

論文の内容の要旨

論文題目: Behavioral interventions for preventing the transmission of HIV infection

among sex workers in Indonesia: A cost-effectiveness analysis

(インドネシアにおけるセックスワーカーの行動介入による

HIV 感染症予防に関する費用効果分析)

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Introduction: Heterosexual transmission accounts for nearly half of HIV prevalence among high-risk populations in Indonesia. The Indonesian National AIDS Commission projects that heterosexual transmission by sex workers will make the largest contribution to new cases of HIV infections by 2020 due to the high level of mobility of both sex workers and their clients. Like other countries, high rates of HIV infection among sex workers relative to other population groups, can affect rates of heterosexual transmission of HIV. Therefore, sex workers are one of the highest priority healthcare needs at the current time, that should be quickly addressed. Behavioral interventions have been identified as a strategy to reduce HIV transmission among sex workers in low- and middle-income countries, but its cost-effectiveness has been questioned and has yet to be investigated in Indonesia. This study aimed to conduct a cost-effectiveness analysis of behavioral interventions for sex workers to provide evidence and to help national health decision makers in identifying appropriate interventions for preventing HIV transmission among sex workers in Indonesia. This study aimed to present an overview of the current state of knowledge about effective behavioral interventions to prevent the spread of HIV/AIDS among sex workers in low- and middle-income countries, through a systematic review of current evidence of efficacy of such interventions. The study then aimed to use the best available information to conduct a cost-effectiveness analysis of the interventions in the Indonesian context. More specifically, the aims of this study include: 1) To compare health gains (i.e. quality-adjusted life-years (QALYs) saved per HIV infection averted) under the best practice method compared to promotion of condom use only; 2) To estimate the lifetime cost of all interventions; and 3) To calculate the incremental cost-effectiveness ratio (ICER) for the best practice case relative to current practice in the Indonesian setting.

Methodology: Systematic reviews and meta-analyses of randomized controlled trials (RCTs) of behavioral interventions amongst sex workers worldwide were performed, to estimate efficacy of interventions to reduce HIV incidence in sex workers population. Through this systematic review, the effectiveness of behavioral interventions for reducing the transmission of HIV among sex workers in low- and middle-income countries was evaluated, as was the effectiveness of behavioral interventions such as condom use and behavior modification in reducing the transmission of HIV when these interventions are delivered in sex worker settings. A systematic review of the published articles on behavioral intervention to prevent transmission of HIV in sex workers to identify the presence and quality of economic evaluations was also conducted, to assess current data for the effectiveness and cost of a variety of behavioral interventions for preventing HIV infections, with a focus on low- and middle-income countries, and to provide critical evidence of economic evaluation focusing on HIV behavior interventions in low- and middle-income countries. This review also summarized the current economic modeling to assess whether there is a need for further modeling. A life-time mathematical model of HIV infection was run over both 5-year and 10-year time horizons to estimate the cost-effectiveness of certain interventions in the Indonesian context. The model includes behavioral intervention programs, the natural history of HIV and AIDS, the costs and health benefits of the spread of HIV, and costs and health benefits of behavioral interventions for female sex workers (FSWs). Epidemiological and behavioral information, utilization rates, effectiveness of interventions and costs data were estimated from both primary and secondary data. Estimation of the probability of HIV incidence, transition probabilities of HIV seroconversion, relative risk and its 95% confidence interval were calculated on the basis of published resource. The model estimated the number of HIV cases prevented, changes in quality-adjusted life expectancy, costs of interventions per additional QALYs gained, and costs of interventions and ICER for two strategies: 1) promotion of condom use including provision of condoms, as a current standard behavioral intervention in Indonesia, and 2) a social cognitive theory-based intervention in addition to provision of condoms, as the interventions which appear to be effective for HIV prevention among FSWs in low- and middle-income countries based on meta-analyses of RCTs. Future costs and health benefits were discounted 3% annually using QALYs as the measure of benefit. Sensitivity analyses were performed to evaluate model robustness. Multivariable probabilistic uncertainty analysis was performed to assess the effect of simultaneous change in all model parameters.

Results: Social cognitive theory-based intervention was found as the most effective behavioral interventions to reduce the transmission of HIV among sex workers in low- and middle-income countries. The cost-effectiveness studies provided a variety of important input parameters including demographic variables, populations targeted, unit prices and the effectiveness of interventions for implementation. The cost-effectiveness studies also provided a greatest clinical benefit with limited evidence. The most cost-effective interventions tested were promotion of condom use, whereas other interventions such as social cognitive theory-based intervention and peer education showed the best value for QALY gained and HIV infection averted. This analysis also indicates that some of the behavioral interventions are cost-effective in terms of costs per DALY averted, QALY gained or HIV infection averted. When this best-practice intervention in combination with data specific to Indonesia in a Markov decision model for cost-effectiveness analysis, I found that the average cost of implementing the social cognitive theory-based intervention scenario in additional to promotion of condom use to five years and ten years on the BSS 2000 behavioral data was found to be US\$463 and US\$814 with an effectiveness of 4.5 QALYs and 8.2 QALYs, respectively. For 10 years implementing the social cognitive theory-based intervention, the Indonesian government, from a health system perspective, spends an average US\$12,049 per HIV infection averted and US\$5,704 (US\$3,637 to US\$11,596) per QALY saved. A reduction of 26% and 29% cumulative HIV cases, respectively were estimated in ten years and five years program implementation. Due to the cost differences, the social cognitive theory-based intervention in additional to promotion condom use is not cost-effective compared to promoting condom use through standard counseling and provision of condoms strategies. This cost-effectiveness result is not consistent across all three data sets used, ranging from an ICER of US\$11,393 for the model run over five years on the BSS 2005 behavioral data, to US\$11,339 for the model run over five years on the IBSS 2007 data. Probabilistic sensitivity analysis through Monte Carlo simulations indicated that the majority of replicates for both five and ten years fall within regions of the cost-effectiveness plane that indicate the intervention is not cost-effective relative to the control. Variations in the incidence rate and the relative risk of HIV were found as the two largest drivers of uncertainty in outcome.

Discussion: This is the first study to estimate the costs and health benefits of different behavioral interventions for reducing the transmission of HIV infection among sex workers, not only in Indonesia but also in low- and middle-income countries using national-level surveillance data. The present analysis of an economic decision model using Markov lifetime methods demonstrated that social cognitive theory-based

intervention targeting high-risk FSWs in Indonesia is not generally effective or cost-effective compared to an existing condom promotion behavioral intervention of standard counseling and provision of condoms. It is likely that there are some circumstances – particularly settings where FSWs experience HIV incidence rates above the background rates for Indonesian FSWs, and hard to reach FSWs for whom interventions are likely to be more costly than average, where the addition of social cognitive theory-based intervention to standard interventions is not cost effective, and other interventions should be considered for these populations. The lack of generalizable cost-effectiveness of social cognitive theory-based intervention, and the lack of support for effectiveness in other behavioral interventions found in my meta-analysis, suggests that behavioral interventions only are not appropriate for preventing HIV transmission among FSWs in Indonesia. This study found that enhanced behavioral interventions is unlikely to be cost-effective in a high-incidence setting, even though extensive support for behavioral change interventions was pre-established. Based on the results of this study, the government of Indonesia should not consider prioritizing social cognitive theory-based intervention, though this does not exclude giving increased attention to other behavioral prevention interventions. Doubts over the effectiveness of behavioral interventions and recent findings on the cost-effectiveness of biomedical interventions have led to a shift in focus towards biomedical strategies. Moreover, the necessity of using modeling was emphasized and highlighted to evaluate the effect of HIV intervention programs. Given the lack of results of HIV studies particularly in behavioral intervention contexts, there is an obvious and urgent need to pursue good quality research. Research on HIV behavior interventions must address the reasons for unprotected sex and the psychological, social, occupational and cultural factors that determine sexual risk behavior among FSWs should be taken into account. Therefore, resources should be allocated to identifying both quality and facilitators to large-scale implementation of targeted interventions and similar cost-effective behavioral interventions. Two more approaches for future research in the restricted-resource context of Indonesia's HIV prevention program are suggested. First, it is necessary to ascertain the impact and cost effectiveness of different preventive interventions in other high risk groups such as male sex workers, transgender, men who have sex with men and injecting drug users. This will inform better resource allocation decisions in the Indonesia National AIDS Control Program. Second, similar interventions are delivered with different intensity and different strategies in different settings. It is suggested therefore, to ascertain the effect of interventions and cost-effectiveness of different strategies of service delivery at all healthcare levels.