies carried out in a range of settings, assuming that these studies are sufficiently homogenous to be comparable, the estimate can then be applied to a more general patient population with different baseline risks, rather than specifically for a population group selected for an individual trial. In cases where a meta-analysis of RCT(s) was not available for particular reasons, then evidence available in a higher hierarchy, based on the table 2**,** which presents the broad agreement on the level of clinical evidence, was considered.

Table 2 Levels of clinical evidence.

1++	Systematic reviews & meta-analyses of RCTs or RCT(s) conducted in Thailand with a very low risk of bias.
1+	Systematic reviews & meta-analyses of RCTs or RCT(s) conducted internationally with a very low risk of bias.
1-	Systematic reviews & meta-analyses of RCTs or RCT(s) conducted in Thailand with a high risk of bias.
1--	Systematic reviews & meta-analyses of RCTs or RCT(s) conducted internationally with a high risk of bias.
2++	Systematic reviews of case control or cohort studies conducted in Thailand with a very low risk of confounding, bias, or chance and a high probability that the relationship is causal.
2+	Systematic reviews of case control or cohort studies conducted internationally with a very low risk of confounding, bias, or chance and a high probability that the relationship is causal.
2-	Case control or cohort studies conducted in Thailand with a high risk of confounding, bias, or chance and a significant risk that the relationship is not causal.
2--	Case control or cohort studies conducted internationally with a high risk of confounding, bias, or chance and a significant risk that the relationship is not causal.

Adapted from [2]

Economic evaluation can be carried out using a number of different perspectives, ranging from the broadest societal perspective, which includes all health and non-health care expenses paid by health providers, health insurers, patients' employers and households, to a narrow individual patient perspective, which only includes expenses paid by patients. Because there is general consensus among health economists that the societal perspective is the most useful for priority setting in health care, this review compared the value for money of different HIV/AIDS preventive interventions using a societal viewpoint. However, if the economic evidence of the societal viewpoint was not provided, only the health care provider perspective was used.

In addition, different monetary currencies and unit costs associated with particular resources between locations and overtime are among the most commonly cited obstacles to applying economic evaluation findings across settings. This study adjusted all cost-effectiveness ratios in a common currency,the international dollar, and at present value—2008, using the exchange rate, consumer price index (CPI) of Thailand and purchasing power parity (PPP) information from the World Bank (12.609 National currency per current international dollar).

With regard to the thresholds for considering an intervention to be cost-effective, WHO-CHOICE has been using criteria suggested by the Commission on Macroeconomics and Health [5]. Gross domestic product (GDP) was used as an indicator to derive the following three categories of cost-effectiveness: Highly cost-effective (less than GDP per capita per QALY); Cost-effective (between one and three times GDP per capita per QALY); and Not cost-effective (more than three times GDP per capita per QALY). In this study, an intervention that cost less than one GDP per capita per QALY was considered to be cost-effective. Since 11.23 QALYs would be saved by avoiding a case of HIV [6], the thresholds for considering an intervention to be cost-effective was (136,921/12.609 x 11.23) = 121,946 PPP$ per HIV case averted. (Thai GDP per capita was 136,921 Baht in 2008)

D. SCOPE AND TYPES OF INTERVENTIONS

Interventions under this investigation were those that showed evidence of reducing HIV incidence or risk behaviours likely to effect horizontal and vertical HIV transmission. The set of interventions was not restricted to those in practice in Thailand or funded by the Thai government. It also covered interventions provided at all levels, i.e. individuals, groups, and communities, which are likely to be beneficial in the reduction of the HIV/AIDS epidemic worldwide.

Given that a wide range of interventions were included in this study, it is vital that they have clear definitions and detailed information to ensure a better understanding of, for example, what specific interventions are, what their delivery modes are, and to whom the interventions targeted. A lack of clarity and descriptive detail of interventions makes it difficult to assess and/or compare either the effectiveness or cost-effectiveness of interventions conducted in different settings. It is also impossible to make sensible recommendations in regards to policy decision making if there are no concise definitions for commonly implemented intervention approaches.

It is necessary that this study establish or adopt a standard structure on how to define and classify interventions for the prevention of HIV/AIDS. Fortunately, a recent framework for classifying HIV prevention interventions proposed by UNAIDS serves this purpose well. The UNAIDS framework recommends that an intervention should be defined based on: i) foundation of brief description including descriptions of activities or services and commodities provided in the intervention and, when relevant, key message content included with the intervention, and ii) detail codified in quality standards namely message content, the method of delivery, target population, setting and the desirable outcomes and its theoretical ground (see diagram 2).

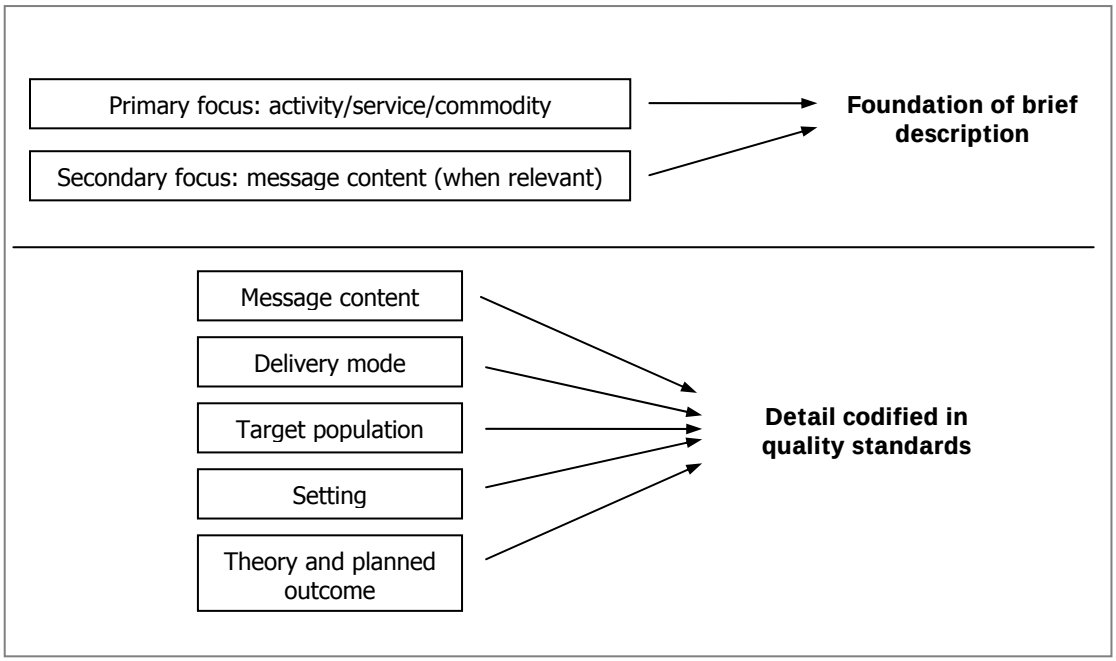


Diagram 2 Proposed framework for establishing intervention definitions [7]

The same UNAIDS report also provides guidance for classifying HIV prevention interventions. Based on its recommendations, interventions are grouped into five broad categories. These are:

1. Interventions that affect knowledge, attitude and beliefs and influence psychological and social correlates of risk;
2. Harm reduction interventions that lower the risk of a behaviour, but do not eliminate the behaviour;
3. Biological/biomedical interventions that strive to reduce HIV infection and transmission risk;
4. Mitigation of barriers to prevention and negative social outcomes of HIV infection;
5. Mitigation of biological outcomes of HIV infection.

However, the fifth category was not related to HIV prevention intervention, so we did not include it in the review.

From the above recommendations, we provide a definition and classification of each HIV prevention intervention in table 3.

Table 3 Classification and definition of HIV prevention intervention under the review

Name of intervention	Activities, services, commodity	Message content (if relevant)	Delivery mode	Target population/ setting	Outcomes/ theory
I. Interventions affecting knowledge, attitudes and beliefs and influencing psychological and social risk correlates					
Abstinence	Abstinence-only programme often targets family involvement and community norms, as well as individual behaviours by addressing multiple influences on knowledge, attitudes, and values. Abstinence-plus programme promotes sexual abstinence as the best means of preventing HIV, but also encourages condom use and other safer-sex practices for sexually active participants.	The social, health-related, and psychological benefits of abstaining from sexual activity--most of them note the potential harms of sexual activity outside marriage	Varies	Young people (10-24 years) who may not yet have initiated sexual activity	To encourage both primary abstinence (remaining a virgin) and secondary abstinence (returning to abstinence after sexual activity) to refrain from sexual activity/ theoretical underpinnings include social learning theory, the health-belief model, cognitive-behavioural theory, the theory of social inoculation, the culture of poverty perspective, and utility maximization perspectives
Community-based education (including opinion leader	This programme affects community-wide behaviour change. In this approach, popular opinion leaders are trained to disseminate risk reduction messages to their peers, and thereby	Varies	Varies	Broad population base	Social change theory

Name of intervention	Activities, services, commodity	Message content (if relevant)	Delivery mode	Target population/ setting	Outcomes/ theory
programmes)	influence other group members to re-evaluate their own HIV risk, modify their attitudes toward safer sexual practices, and change their behaviour.				
Peer education intervention	The peer education intervention is a model of training that supports participants to develop and then deliver information to their peers.	Varies: e.g. mitigation of stigma and discrimination towards people living with HIV	Peer educators, trained outreach workers	Typically targeted to smaller, unique populations	Varies: includes diffusion-based interventions that strive to affect behaviour through the dynamics of social networks
Life Skills-Based Education (LSBE)	LSBE refers to an interactive process of teaching and learning which enables learners to acquire knowledge and to develop attitudes and skills which support the adoption of healthy behaviour.	It is being adopted as a means to empower young people in challenging situations.	Varies	Young people (10-24 years)	Enhanced self-efficacy
Mass media campaigns	Mass communication potentially to influence social norms, expectation and behaviour related to HIV/AIDS	Varies e.g. people in the community are at risk of HIV infection through sexual behaviour	Television, radio, public events	Typically large segments of the population, but content can be targeted to subpopulations	Varies: reduced HIV-related risk behaviour, changes in social norms

Name of intervention	Activities, services, commodity	Message content (if relevant)	Delivery mode	Target population/ setting	Outcomes/ theory
Provider-initiated HIV counselling and testing (PICT)	All patients are offered HIV testing and consent to be tested is implied as with any other clinically indicated laboratory test; patients may opt out if they do not want to be tested.	e.g. Uptake of client-initiated HIV testing and counselling has been hampered by many of the same factors that limit uptake of other HIV-related services, including stigma and discrimination, limited access to treatment, care and health services in general, as well as gender issues.	Healthcare providers	People visiting health care facilities for any purpose	To increase uptake of VCT and early recruit to ART if positive, or maintain low risk behaviour in the population when detected negative
School-based education	School-based education programmes, an aspect of information, education, and communication, provide information to young people and reinforce healthy norms in a school setting.	Varies	Teacher, healthcare provider	School children	Varies

Name of intervention	Activities, services, commodity	Message content (if relevant)	Delivery mode	Target population/ setting	Outcomes/ theory
Voluntary counselling (with/without HIV testing)	Individual or group of people are taught about HIV/AIDS. When HIV testing is performed, counsellors notify their clients to notify them of their HIV status and provide counselling support to help them cope with the outcome. This intervention must be performed on a voluntary basis.	Causes and risk factors of AIDS, the steps necessary to prevent HIV infection, and how to prevent the spread of the disease for those who have already been infected with HIV	Trained counsellor	Varies	Varies
Workplace-based education (including prison-based education)	This programme communicates AIDS prevention messages to employees in either formal or informal settings, acts as a role model for behaviour change, and distributes and demonstrates the correct use of condoms.	Varies	healthcare provider, peer-educator, trainer	Employee	It induced changes in knowledge, attitudes, and risk behaviour.
II. Harm reduction interventions that lower the risk of a behaviour, but do not eliminate the behaviour					
Male and female condom use and/or distribution	This programme provides free condoms in readily visible and accessible sites through health care facilities and private businesses (through social marketing) serving populations at high risk of STDs and HIV.	-	Varies, but typically free distribution in public settings	Sexually active at-risk individuals	Decrease risk from unprotected sexual intercourse

Name of intervention	Activities, services, commodity	Message content (if relevant)	Delivery mode	Target population/ setting	Outcomes/ theory
Needle and syringe programme	This programme provides a way for those IDUs who continue to inject to safely dispose of used needles and syringes and to obtain drug injection equipment at no cost. It provides a range of related prevention and care services that are vital to helping IDUs reduce their risks of acquiring and transmitting blood-borne viruses as well as maintain and improve their health.	-	Most typically community-based	Injecting drug users	Decrease use of contaminated injection equipment
Needle social marketing	The intervention aimed to reach all IDUs at both detoxification centres and local health institutions e.g. drug stores, community hospitals and private clinics. In detoxification centres, the intervention mainly consisted of health education provided by health workers. In the community, health workers or peer educators visited drug users' homes or places where they gathered. The Intervention included face-to-face health education, dispensing and	-	Most typically community-based	Injecting drug users	Decreased use of contaminated injection equipment

Name of intervention	Activities, services, commodity	Message content (if relevant)	Delivery mode	Target population/ setting	Outcomes/ theory
	recalling needles. Drug users could also collect materials/needles from the local hospitals or Centres for Disease Control (CDC) and from peer educators.				
III. Biological/biomedical interventions that strive to reduce HIV infection and transmission risk					
Anti-retroviral prophylaxis for vertical HIV transmission	It is a combination between HIV counselling and testing, anti-retroviral prophylaxis and breastfeeding substitution. The Thai PMTCT programme provides free services for voluntary HIV counselling and testing (VCT) for all pregnant women (approximately 0.8 million per annum), at first antenatal visit and at 28 weeks. HIV infected pregnant women receive free antiretroviral drugs, breast milk substitutes for 12 months and counselling with their partner to test their newborn babies at 12 and 18 months, and recruit them into universal ART programmes when CD4 counts indicate the necessity.	-	Primarily clinic-based, which is linked to antenatal services	Infants born to HIV-positive mothers	Reduction in mother-to-child transmission and prevalence/incidence of HIV positive infants

Name of intervention	Activities, services, commodity	Message content (if relevant)	Delivery mode	Target population/ setting	Outcomes/ theory
Diagnosis and treatment of sexually transmitted infections	The process should be confidential, voluntary and non-coercive and include all sexual partners involved with each STD patient.	-	Healthcare provider, typically clinic-based	Varies	Reduced prevalence of sexually transmitted infections—thought to also reduce HIV incidence
Drug treatment including drug substitution treatment	Methadone administered orally as syrup is the pharmacological agent that is most commonly used for substitution treatment of opioid dependence worldwide. There are two types of interventions. 1) methadone maintenance treatment (60 mg/day or more) 2) Detoxification, the schedule is completed in 90 days. Data about HIV risk behaviour was reported for weeks one and two of treatment while participants were stabilised on methodone (40 mg/day) and weeks five and six at the commencement of the dose taper.	-	Healthcare provider	Injecting drug users/specialist drug and alcohol treatment programme	Decreased dependence on injecting drugs and therefore minimize use of contaminated injecting equipments

Name of intervention	Activities, services, commodity	Message content (if relevant)	Delivery mode	Target population/ setting	Outcomes/ theory
HIV vaccine	The first efficacy trial (Phase III) in Thailand of an HIV candidate vaccine (containing gp120 B and E subtypes) was initiated in 1999. It was conducted among injection drug users attending 17 Bangkok Metropolitan Administration (BMA) drug-treatment clinics. Eligibility criteria were: aged 20-60 years, drug injection during the previous year, being negative for HIV-1 by ELISA at screening and baseline. Vaccine or placebo was injected intramuscularly at months 0, 1, 6, 12, 18, 24, and 36 (36 months of follow-up). The primary end point for vaccine efficacy was HIV-1 infection.	-	healthcare provider	Varies	Reduced incidence of HIV infection
Male circumcision	Male circumcision is the surgical removal of all or part of the foreskin of the penis.	-	Healthcare provider	Males/typically clinic-based	Reduced biological risk of HIV acquisition
Mass or community treatment of	The treatment consisted of azithromycin (1,000 mg single dose oral), ciprofloxacin (250 mg single dose oral)	-	Healthcare provider	All consenting adults aged 15-59 years were	Reduced prevalence of sexually transmitted infections—thought to also

Name of intervention	Activities, services, commodity	Message content (if relevant)	Delivery mode	Target population/ setting	Outcomes/ theory
sexually transmitted infections (STI)	and metronidazole (2.0 g oral). Ciprofloxacin (FDA category C) was not given to pregnant women, who instead received cefixime 400 mg oral. Metronidazole (2.0 g oral) is the recommended single-dose regimen for trichomoniasis and provides short-term remission in 70–85% of cases of bacterial vaginosis; it is safe in pregnancy (FDA category B). Benzathine benzylpenicillin (2.4 million IU intramuscular injection) was given in the home to TRUST (Toluidine Red Unheated Serum Test--the syphillis screening)-positive intervention-group participants within 24 hr of serum collection; treatment was based on serological findings, since the administration of injections to uninfected individuals would be unacceptable. The drug regimen was given over 2 days (azithromycin and			given directly observed treatment of STI at home every ten months, irrespective of laboratory testing results or the presence of symptoms.	reduce HIV incidence

Name of intervention	Activities, services, commodity	Message content (if relevant)	Delivery mode	Target population/ setting	Outcomes/ theory
	ciprofloxacin in day 1; metronidazole and intramuscular benzathine benzylpenicillin on day 2).				
Microbicides	Microbicides are compounds formulated as gels, films, foams, suppositories, or creams and which, when inserted into the vagina, will prevent male-to-female transmission of HIV and other STIs. Nonoxynol-9, one potential vaginal microbicide, is widely used spermicide. The dosage ranged from 70 to 1,000 mg depending on the dosage form.	-	Varies, but typically free distribution in public settings	All women were advised to use vaginal microbicides prior to each episode of intercourse.	One of the important concepts in vaginal microbicide development is that it is a female-controlled method that does not necessarily require negotiation with a male sexual partner for use especially in the context of lower power relationship.
Post-exposure prophylaxis (PEP)	Two or more antiretroviral drugs are recommended for duration of 4 weeks to reduce the likelihood of HIV infection after potential exposure, either occupationally or through sexual intercourse.	-	Healthcare provider	Healthcare workers, rape victims and others exposed to biohazardous material	Reduced incidence of HIV infection
Screening blood products and donated	Blood screening should be anonymous, the test result cannot be linked with the person whose blood has been tested,	-	Healthcare provider	Recipients of blood products and donated	Reduction in iatrogenic transmission of HIV through transfusion of

Name of intervention	Activities, services, commodity	Message content (if relevant)	Delivery mode	Target population/ setting	Outcomes/ theory
organ for HIV	other than by the person themselves or a counsellor. Normally the blood sample is given a number or code, so that the person can be contacted if their results are positive.			organs	blood and blood products
IV. Mitigation of barriers to prevention and negative social outcomes of HIV infection					
Microfinance	The intervention employs such assets as savings accounts, family microenterprises, and scholarships to fight poverty and promote health and social functioning. For example; loans were administered for the development of income generating activities with a group lending model.	-	Varies, individuals, microfinance and microcredit, social protection, insurance	Individuals and families economically affected by AIDS	Economic empowerment. May also reduce secondary transmission of HIV
Increases in alcohol taxes		-	Legal system	Legislators, politicians decision-makers	A more restrictive alcohol policy through supply and demand side interventions reduces alcohol consumption, which in turn decreases risky sexual activity.

E. DESCRIPTION OF STUDIES

As indicated, we started with a search from the Thai databases in which a total of 932 abstracts were initially identified (see diagram 3). Of these, 890 abstracts were excluded based on our exclusion criteria namely: i) publications of the same study, ii) descriptive studies, iii) assessment of satisfaction, knowledge and attitude towards HIV/AIDS, risk behaviours and programme activities (not outcomes), iv) reports of case studies, and v) unit cost analysis.

From the review of the 42 papers, only fourteen papers were found to be relevant, and then included in the analysis. Of the 28 papers excluded, 25 papers reported only immediate outcomes of the HIV prevention programmes. For example, two papers, which reported the effectiveness of the distribution of condom vending machines in the communities, only used numbers of condoms sold per machine and/or customer's satisfaction as their outcome measures [8, 9]. Three other papers that evaluated drug regimens for the prevention of vertical HIV transmission were excluded because the regimen under investigation, i.e. AZT only regimens, is now not in clinical practice in Thailand [10-12].

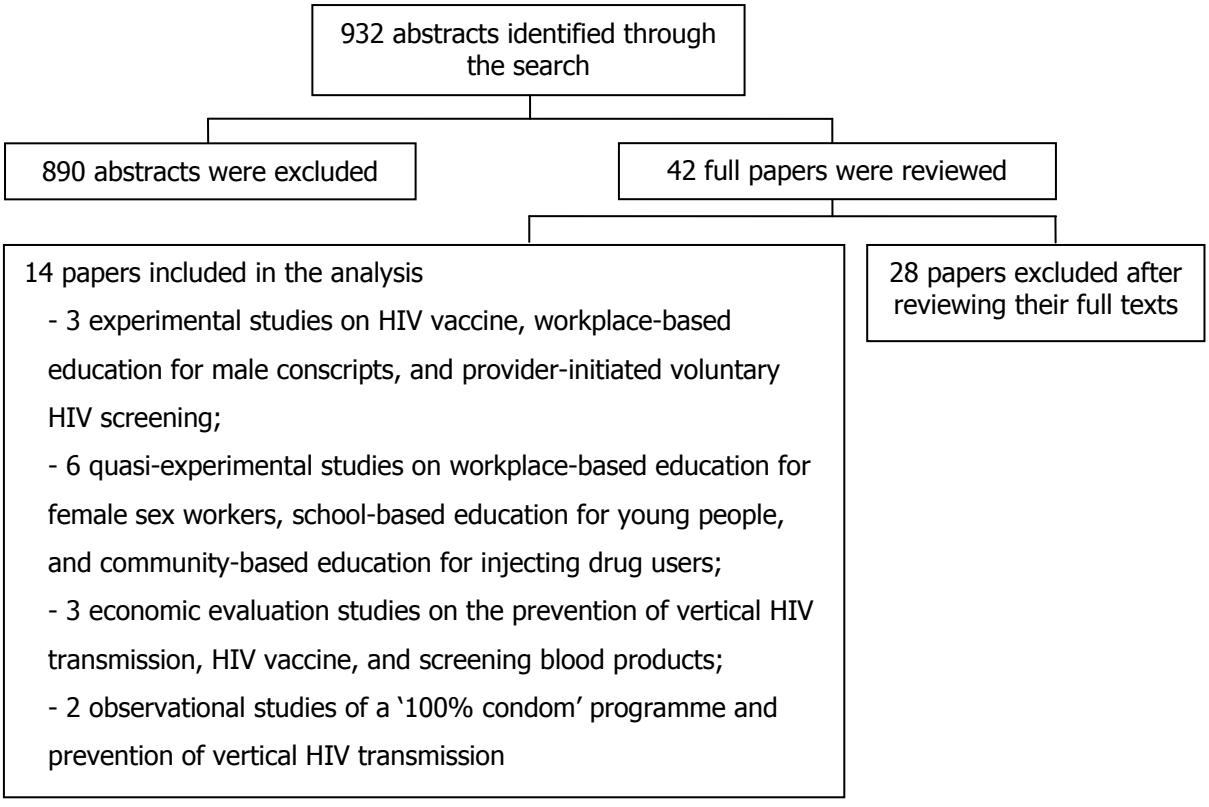


Diagram 3 Literature review profile of the Thai literature

We identified 1,392 abstracts from the international searches (see diagram 4). After reading the abstracts, 1,203 studies were eliminated because they were editorials, descriptive, or qualitative reports. In addition, we also excluded a number of studies that assessed the effectiveness and cost-effectiveness of programmes for the prevention of mother-to-child HIV transmission because the Thai studies had already been identified. The full text of the remaining 189 studies was reviewed and 71 studies were relevant and included in the analysis in the final stage.

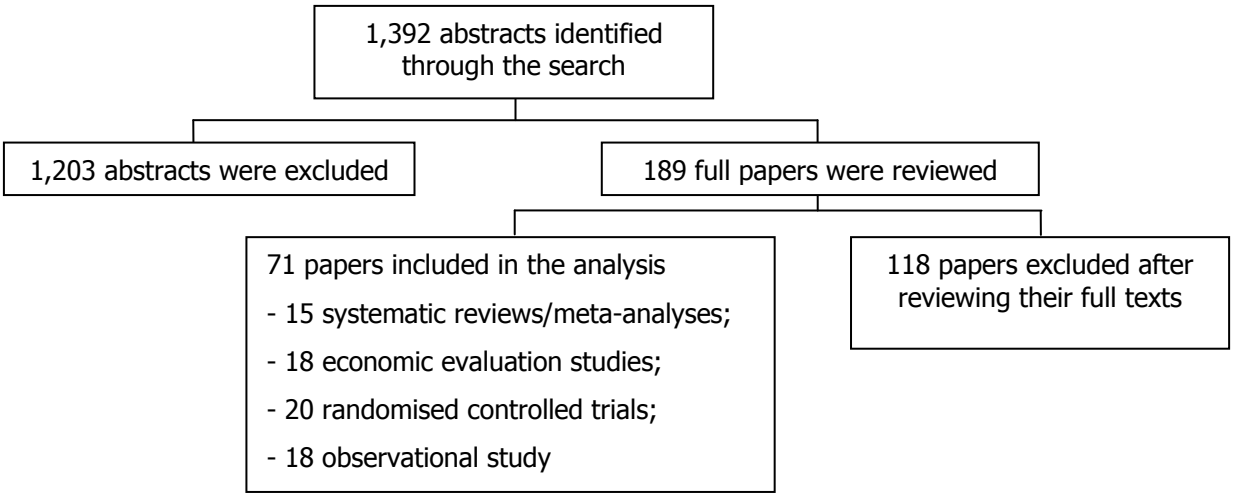


Diagram 4 Literature review profile of the international literature

IV. RESULTS

Table 4 summarizes the effectiveness and cost-effectiveness of each HIV prevention intervention based on the reviews of domestic and international studies. It was not surprising that a much larger proportion of effectiveness and cost-effectiveness studies were conducted in international settings mainly the US followed by Sub-Saharan Africa. There were more effectiveness studies than cost-effectiveness studies conducted for HIV prevention within the Thai setting (11 effectiveness studies vs. 3 cost-effectiveness studies) whereas more effectiveness studies were identified than cost-effectiveness studies from the internationals settings (45 effectiveness studies vs. 26 cost-effectiveness studies).

Furthermore, most of the assessments focused on interventions affecting knowledge, attitudes and beliefs (48/95 or 51%), followed by biological/biomedical interventions (28/95 or 29%), harm reduction interventions (16/95 or 17%) and, lastly, mitigation of barriers to prevention and negative social outcomes of HIV infection (3/95 or 3%).

Table 4 Summary concerning the effectiveness and cost-effectiveness evidence of HIV prevention interventions

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
I. Interventions affecting knowledge, attitudes and beliefs and influencing psychological and social risk correlates								
Abstinence-only programmes	Young people	1+	High-income countries	No evidence that the programmes can reduce HIV risk [13].	NA	NA	NA	NA
Abstinence-plus programmes	Young people	1+	High-income countries	It found a significantly protective effect on sexual risky behaviours i.e. incidence and frequency of unprotected/protected sex; number of sexual partners; increased condom use. However, no significant effect on biological outcomes i.e. incidence of STI and pregnancy [14, 15].	NA	NA	NA	NA
Community-based education	Young girls	1--	US	During 3-12 months of follow-up at a health care setting, the intervention reduced sexual risk behaviours (e.g. vaginal sex without use of	NA	NA	NA	NA

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
				condom, giving oral sex, and alcohol and drug use before sex) [16, 17].				
Community-based education	Young people in rural areas	1--	South Africa	There was no significant improvement for HIV sero-status and sexual risk behaviours after 2 years follow-up [18].	NA	NA	NA	NA
Community-based education	Injecting drug users	2-	Thailand	Drug use and sharing injection equipment with others was not significantly decreased after 1 month follow-up [19].	NA	NA	NA	NA
Community-based education	Women living in low income housing developme-nts	1--	US	The intervention improved HIV knowledge, partner communication, risk-reduction behavioural intentions, and condom use, and decreased perceived barriers to condom use after 6-12 months follow-up [20, 21].	Societal	US	'do nothing'	ICER is PPP$ 2,551,240 per HIV infection averted [21].

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
Community-based intervention (Sonagachi)	Female sex worker	2+	India	HIV prevalence among sex workers (< 10%) had been lower than the national average (~30%) [22].	NA	NA	NA	NA
Community-based education (including opinion leader programme)	Men who have sex with men	1+	Various	The interventions were effective in reducing unprotected sex by 35% at follow-up intervals ranging from 4 months to 1 year. They were also effective in increasing reported condom use during anal intercourse by 59 % [23, 24].	Societal	US	'do nothing'	ICER is PPP$ 165,346 per HIV infection averted [25].
Mass media campaigns	general population aged 17-45 years	2--	US	The media campaign would increase condom use from 48 to 57% [26].	Health care provider's	US	'do nothing'	ICER is PPP$ 87,124 per HIV infection averted [26].
Peer education intervention	Injecting drug users	1--	US	After 6 months of follow-up, the intervention produced a 29% greater decrease in	NA	NA	NA	NA

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
				overall injection risks relative to the control (OR 0.71; 95%CI 0.52- 0.97), and a 76% decrease compared with baseline. Sexual risk behaviours and safe injection were also decreased from baseline, but they did not differ between trial arms [27, 28].				
Peer education intervention	Female sex worker	2+	Kenya	Peer-mediated interventions were associated with an increase in protected sex after 5 years follow-up. Female sex workers (FSW) who received peer interventions had more consistent condom use with clients compared with unexposed FSW (86.2% vs 64.0%; adjusted OR 3.6,	Health care provider's	India/ Cameroon	'do nothing'	ICER of the mixed interventions targeted sex workers ranged from PPP$ 279 to 566 per HIV infection averted [30, 31].

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
				95%CI 2.1–6.1). These differences were larger among FSW with greater peer-intervention exposure. HIV prevalence was 25% (17/69) in FSW attending ≥ 4 peer-education sessions, compared with 34% (25/73) in those attending 1–3 sessions (P=0.21) [29].				
Peer education intervention	Men who have sex with men	2+	UK, Scotland	Peer education had less effecitve in sexual behaviour change among homosexual men. No significant different between control and interven-tion group in the proportion reporting unprotected anal intercourse (OR 1.12, 95%CI 0.81- 1.55) and negotiated safety (OR 1.11, 95%CI 0.79-1.57) [32-34].	NA	NA	NA	NA

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
Peer education intervention	Young people	2+	Italy, US, Kenya	The intervention improved neither condom use nor number of sexual partners after 2 years follow-up. The percentage of students reporting condom use during the most recent sexual intercourse slightly decreased from 55.1% to 49.7% in intervention arm, though the decrease was not significant. The percentage of students with more than one partner was increased [35-37].	NA	NA	NA	NA
Routine (provider-initiated) voluntary HIV screening at healthcare settings	Adults aged 15-65 years	1++	Thailand	Routine provider offering of HIV screening significantly increased the acceptance rate of HIV testing and the number of HIV infection detected compared to the standard practice of patient-	Healthcare provider's	Thailand	'no screening'	ICER is PPP$ 22,899.16 per HIV infection averted [38].

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
				initiated HIV testing (5.59% VS 0.32%) and (23 vs 10 HIV detection within 2 months in 8/8 case and control community hospitals), respectively [38].				
School-based sex education programme (combined with life skills)	Young people	2-	Thailand	Three studies indicate the improvement of AIDS preventive behaviours i.e. decreased number of visits to night clubs, decreased incidence of watching arousal media, increased sporting activities, decreased alcohol drinking, decreased number of sex partners, and increased rate of using condom in the experimental group [39-41]. Another study found that the sexual risk behaviour was significantly	NA	NA	NA	NA

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
				improved after 4 month follow-up [42].				
School-based sex education programme	Young people	1--	US, Italy, Mexico	The results of meta-analysis of 12 controlled studies in the US indicated that the overall mean effect size for abstinent behaviour was very small (effect size=0.05, 95%CI 0.01-0.09) [43]. In addition, the intervention targeted to improve sexual risk behaviour did not induce change in condom use or number of sexual partners after 1-year follow-up. The only apparent benefit was a greater improvement in knowledge of HIV [44].	Societal	India / US / Cameroon	'standard practice'	ICERs ranged from PPP$ 4,853 [45] to 137,950,790 [46, 47] per HIV infection averted.

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
Voluntary HIV counselling and testing (VCT) at workplace	HIV-negative employee	1--	Zimbabwe	Highly acceptable VCT did not reduce HIV incidence at 2-year follow-up. HIV incidence was higher in the intensive VCT arm (mean per-site HIV incidence 1.37 per 100 person-years follow-up (PYFU) than in the standard VCT arm (mean per-site HIV incidence 0.95 per 100 PYFU), but the difference was not significant (adjusted rate ratio 1.49; 95%CI 0.79-2.80) [48].	NA	NA	NA	NA
Voluntary HIV counselling and testing (VCT) in Prisons	Prison inmates at or near their time of release	NA	NA	NA	Societal	US prisons	'no HIV counselling and testing provided at Prisons'	ICER of offering VCT at prisons was PPP$ 508,651 per HIV case averted [49].

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
Voluntary HIV counselling and testing (VCT) and STD services at both clinic setting and community setting	Men who have sex with men	1+	Various	The intervention delivered at the individual level was effective in reducing unprotected anal intercourse (UAI) by 43% OR 0.57, 95%CI 0.37–0.87). These effects were significant in both the short- (median 6 months) and long-term (median 12 months). It also improves sexual risk behaviour: condom use with anal intercourse (OR 1.55, 95%CI 0.73–3.29), number of sex partners (OR 0.97, 95%CI 0.45–2.06), unprotected oral sex (OR 0.58, 95%CI 0.28 –1.24), incident HIV (OR 0.62, 95%CI 0.36 –1.06) [24].	NA	NA	NA	NA

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
Voluntary HIV counselling and testing (VCT) plus STI services and free condom	HIV sero-discordant couples	2--	Zambia	The proportion of reported condom use increased from <3% to >80% and remained stable through > 12 months of follow-up. Since underreporting was common, HIV transmissions were still detected when couples had reported always using condoms. DNA sequencing confirmed that 87% of new HIV infections were acquired from the spouse [50].	NA	NA	NA	NA
Workplace-based education	Male conscripts in military camps	2++	Thailand	Intensive workplace-based education programme for male conscripts (that was applied for 15 months) has successfully decreased incidence of HIV infection by 50% during the period of two years but not statistically	NA	NA	NA	NA

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
				significant (RR 0.49, 95%CI 0.11-2.26) [51].				
Workplace-based education ± condom distribution	Female sex workers	2-	Thailand	The risky sexual behaviour was significantly decreased in the intervention group compared to the control group after 1 week follow-up [52, 53].	NA	NA	NA	NA
Workplace-based education/condom distribution/ free STD clinic visits	Female sex workers	2+	Indonesia, China	The intervention was effective for increasing condom use (from 55-60% to 67-85%, $p<0.01$) and reducing STD among sex workers at 12 months evaluation. The prevalence of gonorrhea fell from 26% to 4%, and chlamydia fell from about 41 to 26% [54, 55]. The prevalence of HIV remained low throughout the study [56].	NA	NA	NA	NA

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
II. harm reduction interventions that lower the risk of a behaviour, but do not eliminate the behaviour								
'100% condom programme'	Male conscripts	2-	Thailand	The data suggests that increased condom use along with some decrease in the frequency of commercial sex among the military conscripts led to a marked decline in STI and also to a subsequent reduction in HIV incidence [57].	NA	NA	NA	NA
Condom use (availability and accessibility)	Sexually active heterosex-ual couples	2+	Various (reviewed evidence)	The HIV incidence in the "always" condom user group was 1.14 (95%CI 0.56-2.04) per 100 person-years. The HIV incidence in "never" condom user group was 5.75 (95%CI 3.16-9.66) per 100 person-years. Overall effectiveness, the proportionate reduction in HIV seroconversion with condom use, was approximately 80% [58].	Healthcare provider's	US	'do nothing'	Increase availability /accessibility of condoms in low HIV prevalence population (1.6% in men and 0.6% in women) appears to be cost-effective with ICER ranged from PPP$ 7,669 to 247,775 per case of HIV averted [46, 59] or about PPP$ 22,065 per QALY saved [60].

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
Condom use and sex education	HIV serodiscor-dant couples	2-	Thailand, India, Uganda	Condom use with their regular partner reached 100% at one-month follow-up visit. At three-month follow-up, more than 90% of the participants reported having been able to communicate and felt more comfortable discussing AIDS with their partner, and very confident that they could refuse sex if their partner refused to use a condom (an increase from 70% at baseline, p=0.0001) [61].	NA	NA	NA	NA
Introduction of Female condom	Female sex workers	2--	Kenya	The introduction of female condoms led to a small, but significant, increase in consistent condom use with all partners. Adjusted odd ratio for consistent condom use after female condom	No specify/ Health care provider's	South Africa/ Kenya	'do nothing'	ICER ranged from PPP$ 934 to 7,863 per HIV infection averted [30, 45].

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
				introduction was 1.7 (95%CI 1.4 - 2.2) [62].				
Needle social marketing	Injecting drug users	1--	China	Needle social marketing can reduce risky injecting behaviour and HIV transmission among injecting drug users after 12-month follow-up. Needle sharing behaviour dropped significantly from 68.4% to 35.3%. However, the number of needle-sharing partners and sharing water was unchanged. The HIV infection rate decreased but was not statistically significant [63].	NA	NA	NA	NA
Needle and syringe programme (under supervision of	Injecting drug users	1--	Canada	After 6 months of follow-up, it was found that more consistent use of a supervised safer injecting facility is associated with positive	Societal	US	'do nothing'	ICER is PPP$ 53,285 per HIV infection averted [65].

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
medical staff)				changes in injecting practices, including less reuse of syringes, increased use of sterile water, cleaning of injection sites and cooking/ filtering of drugs (OR 2 – 3, 95%CI 1.38 - 4.37) [64].				
Street outreach	Injecting drug users	2+	Various	Injecting drug users changed their baseline drug-related and sex-related risk behaviour. Significant reductions in drug injection, multi-person reuse of syringes and needles and other injection equipment was found. The studies also showed a significant growth in promoting entry into drug treatment and increasing needle disinfection. However, although there was a	Health care provider's	Ukraine	'do nothing'	ICER is PPP$ 309 per HIV infection averted [69].

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
				reduction among drug users concerning sex-related risks and an increase in condom use, the majority still practiced unsafe sex. Regarding dosage effects, the longer the exposure to outreach-based interventions, the greater the reductions in drug injection frequency [66, 67]. At cross border areas between China and Vietnam, new injectors declined 3-14% after 36-month follow-up. HIV prevalence and estimated incidence fell by approximately half at the 24-month survey and by approximately three quarters at the 36-month survey in both areas (P<0.01) [68].				

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
III. Biological/biomedical interventions that strive to reduce HIV infection and transmission risk								
HIV vaccine	Injecting drug users	1++	Thailand	The phase III HIV vaccine trial in Thailand demonstrated that the vaccines are safe and well tolerated. However, after 36-month follow-up, there was no difference in terms of new HIV infection between the vaccine and placebo arms (the vaccine efficacy was estimated at 0.1%, 95%CI -30.8% to 23.8%) [70].	Not clearly specify	Thailand	'do nothing'	At the assumption of 30% vaccine efficacy, the ICER of vaccination, HAART, and their combination were about PPP$ 265, PPP$ 2,158, and PPP$ 944 per DALY averted compared with the do-northing strategy [71].
Improved STI treatment services	Persons with suspected STI	1+	Various	Improved STI treatment services significantly reduced HIV incidence. The two large systematic reviews indicated OR ranged from 0.58 (95%CI 0.42-0.70) to 0.77 (95%CI 0.68-0.87) [72].	Healthcare provider's	Tanzania /US	'standard practice'	ICERs is PPP$ 916 per HIV infection averted [45].

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
Male circumcision	Heterosex-ual male	1--	Various (mainly Africa)	The results from the review of existing observational studies demonstrate a strong association between male circumcision and prevention of HIV, especially among high-risk groups [73-75]. Moreover, a randomised trial in Uganda showed that Male circumcision reduced HIV incidence in men without behavioural disinhibition after 24-month follow-up. HIV incidence was 0.66 cases per 100 person-years in the intervention group and 1.33 cases per 100 person-years in the control group (estimated efficacy of intervention 51%, 95%CI 16–72; p=0.006) [76].	Health care provider's	South Africa/ US	'do nothing'	Male circumcision appears to be very cost-effective in areas with high HIV prevalence (PPP$ 1,668 per HIV infection averted in areas with HIV prevalence of 8.4% and PPP$ 548 per HIV infection averted in areas with HIV prevalence of 25.6%) [77]. However, this intervention is unlikely to be cost-effective in the US where baseline HIV prevalence is relatively lower (2%) and homosexual and infection from needle sharing were major causes of HIV infection [46, 73].

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
Mass or community treatment of STI	Adults aged 15-59 years	1+	Rural areas in Uganda with high rates of HIV and STI	After three rounds of mass treatment (30 months) there was no evidence indicating that universal treatment of STI reduced new HIV infections (rate ratio of 0.97% with 95%CI 0.81 - 1.16) [78].	Healthcare provider's	Tanzania /US	'standard practice'	ICERs is PPP$ 694,605 per HIV infection averted [46].
Microbicides	Female sex workers	1+	Various	There is no evidence that nonoxynol-9 protects against vaginal acquisition of HIV infection (RR 1.12, 95%CI 0.88-1.42). Nevertheless, the risk of genital lesions was significantly greater among women receiving nonoxynol-9 (RR 1.18, 95%CI 1.02-1.36) [79].	NA	NA	NA	NA

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
Post-exposure prophylaxis	Healthcare workers	2+	Various (reviewed evidence)	No evidence suggests that offering post-exposure prophylaxis with Zidovudine lowers the rate of HIV infection compared to 'no intervention'. Please note that no studies were found that evaluated the effect of two or more antiretroviral drugs [80].	NA	NA	NA	NA
Post-exposure prophylaxis (using two antiretroviral drugs for 28 days and if subject reported having recently had a detectable	Men and women with a potential sexual or injection drug use exposure to HIV in the previous 72 hours	2--	US	There was not a significant difference in the proportions of sero-converters (85.7%) and non sero-converters (94.1%) who were initially prescribed antiretroviral drug (P=0.4) [81].	NA	NA	NA	NA

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
plasma HIV RNA level, then a protease inhibitor was also offered.								
Prevention of mother-to-child transmission of HIV	Pregnant women	1++	Thailand	A randomized clinical trial demonstrated that a combination of Zidovudine (AZT) and a single does of Nevirapine (NVP), administered both to the mother during labour and to the newborn, is highly effective in prevention of HIV vertical transmission, resulting in only 2.2 ($\pm$0.6) % of children being born with HIV compared to 6.9 ($\pm$1.4)% in the AZT-only arm [82, 83]*.	Healthcare provider's	Thailand	'do nothing'	Combining the administration of AZT and NVP is the most cost-effective drug option. Cost-effectiveness ratio per averted infection of single VCT (1D) is PPP$ 1,938. Cost-effectiveness ratio per averted infection of double VCT (2D) is PPP$ 4,412 [82].

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
Screening blood products and donated organs for HIV	Blood donations	NA	NA	NA	Healthcare provider's	US/ Sub-Saharan Africa	'no test'	HIV antibody testing for donated blood is a cost-saving intervention in the US [84] and very cost-effective in Sub-Saharan Africa (ICER PPP$ 64-870 per HIV infection averted) [30, 45].
Substitution treatment	Injecting drug users	1+	Various	The follow-up interview ranged from one month to 18 to 24 months; it was found that the intervention was associated with statistically significant reductions in illicit opioid use, injecting use and sharing of injection equipment. It is also associated with reductions in multiple sex partners or exchanges of sex for drugs or	NA	NA	NA	NA

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
				money, but has little effect on condom use. The reporting period for assessment of HIV risk behaviour ranged from 2 weeks to 6 months, and it appears that the reductions in risk behaviour relating to drug use does translate into reductions in cases of HIV infection [85-87].				
Using nucleic acid test screening (NAT) of volunteer blood donations	Blood donations	2-	Thailand	It was estimated that there were approximately 38 to 155 additional units of donated blood detected with hepatitis B and C and HIV compared to the current practice (serology screening without NAT) [88].	Healthcare provider's	Thailand	'serology test without NAT'	ICER of providing NAT for blood donations was PPP$ 100,923 – 404,498 per hepatitis B or C or HIV detection PPP$ 553,455 - 1,937,715 per HIV infection averted [88].

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
IV. Mitigation of barriers to prevention and negative social outcomes of HIV infection								
Increased alcohol tax	General population	NA	NA	NA	Health care provider's	US	'current practice'	ICER is PPP$ 5,484 per HIV infection averted [46].
Microfinance	Community	1--	Africa	The intervention did not affect HIV incidence (adjusted RR 1.06, 95%CI 0.66–1.69) or rate of unprotected sexual intercourse with a non-spousal partner (adjusted RR 0.89, 95%CI 0.66–1.19). The experience of intimate-partner violence was reduced by 55% (adjusted RR 0.45, 95%CI 0.23–0.91; adjusted risk difference –7.3%, 95%CI –16.2 to 1.5) [89].	NA	NA	NA	NA
Microfinance (combined with training intervention)	Female aged 14-35 year	2-	Africa	Young participants were likely to have protected sex at last intercourse with a non-spousal partner (adjusted risk	NA	NA	NA	NA

Interventions	Population	Effectiveness			Cost-effectiveness			
		Level of evidence	Settings	Findings	Perspective	Setting	Comparators	Incremental cost-effectiveness ratio(s)
				ratio 0.76, 95%CI 0.60–0.96) after 2 years follow-up when compared with controls. In addition, they had higher levels of HIV-related communication (adjusted risk ratio 1.46, 95%CI 1.01–2.12) and were more likely to have accessed voluntary counselling and testing (adjusted risk ratio 1.64, 95%CI 1.06–2.56) [90].			

*We did not report results from another observational study because it would not change the overall conclusion but provide weaker evidence [91].

There were thirteen interventions where effectiveness and cost-effectiveness information were both available for the same groups of population. These included:

- Community-based education among men who have sex with men and low income women;
- Improved sexually transmitted infection treatment services;
- Male and female condom use;
- Mass media campaign;
- Mass treatment of sexually transmitted infections;
- Male circumcision;
- Needle and syringe programme;
- Nucleic acid test for voluntary blood donations;
- Peer education for female sex workers;
- Programme for prevention of mother-to-child HIV transmission;
- Provider-initiated HIV screening at health care settings;
- School-based education;
- Street outreach programme for injecting drug users

Of the above thirteen interventions, six of them, namely (1) improvement in sexually transmitted infection treatment, (2) male condom use, (3) street outreach programme, (4) circumcision, (5) needle and syringe programme, and (6) prevention of mother-to-child HIV transmission through the use of the combination of antiretroviral drugs and breastfeeding substitute showed significant benefits in reducing HIV incidence among target populations. In addition, although there was no evidence regarding a reduction in HIV incidence, the community-based education among men who have sex with men and peer education for female sex workers showed a stronger effect in reducing HIV risk behaviour than the school-based education programme. Only mass treatment of sexually transmitted infections showed no evidence of reducing of either risk behaviour or HIV incidence in clinical studies. Its economic modelling, however, indicated approximately 695,000 PPP$ per HIV infection averted.

There were twelve interventions that had effectiveness information but lacked cost-effectiveness evidence. These are:

- Abstinence-only programme;
- Abstinence-plus programme;
- Community-based education among young people, injecting drug users, and female sex workers;
- Drug substitution treatment;
- HIV vaccine for injecting drug users;
- Microbicides;
- Microfinance;
- Needle social marketing;
- Peer education for injecting drug users, men who have sex with men and young people;
- Post-exposure prophylaxis;
- Voluntary counselling and HIV testing for HIV-negative employees, men who have sex with men and HIV serodiscordant couples;
- Workplace-based education among male conscripts and female sex workers

There were indications to suggest that abstinence-plus programmes, community-based education, drug substitution treatment, needle social marketing, peer education among female sex workers and injecting drug users, voluntary counselling and HIV testing, and workplace-based education among female sex workers reduced HIV risk behaviour among the target populations, though their respective studies were not designed to assess the reduction in HIV incidence. No evidence was observed in regards to better effectiveness (i.e. reduction of HIV incidence and HIV risk behaviour) for the following interventions, namely i) abstinence only programme, ii) HIV vaccine for injecting drug users, iii) single ante-retroviral drug for post-exposure prophylaxis, iv) microbicides, v) microfinance, vi) peer education for men who have sex with men and young people and vii) workplace-based education among male conscripts, in comparison to the 'standard' or 'current' practice.

There were four interventions where only cost-effectiveness information is available through the use of mathematical estimations. These interventions are:

- HIV vaccine for ten-year-old uninfected children;
- Increased alcohol tax;
- Screening blood products and donate organs;
- Voluntary counselling and HIV testing for prison inmates;

It is noteworthy that the cost-effectiveness of HIV vaccine is mainly based on the assumption that the HIV preventive vaccine would be available at 30% efficacy.

Figure 1 compares the cost per HIV infection averted of each HIV prevention intervention. It can be seen that the cost-effectiveness ratios vary largely, ranging from 70 PPP$ per HIV infection averted for screening blood product to 2,000,000 PPP$ per HIV infection averted for community-based education for women living in low income housing development. It is likely that biological/biomedical interventions (highlighted in blue) are more cost-effective than those interventions affecting knowledge, attitudes and beliefs (highlighted in pink).

Figure 1 Summary of cost-effectiveness data for HIV prevention intervention (PPP$ 2008 per HIV infection averted)

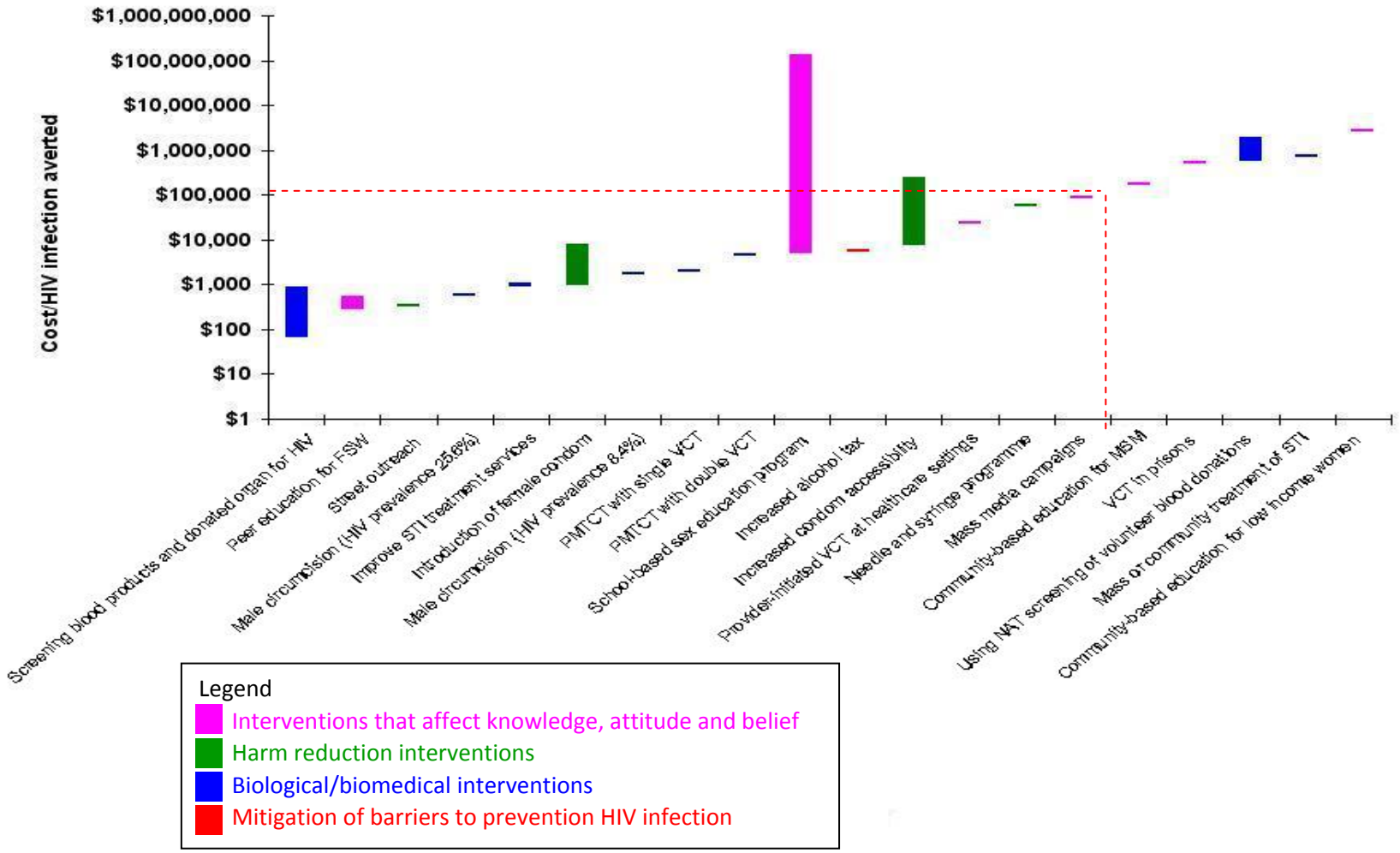


Table 5 summarises the findings from the reviews. It aims to prioritise HIV prevention interventions based on effectiveness and cost-effectiveness evidence. The table presents results by targeted population including female sex workers, injecting drug users, men who have sex with men and serodiscordant couples, who are currently the major sources of HIV infection in Thailand.

Those interventions proven to be both effective and cost-effective for female sex workers were: voluntary HIV counselling and testing, peer education, improvement of STI treatment services, and male and female condom use. Community-based education and workplace-based education proved to be effective, but no evidence regarding the value for money among female sex workers was found. Please note that this study found that microbicides were not effective in preventing HIV transmission amongst female sex workers.

Condom use and improvement of STI treatment services were proven to be the only effective and cost-effective intervention for men who have sex with men while voluntary HIV counselling and testing demonstrated effectiveness but lacked cost-effectiveness information. Community-based education was clinically effective but cost-ineffective. Peer education was shown to be ineffective among them.

For injecting drug users voluntary HIV counselling and testing, condom use, needle and syringe programme, improved STI treatment services and street outreach were amongst the programmes shown to be both effective and cost-effective. Needle social marketing, peer education, and substitution treatment demonstrated clinical effectiveness but was unsupported by economic evidence. Community-based education, HIV vaccines and post-exposure prophylaxis were shown to be ineffective in the prevention of HIV transmission amongst injecting drug users.

Condom use and improved STI treatment services were the only intervention proven to be both effective and cost-effective for serodiscordant couples. Voluntary HIV counselling and testing was amongst the interventions proven clinically effective but no cost-effectiveness information was available.

Considering all the interventions, voluntary HIV counselling and testing, condom use and improved STI treatment services were the only interventions with extensive evaluations concerning effectiveness and cost-effectiveness across population groups. It can be observed that in the information gap for 1) many interventions, including routine (provider-initiated) voluntary HIV screening at healthcare settings, introduction of female condoms, HIV vaccine, male circumcision, microbicides, and post-exposure prophylaxis, and 2) some targeted populations, namely serodiscordant couples, prison inmates, health care workers both effectiveness and cost-effectiveness studies need to be conducted to provide proper evidence to guide resource allocation decisions regarding HIV prevention and control.

Table 5 Summary of findings by intervention and targeted population

Interventions	FSW	MSM	IDU	SDC	Preg	PI	HCW	Young	G pop
I. Interventions that affect knowledge, attitude and beliefs and influence psychological and social correlates of risk									
Abstinence-only programmes									
Abstinence-plus programmes									
Community-based education									
Mass media campaigns									
Peer education									
Routine (provider-initiated) voluntary HIV screening at healthcare settings									
School-based sex education programmes (+ life skills)									
Voluntary HIV counselling and testing (VCT) (± STI clinic and condom distribution)									
Workplace-based education (±condom distribution / free STI clinic)									
II. Harm reduction interventions that lower the risk of a behaviour, but do not eliminate the behaviour									
Condom use (availability and accessibility)									
Introduction of female condoms									
Needle and syringe programme									
Needle social marketing									
Street outreach									
III. Biological/biomedical interventions that strive to reduce HIV infection and transmission risk									
HIV vaccine									
Improved STI treatment services									
Mass or community treatment of sexually transmitted infections									
Male circumcision									
Microbicides									
Post-exposure prophylaxis									
Prevention of mother-to-child transmission of HIV									
Screening blood products and donated organs for HIV									
Substitution treatment									
Using nucleic acid test screening (NAT) of volunteer blood donations									
IV. Mitigation of barriers to prevention and negative social outcomes of HIV infection									
Increased alcohol tax									
Microfinance									
Microfinance (combined with education)									

Abbreviations

FSW – female sex worker

MSM – men who have sex with men

IDU – injecting drug user

SDC – serodiscordant couples

Preg – pregnant women

PI – prison inmate

HCW – healthcare worker

Young – people aged 10-24 years old

G pop – general people

The colour of effectiveness and cost-effectiveness

Colours	Effectiveness	Cost-effectiveness	Description
	Yes	Yes	The intervention proven to be effective and cost-effective
	Yes	Data not available	The intervention proven to be effective but no evidence regarding cost-effectiveness
	Yes	No	The intervention proven to be effective but not cost-effective
	No	No, data not available	The intervention proven to be neither effective nor cost-effective
	Data not available	Data not available	No evidence concerning effectiveness or cost-effectiveness of the intervention
			The intervention is not relevant or used for particular target population

Because decision makers always prefer to use local evidence over the international information when they make policy decisions, table 6 reveals the disparities of information among different groups of population. We found a lack of local information concerning the effectiveness and cost-effectiveness of HIV prevention among young people, MSM, injecting drug users, and female sex workers, and serodiscordant couples who are the highest HIV risk in Thailand.

Table 6 Summary of interventions conducted for each target population

Target populations	Interventions	
	Domestic studies	**International studies**
Young people	- School-based education	- Abstinence programmes - School-based education - Community-based education - Peer education intervention
Men who have sex with men	NA	- Community-based education - Voluntary HIV counselling and testing - Peer education intervention
Injecting drug users	- Community-based education - HIV vaccine	- Street outreach - Drug substitution treatment - Community-based education - Needle social marketing - Needle and syringe programme - Post-exposure prophylaxis - Peer education intervention
Female sex workers	- Workplace-based education	- Workplace-based education /condom distribution/free STI clinic visits - Community based intervention (Sonagachi) - Microbicide - Introduction of female condom - Peer education intervention
HIV serodiscordant couples	NA	- Increase condom use - Voluntary HIV counselling and testing/STI services/free condoms
Male	- Workplace-based education - 100% condom programme	- Condom distribution - Circumcision
Prison inmates	NA	- Voluntary HIV counselling and testing
Pregnant women	- Programme for prevention of mother-to-child transmission	NA (stop the search)
Health care workers	NA	- Post-exposure prophylaxis
General population	- Provider-initiated HIV screening - HIV screening for blood donations	- Mass media campaign - Mass treatment of STI - Community-based education - Microfinance - Voluntary HIV counselling and testing
Infrastructure	NA	- Increased alcohol tax - Improvement of STI treatment services

V. DISCUSSION AND CONCLUSION

This review demonstrated several limitations in using effectiveness and cost-effectiveness evidence for policy decision making or programme reorientation regarding HIV/AIDS. First, a lack of proper assessment about the effectiveness and/or cost-effectiveness outcomes of many interventions poses a significant challenge in making evidence-based health policy decisions. During the review we found that most domestic studies evaluated the effectiveness or cost-effectiveness of interventions using only immediate measures e.g. knowledge, attitudes, perception, and skills. The use of such immediate measures will severely limit the usefulness of the evaluations because they do not allow for the comparison of value for money across different types of interventions, due to variation in outcome measurement. In addition, these immediate outcomes may not be of primary interest to decision makers or health care planners when they consider health resource allocation.

Second, although a high quality of evidence was observed for assessing intervention effectiveness, a major concern is the strength of evidence used to generate the cost-effectiveness information. For example, many cost-effectiveness studies did not obtain intervention effectiveness from data sources that have potentially minimum biases, i.e. systematic review or experimental studies, but expert opinions or even unconvincing assumptions, in the case of the economic evaluation of HIV vaccine, were applied [71]. Economic evaluation can be useful for guiding policy decisions only when it is performed correctly and reported accurately; these findings clearly depict barriers that would diminish the use of cost-effectiveness evidence to inform policy decisions.

Third, given that we invested a lot into determining local information for HIV prevention, a majority of studies reporting the effectiveness and cost-effectiveness of HIV interventions were identified from international publications rather than domestic journals or grey literature (see table 7). This reflects the fact that good quality studies are likely to be published in international journals. Thus, it is sensible to recommend that the international databases are still major sources of information, and can be used to inform decision making about the effectiveness and cost-effectiveness of HIV prevention interventions.

Table 7 Review profile of domestic literature

Type of literature	Initial search	Review of full text	Final inclusion
Articles published in domestic journals	528	16	1
Articles published in international journals	111	11	5
Theses/dissertations	99	11	5
Research reports	24	3	2
Conference proceedings	170	1	1
Total	**932**	**42**	**14**

This study found that male/female condoms, street outreach programmes, programmes for the prevention of mother-to-child HIV transmission, improvement of sexually transmitted infection treatment services and circumcision were the only interventions to show strong evidence of reducing HIV infection among target populations. The DCP2 also included these four interventions, excluding circumcision, in its recommendations for concentrated epidemic areas including East Asia and the Pacific region [3]. [note that Thailand is now classified as combined generalized and concentrated epidemic [92].] The differences between recommendations from DCP2 and our findings are.

- Although it was recommend in DCP2, lack of strong evidence proved that community-based education offers good value for money in the prevention of HIV infection in either low or high HIV prevalence settings.
- There were very consistent results showing that screening blood products and donated organs for HIV is very cost-effective while there was little reference to this intervention in the DCP2.
- This study found that there was potential for interventions that aim to mitigate barriers to prevention and negative social outcomes of HIV infection e.g. increased alcohol tax and micro-financing. These interventions should be under careful assessment in the future.

It is interesting to note that we found very limited local information about HIV interventions for those high risk populations in Thailand i.e. injecting drug users, men who have sex with men, female sex workers, and young people. Of the nine interventions conducted in Thailand identified from our review, only one study on HIV

vaccine for injecting drug users was conducted in Thailand with an absurd assumption of vaccine efficacy. In addition, HIV preventive vaccines are not available in the global market. These findings underline the urgent need to prioritise health research resources to assess the effectiveness and cost-effectiveness of HIV interventions aimed at the reduction of HIV infection among high risk groups.

Caution should be made when applying the effectiveness and cost-effectiveness data from this study to inform policy decision making. Firstly, because many studies were conducted in various settings with different sized target populations, different HIV prevalence, different attitudes towards HIV/AIDS and socio-economic and cultural determinants of risk behaviours responses to interventions, these factors would greatly affect not only the effectiveness of the intervention but also its value for money. Furthermore, we would argue that this matter is rather more important because almost all preventive interventions need to be delivered on a population basis.

Secondly, although we have made explicit criteria to judge whether the effectiveness studies/data are good enough to be used in decision making, there was no such standard to measure the quality of cost-effectiveness studies. We found that most of the effectiveness studies are of good quality (mainly in the 1st or 2nd hierarchy) but we are in doubt of the quality of data used in many of the cost-effectiveness studies.

Lastly, it is important to recognise that it is not only effectiveness or cost-effectiveness information is useful in guiding health care rationing but that political and ethical dimensions or other societal values e.g. equity, also play significant roles in decision making processes. However, these issues were not under consideration in this study.

REFERENCES

1. Tangcharoensathien V, Tantivess S, Teerawattananon Y, Auamkul N, Jongudoumsuk P. Universal coverage and its impact on reproductive health services in Thailand. Reprod Health Matters 2002;10(20):59-69.
2. Teerawattananon Y, Russell S, Mugford M. A systematic review of economic evaluation literature in Thailand: are the data good enough to be used by policy-makers? Pharmacoeconomics 2007;25(6):467-79.
3. Bertozzi S, Padian NS, Wegbreit J, DeMaria LM, Feldman B, Gayle H, et al. HIV/AIDS Prevention and Treatment. In: Jamison DT, Breman JG, Measham AR, Alleyne G, Claeson M, Evan DB, et al., editors. Disease control priorities in developing countries. 2nd ed. New York: Oxford University Press; 2006.
4. Thorogood M, Coombes Y. Evaluating health promotion: practice and methods. New York: Oxford University Press Inc; 2006.
5. WHO Commission on Macroeconomics and Health. Macroeconomics and health: investing in health for economic development. Geneva: World Health Organization; 2001.
6. Holtgrave DR, Pinkerton SD. Updates of cost of illness and quality of life estimates for use in economic evaluations of HIV prevention programs. J Acquir Immune Defic Syndr Hum Retrovirol 1997;16(1):54-62.
7. Sweat M. A framework for classifying HIV prevention interventions. USA: Joint United Nations Programme on HIV/AIDS (UNAIDS); 2008.
8. Kaeodumkoeng N, Lertpiriyasuwat C, Chawanangkul V, Sukhonthaman C, Jantharathaneewat K, Chanthongkum N, et al. Model Development of Condom Accessibility by Condom Vending Machine. Thai Aids J 2007;19:73-84.
9. Umsuriya S, Srisawang O, Pibaljommee T, Unnanan M, Netthip N. Evaluation of condom use accession by condom teller machine, Ayutthaya province 2006. Disease Control Journal 2006;10(2):103-108.
10. Kanshana S, Thewanda D, Teeraratkul A, Limpakarnjanarat K, Amornwichet P, Kullerk N, et al. Implementing short-course zidovudine to reduce mother-infant HIV transmission in a large pilot program in Thailand. Aids 2000;14(11):1617-23.
11. Kongsin S, Kongsin P, Jiamton S, Intraprasong B, Boonthum A, Tarunothai U, et al. Pilot Study Potential Benefit of AZT Preventive Therapy in Perinatal HIV Transmission and Its Cost-effectiveness Analysis: A Case Study of BMA Medical College and Vajira Hospital. Bangkok; 2004.
12. Chantanakorn N, Weerawongphom R. The Prevention of Mother-to-Child Transmission Project (PMTCT) of Phichit Province FY 2001-2004. Thai Aids J 2006;18:214-225.
13. Underhill K, Operario D, Montgomery P. Abstinence-only programs for HIV infection prevention in high-income countries. Cochrane Database Syst Rev 2007(4):CD005421.

14. Underhill K, Montgomery P, Operario D. Abstinence-plus programs for HIV infection prevention in high-income countries. Cochrane Database Syst Rev 2008(1):CD007006.
15. Di Noia J, Schinke SP. Gender-specific HIV prevention with urban early-adolescent girls: outcomes of the Keepin' It Safe Program. AIDS Educ Prev 2007;19(6):479-88.
16. Morrison-Beedy D, Carey MP, Kowalski J, Tu X. Group-based HIV risk reduction intervention for adolescent girls: evidence of feasibility and efficacy. Res Nurs Health 2005;28(1):3-15.
17. Jemmott JB, 3rd, Jemmott LS, Braverman PK, Fong GT. HIV/STD risk reduction interventions for African American and Latino adolescent girls at an adolescent medicine clinic: a randomized controlled trial. Arch Pediatr Adolesc Med 2005;159(5):440-9.
18. Jewkes R, Nduna M, Levin J, Jama N, Dunkle K, Khuzwayo N, et al. A cluster randomized-controlled trial to determine the effectiveness of Stepping Stones in preventing HIV infections and promoting safer sexual behaviour amongst youth in the rural Eastern Cape, South Africa: trial design, methods and baseline findings. Trop Med Int Health 2006;11(1):3-16.
19. Wongjak T, Wibulnuttakul K, Wichacharn M, Tejafong k, Cheewawat W, Saokaew P, et al. A study of behavior post intervention on reducin HIV risk in intravenous drug users in Northern drug dependence treatment center and community clinic Chiangmai. Chiang Mai: Research Institute for Health Sciences, Chiang Mai University; 2004.
20. Peragallo N, Deforge B, O'Campo P, Lee SM, Kim YJ, Cianelli R, et al. A randomized clinical trial of an HIV-risk-reduction intervention among low-income Latina women. Nurs Res 2005;54(2):108-18.
21. Johnson-Masotti AP, Pinkerton SD, Sikkema KJ, Kelly JA, Wagstaff DA. Cost-Effectiveness of a Community-Level HIV Risk Reduction Intervention for Women Living in Low-Income Housing Developments. The Journal of Primary Prevention 2005;26(4):345-62.
22. Shahmanesh M, Patel V, Mabey D, Cowan F. Effectiveness of interventions for the prevention of HIV and other sexually transmitted infections in female sex workers in resource poor setting: a systematic review. Trop Med Int Health 2008;13(5):659-79.
23. Johnson WD, Hedges LV, Ramirez G, Semaan S, Norman LR, Sogolow E, et al. HIV prevention research for men who have sex with men: a systematic review and meta-analysis. J Acquir Immune Defic Syndr 2002;30 Suppl 1:S118-29.
24. Herbst JH, Beeker C, Mathew A, McNally T, Passin WF, Kay LS, et al. The effectiveness of Individual-, group-, and community-level HIV behavioral risk-reduction interventions for adult men who have sex with men: A systematic review. Am J Prev Med 2007;32(4S):S38-67.
25. Pinkerton SD, Holtgrave DR, DiFranceisco WJ, Stevenson LY, Kelly JA. Cost-Effectiveness of a Community-Level HIV Risk Reduction Intervention. Am J Public Health 1998;88:1239-42.

26. Cochen DA, Wu S-Y, Farley TA. Structural Interventions to Prevent HIV/Sexually Transmitted Disease: Are They Cost-Effective for Women in the Southern United States? Sex Transm Dis 2006;33(7):S46-9.
27. Garfein RS, Golub ET, Greenberg AE, Hagan H, Hanson DL, Hudson SM, et al. A peer-education intervention to reduce injection risk behaviors for HIV and hepatitis C virus infection in young injection drug users. Aids 2007;21(14):1923-32.
28. Weeks MR, Li J, Dickson-Gomez J, Convey M, Martinez M, Radda K, et al. Outcomes of a peer HIV prevention program with injection drug and crack users: the Risk Avoidance Partnership. Subst Use Misuse 2009;44(2):253-81.
29. Luchters S, Chersich MF, Rinyiru A, Barasa MS, King'ola N, Mandaliya K, et al. Impact of five years of peer-mediated interventions on sexual behavior and sexually transmitted infections among female sex workers in Mombasa, Kenya. BMC Public Health 2008;8:143.
30. Creese A, Floyd K, Alban A, Guinness L. Cost-effectiveness of HIV/AIDS interventions in Africa: a systematic review of the evidence. Lancet 2002;359:1635-42.
31. Fung IC-H, Guinness L, Vickerman P, Watts C, Vannela G, Vadhvana J, et al. Modelling the impact and cost-effectiveness of the HIV intervention programme amongst commercial sex workers in Ahmedabad, Gujarat, India. BMC Public Health 2007;7:195.
32. Elford J, Bolding G, Sherr L. Peer education has no significant impact on HIV risk behaviours among gay men in London. Aids 2001;15(4):535-8.
33. Williamson LM, Hart GJ, Flowers P, Frankis JS, Der GJ. The Gay Men's Task Force: the impact of peer education on the sexual health behaviour of homosexual men in Glasgow. Sex Transm Infect 2001;77(6):427-32.
34. Flowers P, Hart GJ, Williamson LM, Frankis JS, Der GJ. Does bar-based, peer-led sexual health promotion have a community-level effect amongst gay men in Scotland? Int J STD AIDS 2002;13(2):102-8.
35. Borgia P, Marinacci C, Schifano P, Perucci CA. Is peer education the best approach for HIV prevention in schools? Findings from a randomized controlled trial. J Adolesc Health 2005;36(6):508-16.
36. Mahat G, Scoloveno MA, De Leon T, Frenkel J. Preliminary evidence of an adolescent HIV/AIDS peer education program. J Pediatr Nurs 2008;23(5):358-63.
37. Miller AN, Mutungi M, Facchini E, Barasa B, Ondieki W, Warria C. An outcome assessment of an ABC-based HIV peer education intervention among Kenyan university students. J Health Commun 2008;13(4):345-56.
38. Teerawattananon Y, Hiransuthikul N, Hanvoravongchai P, Tantivess S, Lertpiriyasuwat C, Chaikledkaew U, et al. Effectiveness of routine offer of HIV counseling and testing at community hospitals in Thailand. Nonthaburi: Health Intervention and Technology Assessment Program; 2008.

39. Nilabut S. Achievement of integrated teaching using the applied protection motivation theory on AIDS prevention among informal education students in Saraburi [Master of Science (Public Health)]. Bangkok: Mahidol University; 1999.
40. Sunsiri M. An application of life skills to AIDS prevention among grade 9 junior high school students in Burirum province [Master of Science (Public Health)]. Bangkok: Mahidol University; 2002.
41. Nobnorb S. The effectiveness of health education program on AIDS prevention among vocational male students in Krabi province [Master of Science (Public Health)]. Bangkok: Mahidol University; 2002.
42. Simtaraj P. Effects of skills development for prevention of sexual risk behavior on perceived self-efficacy and sexual risk behavior among male vocational students. Chiang Mai: Chiang Mai University; 2001.
43. Silva M. The effectiveness of school-based sex education programs in the promotion of abstinent behavior: a meta-analysis. Health Education Research 2002;17(4):471-481.
44. Walker D, Gutierrez JP, Torres P, Bertozzi SM. HIV prevention in Mexican schools: prospective randomised evaluation of intervention. Bmj 2006;332(7551):1189-94.
45. Walker D. Cost and cost-effectiveness of HIV/AIDS prevention strategies in developing countries: is there an evidence base? Health Policy Plan 2003;18(1):4-17.
46. Cohen DA, Wu SY, Farley TA. Comparing the cost-effectiveness of HIV prevention interventions. J Acquir Immune Defic Syndr 2004;37(3):1404-14.
47. Wang LY, Davis M, Robin L, Collins J, Coyle K, Baumler E. Economic Evaluation of Safer Choices. Arch Pediatr Adolesc Med 2000;154:1017-24.
48. Corbett EL, Makamure B, Cheung YB, Dauya E, Matambo R, Bandason T, et al. HIV incidence during a cluster-randomized trial of two strategies providing voluntary counselling and testing at the workplace, Zimbabwe. Aids 2007;21(4):483-9.
49. Varghese B, Peterman TA. Cost-effectiveness of HIV counseling and testing in US prisons. J Urban Health 2001;78(2):304-12.
50. Allen S, Meinzen-Derr J, Kautzman M, Zulu I, Trask S, Fideli U, et al. Sexual behavior of HIV discordant couples after HIV counseling and testing. Aids 2003;17(5):733-40.
51. Celentano DD, Bond KC, Lyles CM, Eiumtrakul S, Go VF, Beyrer C, et al. Preventive intervention to reduce sexually transmitted infections: a field trial in the Royal Thai Army. Arch Intern Med 2000;160(4):535-40.
52. Yotruean K. Using acitivities to promote self-prevention of HIV infection female sex workers, Chiang Mai Province. Chiang Mai: Chiang Mai University.
53. NaThalang D. The effectiveness of a health education program on AIDS prevention through behavior modification among traditional massage working girls in Satun province [Master of Science (Public Health)]. Bangkok: Mahidol University; 2001.

54. Wu Z, Rou K, Jia M, Duan S, Sullivan SG. The first community-based sexually transmitted disease/HIV intervention trial for female sex workers in China. Aids 2007;21 Suppl 8:S89-94.
55. Rou K, Wu Z, Sullivan SG, Li F, Guan J, Xu C, et al. A five-city trial of a behavioural intervention to reduce sexually transmitted disease/HIV risk among sex workers in China. Aids 2007;21 Suppl 8:S95-101.
56. Ford K, Wirawan DN, Reed BD, Muliawan P, Wolfe R. The Bali STD/AIDS Study: evaluation of an intervention for sex workers. Sex Transm Dis 2002;29(1):50-8.
57. Celentano DD, Nelson KE, Lyles CM, Beyrer C, Eiumtrakul S, Go VF, et al. Decreasing incidence of HIV and sexually transmitted diseases in young Thai men: evidence for success of the HIV/AIDS control and prevention program. Aids 1998;12(5):F29-36.
58. Weller S, Davis K. Condom effectiveness in reducing heterosexual HIV transmission. Cochrane Database Syst Rev 2002(1):CD003255.
59. Chesson HW, Greenberg JB, Hennessy M. The cost-effectiveness of the WINGS intervention: a program to prevent HIV and sexually transmitted diseases among high-risk urban women. BMC Infect Dis 2002;2:24.
60. Bedimo AL, Pinkerton SD, Cohen DA, Gray B, Farley TA. Condom distribution: a cost-utility analysis. Int J STD AIDS 2002;13(6):384-92.
61. McGrath JW, Celentano DD, Chard SE, Fullem A, Kamya M, Gangakhedar RR, et al. A group-based intervention to increase condom use among HIV serodiscordant couples in India, Thailand, and Uganda. AIDS Care 2007;19(3):418-24.
62. Thomsen SC, Ombidi W, Toroitich-Ruto C, Wong EL, Tucker HO, Homan R, et al. A prospective study assessing the effects of introducing the female condom in a sex worker population in Mombasa, Kenya. Sex Transm Infect 2006;82(5):397-402.
63. Wu Z, Luo W, Sullivan SG, Rou K, Lin P, Liu W, et al. Evaluation of a needle social marketing strategy to control HIV among injecting drug users in China. Aids 2007;21 Suppl 8:S115-22.
64. Stoltz JA, Wood E, Small W, Li K, Tyndall M, Montaner J, et al. Changes in injecting practices associated with the use of a medically supervised safer injection facility. J Public Health (Oxf) 2007;29(1):35-9.
65. Laufer FN. Cost-effectiveness of syringe exchange as an HIV prevention strategy. J Acquir Immune Defic Syndr 2001;28(3):273-8.
66. Coyle SL, Needle RH, Normand J. Outreach-based HIV prevention for injecting drug users: a review of published outcome data. Public Health Rep 1998;113 Suppl 1:19-30.
67. Lau JT, Zhang L, Zhang Y, Wang N, Lau M, Tsui HY, et al. Changes in the prevalence of HIV-related behaviors and perceptions among 1832 injecting drug users in Sichuan, China. Sex Transm Dis 2008;35(4):325-35.

68. Des Jarlais DC, Kling R, Hammett TM, Ngu D, Liu W, Chen Y, et al. Reducing HIV infection among new injecting drug users in the China-Vietnam Cross Border Project. Aids 2007;21 Suppl 8:S109-14.
69. Vickerman P, Kumaranayake L, Balakireva O, Guinness L, Artyukh O, Semikop T, et al. The Cost-Effectiveness of Expanding Harm Reduction Activities for Injecting Drug Users in Odessa, Ukraine. Sex Transm Dis 2006;33(10):S89-102.
70. Pitisuttithum P, Gilbert P, Gurwith M, Heyward W, Martin M, van Griensven F, et al. Randomized, double-blind, placebo-controlled efficacy trial of a bivalent recombinant glycoprotein 120 HIV-1 vaccine among injection drug users in Bangkok, Thailand. J Infect Dis 2006;194(12):1661-71.
71. Ono S, Kurotaki T, Nakasone T, Honda M, Boon-Long J, Sawanpanyalert P, et al. Cost-Effectiveness Analysis of Antiretroviral Drug Treatment and HIV-1 Vaccination in Thailand Jpn J Infect Dis 2006;59:168-73.
72. Sangani P, Rutherford G, Wilkinson D. Population-based interventions for reducing sexually transmitted infections, including HIV infection. Cochrane Database Syst Rev 2004(2):CD001220.
73. Siegfried N, Muller M, Volmink J, Deeks J, Egger M, Low N, et al. Male circumcision for prevention of heterosexual acquisition of HIV in men. Cochrane Database Syst Rev 2003(3):CD003362.
74. Weiss HA, Quigley MA, Hayes RJ. Male circumcision and risk of HIV infection in sub-Saharan Africa: a systematic review and meta-analysis. Aids 2000;14(15):2361-70.
75. Weiss HA. Male circumcision as a preventive measure against HIV and other sexually transmitted diseases. Curr Opin Infect Dis 2007;20(1):66-72.
76. Gray RH, Li X, Kigozi G, Serwadda D, Nalugoda F, Watya S, et al. The impact of male circumcision on HIV incidence and cost per infection prevented: a stochastic simulation model from Rakai, Uganda. Aids 2007;21(7):845-50.
77. Kahn JG, Marseille E, Auvert B. Cost-Effectiveness of Male Circumcision for HIV Prevention in a South African Setting. Plos Medicine 2006;3(12):2349-58.
78. Wawer MJ, Sewankambo NK, Serwadda D, Quinn TC, Paxton LA, Kiwanuka N, et al. Control of sexually transmitted diseases for AIDS prevention in Uganda: a randomised community trial. Rakai Project Study Group. Lancet 1999;353(9152):525-35.
79. Wilkinson D, Ramjee G, Tholandi M, Rutherford G. Nonoxynol-9 for preventing vaginal acquisition of HIV infection by women from men. Cochrane Database Syst Rev 2002(4):CD003936.
80. Young TN, Arens FJ, Kennedy GE, Laurie JW, Rutherford G. Antiretroviral post-exposure prophylaxis (PEP) for occupational HIV exposure. Cochrane Database Syst Rev 2007(1):CD002835.

81. Roland ME, Neilands TB, Krone MR, Katz MH, Franses K, Grant RM, et al. Seroconversion following nonoccupational postexposure prophylaxis against HIV. Clin Infect Dis 2005;41(10):1507-13.
82. Teerawattananon Y, Vos T, Tangcharoensathien V, Mugford M. Cost-effectiveness of models for prevention of vertical HIV transmission - voluntary counseling and testing and choices of drug regimen. Cost Eff Resour Alloc 2005;3:7.
83. Lallemant M, Jourdain G, Le Coeur S, Mary JY, Ngo-Giang-Huong N, Koetsawang S, et al. Single-dose perinatal nevirapine plus standard zidovudine to prevent mother-to-child transmission of HIV-1 in Thailand. N Engl J Med 2004;351(3):217-28.
84. AuBuchon JP, Birkmeyer JD, Busch MP. Cost-effectiveness of expanded human immunodeficiency virus-testing protocols for donated blood. Transfusion 1997;37(1):45-51.
85. Gowing L, Farrell M, Bornemann R, Ali R. Substitution treatment of injecting opioid users for prevention of HIV infection. Cochrane Database Syst Rev 2004(4):CD004145.
86. Wong KH, Lee SS, Lim WL, Low HK. Adherence to methadone is associated with a lower level of HIV-related risk behaviors in drug users. J Subst Abuse Treat 2003;24(3):233-9.
87. Pang L, Hao Y, Mi G, Wang C, Luo W, Rou K, et al. Effectiveness of first eight methadone maintenance treatment clinics in China. Aids 2007;21 Suppl 8:S103-7.
88. Lertiendumrong J, Techakehakij W, Pongpirul K, Tangcharoensathien V, Srirattana S. Using nucleic acid testing in screening donated blood in Thailand :a policy analysis. Nonthaburi: International Health Policy Program; 2007.
89. Pronyk PM, Hargreaves JR, Kim JC, Morison LA, Phetla G, Watts C, et al. Effect of a structural intervention for the prevention of intimate-partner violence and HIV in rural South Africa: a cluster randomised trial. Lancet 2006;368(9551):1973-83.
90. Pronyk PM, Kim JC, Abramsky T, Phetla G, Hargreaves JR, Morison LA, et al. A combined microfinance and training intervention can reduce HIV risk behaviour in young female participants. Aids 2008;22(13):1659-65.
91. Sirikwin S, Kuntiranant K, Waradejwinyoo S, Buaraj S, Boonterm B, Likanonsakul S. Efficacy of zidovudine plus single dose nevirapine for prevention fo perinatal HIV transmission. Bull Dept Med Serv 2002;27(2):47-55.
92. National AIDS Prevention and Alleviation Committee. UNGASS COUNTRY PROGRESS REPORT THAILAND; 2008 June 9, 2008.

Health Intervention and Technology Assessment Program (HITAP)
6th Floor, 6th Building, Department of Health, Ministry of Public Health
Tiwanon Road, Mueng, Nonthaburi, Thailand 11000
Tel: +662 590 4374-5 Fax: +662 590 4369
http://www.hitap.net