ORIGINAL ARTICLE

Cost-Effectiveness Analysis of HIV/AIDS Prevention among Intravenous Drug Users in Iran's Drop-in Centers

Reza Majdzadeh[1], PhD;
Kazem Mohammad[2], PhD;
Alireza Mirahmadizadeh[3], MD, MPH, PhD

[1]Epidemiology Community Based Participatory Research Center, Iranian Institute for Reduction of High-Risk Behaviors, Tehran, Iran
[2]Department of Biostatistics and Epidemiology, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran
[3]Non-communicable Diseases Research Center, Shiraz University of Medical Sciences, Shiraz, Iran

Correspondence:
Alireza Mirahmadizadeh, Department of Epidemiology, School of Health, P. O. Box: 71536-75541, Shiraz, Iran
Tel: +98-912-5169146
Email: mirahmadia@sums.ac.ir
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Abstract

Background: The goal of this study was to analyze the cost-effectiveness of harm reduction programs among Intravenous Drug Users (IDUs) who referred to Drop-In Centers (DICs) for prevention of Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS) infection.

Methods: To calculate the cost-effectiveness of HIV/AIDS prevention, we used data from a cross-sectional study carried out in 2009 in which we selected 13 DICs out of 45 active DICs using systematic random sampling. Through interview, data of all IDUs (1309) who had attended DICs were collected by means of a questionnaire approved by 3 experts. Averted cases of HIV infection were considered as the unit of effectiveness. The cost was also calculated from the perspective of governmental service provider and all costs were converted into US dollar (USD). Sensitivity analysis was used to measure the effect of some uncertain parameters in modeling the number of HIV cases that have been averted; also, Incremental Cost-Effectiveness Ratio (ICER) was estimated.

Results: Results showed that the DICs averted around 120.2 HIV cases in one year (102.977 cases from drug injection, 11.45 cases from homosexual and 5.77 cases from heterosexual ways). ICER for each HIV infection averted was 13,248.5 USD. Sensitivity analysis showed that providing harm reduction services in the best and worst case scenarios could change the ICER from 13,055 to 13,954 USD for each HIV case averted, respectively.

Conclusion: Since the most common cause of transmission and spread of HIV infection in Iran is drug injection via needle shared by IDUs, DICs programs in Iran could be cost-effective. The necessity of expanding and developing DICs and their harm reduction programs performed locally and nationally in order to protect this high-risk groups is inevitable.

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Introduction

HIV/AIDS has been one of the most challenging health problems of the late twentieth century.[1] Unfortunately, there is no treatment or vaccine for the disease.[2-4] Recently, HIV/AIDS epidemic has mostly been concentrated among IDUs.[5] There have been about 16 million IDUs in the world in 2012,[6] among which more than 3 million have HIV/AIDS infection.[7] In Iran, IDUs accounted for 65% of HIV/AIDS cases.[8, 9] Among this group, the most common way of HIV transmission is injecting drug use by sharing syringes and needles.[10, 11]

Harm reduction programs for IDUs minimize and reduce the spread of HIV/AIDS.[12] One of these interventions is having access to sterile syringes and needles[13] and is considered as the essential part of HIV/AIDS prevention and harm reduction programs.[14] Many studies showed the effectiveness of using sterile syringes and needles to reduce HIV transmission among IDUs.[15-17] Due to the increasing cost of HIV/AIDS treatment,[18, 19] researchers and health politicians need more accurate information about the costs and benefits of harm reduction to be able to properly evaluate the programs that are provided in DICs.[20] In most countries, including Iran, the cost of treatment, care and reduction of risky behaviors among IDUs are covered by the government.[21] In Iran, policymakers decided to start-up these centers and DICs have been gradually established since 2003.[22] Research on the cost-effectiveness of such interventions gives health policymakers useful and valuable information.[23] Scientific literature is more focused on the effectiveness versus cost-effectiveness of the interventions.[6]

Pham et al. in a study during 2006 to 2010 managed to prevent 50600 new HIV/AIDS cases and 42600 deaths. The costs related to any new HIV/AIDS infections averted and deaths prevented by harm reduction were estimated to be $1,972.00 and $248.00, respectively.[24] In Iran, few studies have been done on the effectiveness and cost-effectiveness of harm reduction strategies for IDUs.[21, 23, 25] Notably, the findings of a study showed that seven methadone maintenance therapy centers could avert 128 new cases of HIV/AIDS. The total cost of harm reduction and HIV care and treatment during lifetime was $547,423.00 was and $14,171,816.00, respectively. The ICER of HIV prevention was $106,382.00. The results of the sensitivity analysis even in the worst-case scenarios in which the ICER was changed from $39,149.00 to $290,004.00 per HIV averted case were still effective.[21]

Notably, DICs in Iran have begun since 2003 with the implementation of training programs, delivering condoms, clean and disposable needles and syringes, and other services such as wound care to reduce risky behaviors. Based on the social, cultural and economic differences between Iran and other countries, as well as a more specific way of HIV transmission and also different costs of HIV/AIDS care and treatment,[26] we aimed to study the cost-effectiveness of harm reduction programs in DICs in Iran to provide scientific and documentary convincing evidence to justify the costs of these centers for health decision makers.

Material and Methods

To calculate the cost-effectiveness of HIV/AIDS prevention, we used data from a cross-sectional study that was carried out in 2009; systematic random sampling was used to select 13 DICs out of 45 active DICs in Iran. Through interviews, data of all IDUs (1309) who had attended DIC centers to receive health care services were collected by a questionnaire t approved by 3 experts and conducted by trained staff. The questionnaire had 5 sections about DICs, IDU demographic, risky behaviors before and after DIC, type of services, and HIV and HCV status. In this study, we compared the high-risk behaviors one year before and one year after entering DICs. Information on the costs was collected from the perspective of governmental service delivery for two reasons: 1) Iranian government undertakes and spends all costs of DICs and also all costs of treating HIV patients, and 2) second, cost calculation from a societal perspective is impossible due to the unavailability of subjects and all different costs.

To determine the cost of HIV treatment, we used guidelines of the United Nations Program on HIV/AIDS (UNAIDS).[27] Meanwhile, through interviewing with experts and stakeholders, the average life time and annual cost per HIV/AIDS case waere considered to be 10 years and 13,200 USD, respectively. To calculate the cost of non-intervention, we estimated the cost of treatment and care for each HIV infection during lifetime. To do so, we multiplied the number of cases averted by the cost of treatment and care of each HIV/AIDS case by average lifespan of an HIV case in Iran. The annual cost of each IDU in DIC was calculated and equaled to 221.55 USD. The discount rate was considered to be 3%. To convert Iranian Rial to United State Dollar (USD), the currency exchange rate was extracted from the Central Bank of Iran simultaneously. Finally, USD was adjusted by purchase power parity (PPP), according to PPP conversion rate site.

The HIV case averted was considered as the unit of effectiveness. Risky behaviors one year before entering the DICs and its probable HIV cases in that period, as well as risky behaviors one year after entering DICs and its probable cases of HIV were estimated and compared. For better understanding, we bring a part of decision tree model t we used in this study (Figures 1 and 2).

Decision tree was designed by the probability of each outcome at any state or node according to the rate of HIV transmission for each risky behavior. The difference between these two periods was considered as the averted cases of HIV infection. To find out the effectiveness of DICs, we used AVERT model, from "evaluating programs for HIV/AIDS prevention and care in developing countries" guideline published by family health international (FHI).[28] To calculate the number of averted HIV, we used a mathematical simulation model designed by Weinstein et al. This model provides us with information about how many HIV cases are caused by high-risk behaviors. In this

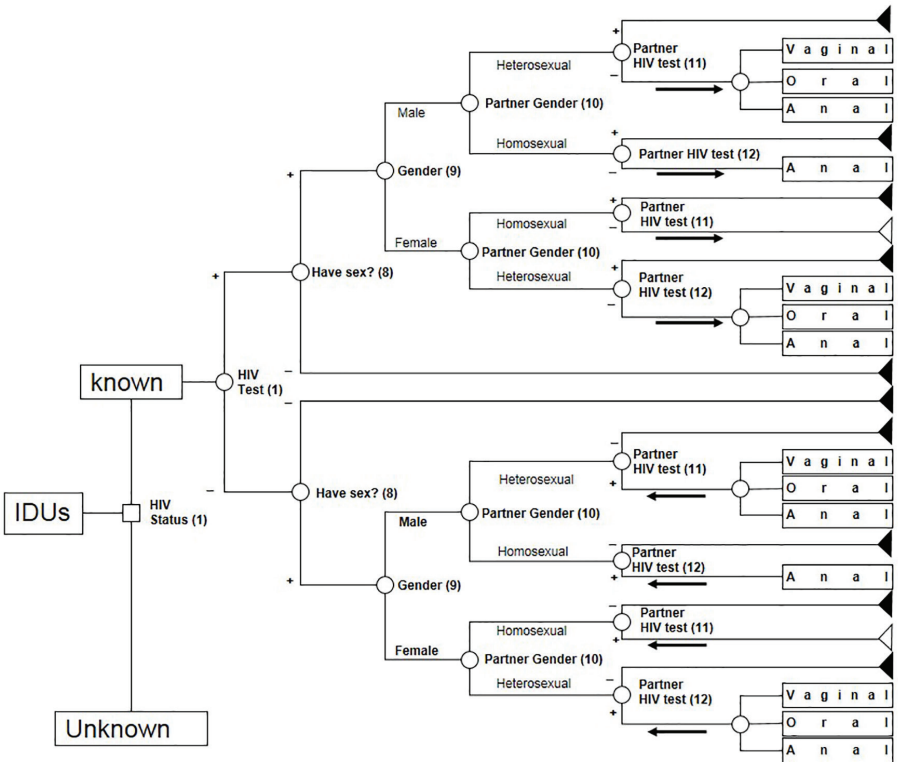

Figure 1: Decision tree model of HIV transmission via sexual contacts among IDUs

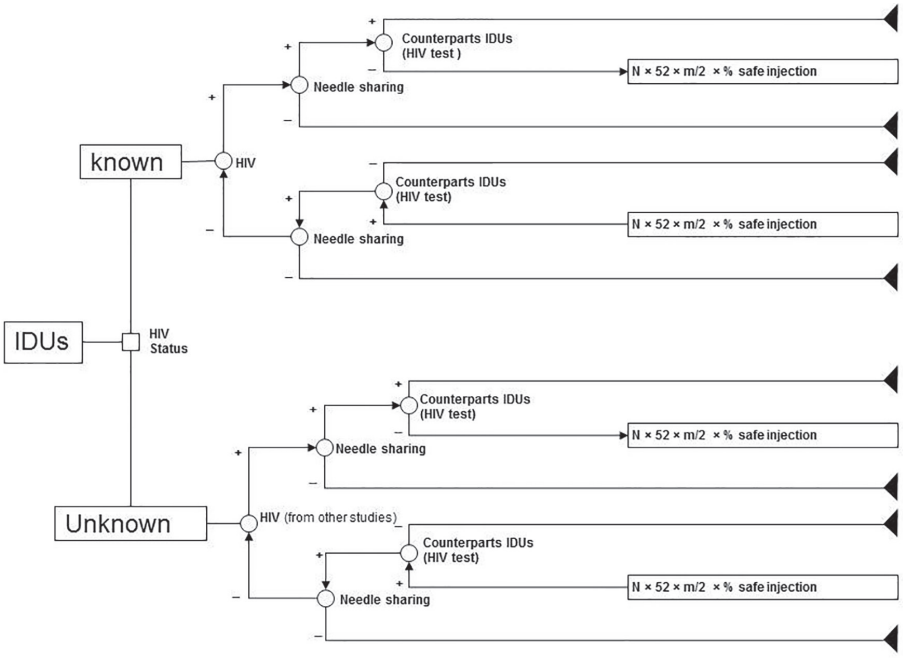

Figure 2: Decision tree model of HIV transmission via sharing needles and syringes among IDUs

model, the probability of becoming infected patients (A) from other IDUs (B) which is shown as $P_{B\to A}$ is calculated by the following formula:

$$P_{B\to A}=1 - \{P_B [(1 - ROT)^{n/2}] + (1 - P_B)\}^m$$

Where P_B=HIV prevalence among other IDUs; m=average number of other IDUs; n=average number of injections with a given IDU; ROT=rate of transmission HIV in every injection.

The probability of becoming an infected partner (B) through injection by patients (A) which is shown as $P_{A\to B}$ is calculated by the following formula:

$$P_{A\to B}=1 - \{P_A [(1 - ROT)^{n/2}] + (1 - P_A)\}^m$$

Where P_B=HIV prevalence among IDUs; m=average number of other IDUs who shared needles and syringes; n=average number of injections with a given IDU; ROT=rate of transmission of HIV in every

injection. The rest of formulas used in this study were selected from the above-mentioned guideline.[29]

To determine ICER, the numerator was the difference between the cost of intervention and non-intervention, and denominator was the number of estimated averted cases. One-way sensitivity analysis was performed to calculate the effect of uncertainty from some external parameters on the averted cases. Two parameters of HIV prevalence among IDUs and ROT via sharing needle and syringe had the most effect on ICER. Participants completed informed consent forms in accordance with ethics committee guidelines. All data were entered into Microsoft Excel 2010 (Microsoft Corporation; Redmond, Washington, USA) and all statistical analyses were performed using the statistical software SPSS version 20.0 and Microsoft Excel (SPSS Inc., Chicago, Illinois, USA).

Results

In this study, 96.1% out of 1309 participants were male. The mean age of the subjects was 33±9 years and HIV prevalence among them was 20.5% (Table 1). Mathematical simulation estimated that the total number of HIV infection due to sharing injection and sexual contacts was approximately 22.4 and 142.6 in the intervention and non-intervention periods, respectively (120.2 averted cases). The amount of risky behaviors before and after the intervention has been shown in the study of Mirahmadizadeh et al.[8] The annual cost of DICs for each averted case was 221.55 USD (Total cost of intervention=290,008.95 USD) and experts stated that the cost of care and treatment of 1 case of HIV/AIDS in Iran was 1100 USD per month and average lifespan of HIV/AIDS cases is around 10 years (Total cost of non-intervention=1,882,478.4 USD). Incremental cost-effectiveness ratio was 13,248.5 USD per averted case of HIV/AIDS infection. The overall cost saving was 1,586,640 USD per year.

One-way sensitivity analysis, based on the worst and best case scenario, showed that changes in HIV prevalence among IDUs as well as HIV transmission through needle injection had the greatest effect on ICER. The ICER of the lowest prevalence (best scenario=0.005)[7] to the highest prevalence (worst scenario=0.7)[29] reported among IDUs changed from 13,055 to 13,680 USD.

Also, one-way sensitivity analysis was performed to combat uncertainty from ROT which showed that ICER changed from 12,986 to 13,954 USD along with ranging ROT from 0.001,[30] to 0.05,[31] respectively.

Table 1: Distribution of the Characteristics of the Participants Referred to 13 selected DICs

Characteristics	No. (%)
Sex	
Male	1258 (96.1)
Female	51 (3.9)
Marital Status	
Single	626 (47.8)
Married	459 (35.1)
Divorce	202 (15.4)
Widow	18 (1.4)
Others	4 (0.31)
HIV and HCV status	
HIV (n=801)	164 (20.5)
HCV (n=759)	347 (45.7)

HIV, Human Immunodeficiency Virus; HCV, Hepatitis C Virus.

Discussion

This study was designed to determine the cost-effectiveness of prevention of HIV infection among IDUs, performed by the programs of DIC centers. The results showed that the selected DICs prevented around 120.2 HIV cases.

Pham conducted a similar study in Vietnam during 2006-2010 and showed that a large number of HIV cases were averted like the present study.[24] During a two-year study, Kumaranayake et al. prevented 176 HIV infections among 565 IDUs.[32] Also, according to Ni et al.'s study in China during 2005-2010, about 5,678 HIV cases were averted among 17,108 IDUs.[33] The main reason for this difference could be the sample size and the difference in mathematical models in which averted cases were estimated. The findings showed that most HIV infections were prevented from reducing risky injection, but unprotected sexual contact had a little effect. The reasons for this finding is that firstly the overall risk of transmission of HIV infection in sexual contacts was low even without condom use[7] and secondly sexual contacts were much less common than injection.

Incremental cost-effectiveness ratio was estimated to be 13,248.5 USD for each HIV averted case. Notably, based on the results of the study, intervention by DICs could save 594.80 USD for each 1 dollar spent for harm reduction programs. ICER of Methadone Maintenance Therapy (MMT) centers in Iran was estimated to be $106,382.39 for each averted HIV case and overall cost saving was $13,624,392.00.[21]

Kim et al. studied the application cost of sterile syringe and needle for each HIV averted case which was estimated to be $487.40.[6] According to the study of Kumaranayake et al., the cost of each prevented HIV infection was calculated to be 359 USD.[32] In a study in Canada in 2008, the cost of per HIV infection prevented was estimated as $20,100.00.[34] Also, according to Laufer's study, the cost of each HIV infection averted case was $20,947.00 and 2 dollars is saved for every dollar spent.[13] In another study in Canada, within five years of the implementation of harm reduction programs, 24 HIV cases were averted; in this case, regarding the cost of 1.3 million dollars,

cost savings were 4 USD for every dollar spent.[35] Although the differences mentioned above can limit this study to be compared with other studies, but in general, low ICER in those studies in comparison with the present study could be due to the low cost of harm reduction programs in DICs and high costs of care and treatment in Iran (as compared with developed countries) as well as differences in cost perspective and different methods to estimate the averted case.

The limitations of the present study include challenges in collaboration of IDUs and failure to recall information at interviews. Therefore, conducting a randomized controlled clinical trial study is suggested to achieve the cost-effectiveness. Avants et al. showed that the cost-effectiveness studies in randomized clinical trials have a better validity and reliability and it is a gold for economic evaluation.[36] In this study, we assumed all probable new HIV cases were diagnosed and calculated both costs of harm reduction programs and HIV care and treatment by simulation method, while in reality we considered the cost of HIV care and treatment, but it will not count the cost of harm reduction.

Conclusion

According to the results of the present study, harm reduction programs in Iran, especially DICs, are cost-effective. However, precise and accurate data from a proper randomized controlled trial, as the best way to determine effectiveness, is needed to ensure the efficiency of DICs. We also recommend that the number of these centers should be increased to cover more IDUs.

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Conflict of Interest: None declared.

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