



Cost-Effectiveness of HIV Counseling and Testing in US Prisons

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ABSTRACT *The prevalence of human immunodeficiency virus (HIV) in correctional facilities is much higher than in the general population. However, HIV prevention resources are limited, making it important to evaluate different prevention programs in prison settings. Our study presents the cost-effectiveness of offering HIV counseling and testing (CT) to soon-to-be-released inmates in US prisons. A decision model was used to estimate the costs and benefits (averted HIV cases) of HIV testing and counseling compared to no CT from a societal perspective. Model parameters were HIV prevalence among otherwise untested inmates (1%); acceptance of CT (50%); risk for HIV transmission from infected individuals (7%); risk of HIV acquisition for uninfected individuals (0.3%); and reduction of risk after counseling for those infected (25%) and uninfected (20%). Marginal costs of testing and counseling per person were used (no fixed costs). If infected, the cost was \$78.17; if uninfected, it was \$24.63. A lifetime treatment cost of \$186,900 was used to estimate the benefits of prevented HIV infections. Sensitivity and threshold analysis were done to test the robustness of these parameters. Our baseline model shows that, compared to no CT, offering CT to 10,000 inmates detects 50 new or previously undiagnosed infections and averts 4 future cases of HIV at a cost of \$125,000 to prison systems. However, this will save society over \$550,000. Increase in HIV prevalence, risk of transmission, or effectiveness of counseling increased societal savings. As prevalence increases, focusing on HIV-infected inmates prevents additional future infections; however, when HIV prevalence is less than 5%, testing and counseling of both infected and uninfected inmates are important for HIV prevention.*

KEYWORDS *Correctional Health Care, Cost-Effectiveness Analysis, HIV Counseling and Testing, HIV Prevention.*

INTRODUCTION

Correctional facilities in the United States are becoming increasingly important in the control of the human immunodeficiency virus (HIV) epidemic. Jail and prison populations in the United States have tripled since the 1980s when the first acquired immunodeficiency syndrome (AIDS) cases were reported.¹ The HIV prevalence rate is markedly higher in this population than in other parts of the community, and inmates also represent groups with increasing rates of HIV infections—*injection drug users (IDUs) and minorities*. The correctional setting thus provides relatively easy access to this high-risk population^{2,3} and presents important public health op-

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opportunities for identifying HIV-infected persons, getting them appropriate care, and providing counseling to prevent further HIV transmission. The setting also may enable identification of high-risk uninfected persons, providing the opportunity for counseling to reduce their risk of acquiring HIV infection.

Earlier studies have provided valuable information on the prevalence and risk factors for HIV in jails and prisons and have discussed the importance of HIV interventions for inmates.¹⁻³ Given that HIV prevention resources are limited, it is important to evaluate the cost-effectiveness of HIV prevention programs in prison settings. HIV counseling and testing (CT) has proved cost-effective in clinic settings.^{4,5} This study evaluates the cost-effectiveness of HIV CT among prison inmates at or near their time of release.

METHODS

We did a standard cost-effectiveness analysis using a decision model from a societal perspective.⁵ The societal perspective generally includes all costs and benefits of a program irrespective of the source of resources, including patient costs, lifetime treatment costs, and productivity losses. Given that the study populations are prison inmates, we have not included cost of patient time or productivity losses in our model. We did not have cost estimates for CT services in a prison; therefore, we used estimates collected from HIV/STD (sexually transmitted disease) clinics at the Michigan Department of Community Health, along with a few time estimates and lifetime treatment costs from the literature.⁶⁻⁸ All cost figures are expressed in 1999 dollars and are additional costs required to provide testing and counseling service through an existing program that already offers serologic tests and counseling in prisons (no fixed costs included).

We estimated the following benefits and costs of adding CT services: (1) number of future HIV infections prevented; (2) total and additional costs or savings for society; and (3) total cost to the prison system. Sensitivity and threshold analyses were used to test the robustness of the model parameters.

Model Probabilities

The Figure shows a simplified decision tree model comparing counseling and testing to no counseling and testing in US prisons. Hammett et al.⁹ estimated that, in 1996, 2.4% of state prisoners knew they were HIV infected. We assumed that two thirds of all infected persons know their HIV status,¹⁰ so 1.2% of inmates would be infected and not know it. For our base model, we used an estimate of HIV prevalence of 1% among inmates who did not know they were infected. In state prisons,⁹ HIV prevalence ranged from 0.2% to 13.6%, and we used a range of 0.1% to 15% in the sensitivity analysis (Table 1).

Correctional facilities in 17 states have mandatory testing, and the rest offer some form of voluntary or "on request" HIV testing.⁹ Published reports show that 47% of inmates in Maryland and 71% in Wisconsin accepted voluntary testing.^{11,12} For our base model, we assumed that, among inmates who did not know their HIV status, 50% would accept CT if offered; we used a range of 20%–90% for sensitivity analysis.

Several partner notification studies found that 18%–40% of the partners of HIV-infected individuals are infected.¹³⁻¹⁶ Although a similar estimate for the prison population is not known, based on these studies, we assumed that 20% of the

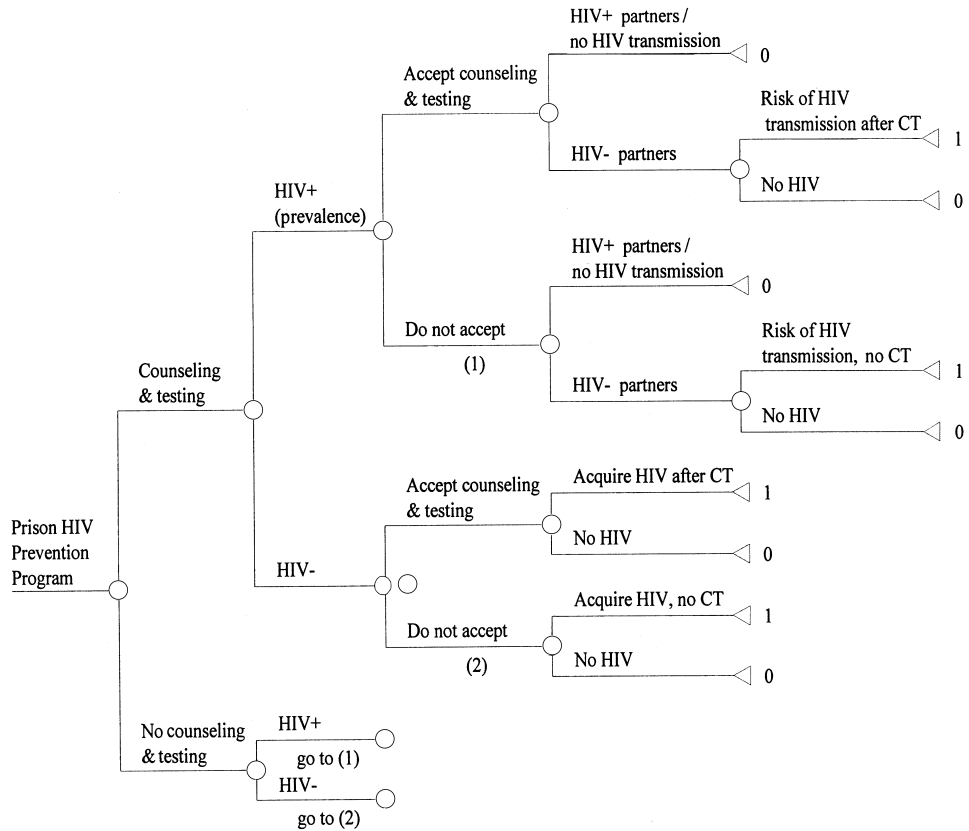


FIGURE. Decision model comparing HIV testing and counseling with no testing and counseling option.

TABLE 1. Cost-effectiveness of counseling and testing in US prison: Decision model probabilities and cost variables

Input variable	Value (range)	Ref. no.
HIV prevalence	1% (0.1%–15%)	9
Accept voluntary counseling/testing	50% (20%–90%)	^a
Partners of HIV-infected persons who are infected	20% (15%–40%)	13–16
Risk of HIV transmission from infected to uninfected partner with no counseling	7% (5%–30%)	18
Risk of acquiring HIV infection for uninfected person with no counseling	0.30%	4
Reduction in risk after counseling		
HIV infected	25% (10%–50%)	19–25
Uninfected	20% (10%–50%)	4
Lifetime treatment cost of HIV	\$186,900 (\$107,000–\$267,000)	8, 26, 27
Provider cost of counseling and testing		
HIV infected	\$78.17 (\$78.17–\$98.17)	6, 7
HIV uninfected	\$24.63 (\$24.63–\$34.63)	

^aBaseline assumption.

partners of an infected inmate were HIV infected, and the remaining 80% were at risk of acquiring infection.

Racial and ethnic minorities and IDUs are overrepresented in the US correctional systems. A survey found that 35% of male and 30% of female inmates have injected drugs.¹⁷ However, we do not have information on the risk of HIV transmission among IDUs. We assumed the risk of HIV transmission from a released infected inmate to an uninfected partner in the community was similar to the risk of transmission among sexually active HIV-discordant couples. A 2-year longitudinal study of HIV-discordant couples found that 7% of the uninfected partners acquired HIV during this time.¹⁸ For our analysis, we used a no counseling transmission rate of 7% for the base model and a range of 5%–30% in the sensitivity analysis.

Studies have shown that 20%–80% of people will reduce their risk behavior when they learn they are HIV seropositive.¹⁹ Another study used point estimates of 20% and 50% for its model to measure the benefits of counseling and knowledge of seropositivity on reducing risk behavior.²⁰ However, studies of IDUs have reported conflicting evidence for the effectiveness of counseling in risk reduction. Some have reported significant risk reduction following counseling,^{21–23} while others have found no significant benefits.^{24,25} Therefore, given the nature of the prison population, we conservatively assumed that 25% of the infected inmates who received counseling would adopt safer behaviors and reduce their risk of transmission from 7% to 5.2%. We used a range of 10%–50% in the sensitivity analysis to depict the possible range of the effectiveness of counseling in reducing risk behavior.

The risk of acquiring HIV infection for an uninfected, STD clinic patient was 0.30% in the year following enrollment in a randomized controlled prevention trial.⁴ Client-centered counseling in this study resulted in a 20% reduction in risk of acquiring a sexually transmitted infection at 12-month follow-up. Based on this finding, we estimated that 20% of the uninfected prison inmates who receive high-quality prevention counseling would reduce their risk of acquiring HIV infection in a 1-year period (from 0.3% to 0.24%). For sensitivity analysis, we used the same lower (10%) and upper (50%) limits for effectiveness of counseling as for infected inmates (Table 1).

Estimations of Future HIV Infections Averted

To estimate the number of HIV infections that can be prevented through counseling, we used information on the risk of HIV transmission among heterosexual couples¹⁸ combined with estimates of the effectiveness of counseling on risk reduction.^{4,19–25} A value of 1 was assigned for HIV transmission, and 0 was used for no HIV transmission. Therefore, the expected value obtained from the analysis gives the total number of HIV infections that would occur with and without CT services, and the difference between the two is the number of infections that can be prevented by the CT intervention (Figure).

Input Costs

Cost estimates for CT in a prison setting are not available in the literature. Therefore, we used costs (in 1999 dollars) of providing CT services in a facility that already offers serologic testing and counseling. For infected inmates, the costs of CT include wage and time cost for administrators, counselors, phlebotomists, and laboratory staff; and cost of serum collection kits, the enzyme immunoassay (EIA), Western blot tests, and controls.^{6,7} To the provider (prison system), these total \$78.17 for each seropositive inmate. Seronegative inmates cost the provider \$24.63

because they do not need a Western blot test, and posttest counseling requires less time. To assess the effect of possible additional costs (training costs for counselors and guards and travel to the health clinic) of CT services in prison, we added \$20 per infected person and \$10 per uninfected person to the above costs in the sensitivity analysis.

The benefits of prevention were quantified using the lifetime treatment cost for HIV infection. Studies have estimated that lifetime treatment cost for HIV ranges from \$165,000 to \$267,000 at a 3% discount rate.^{8,26,27} We used a conservative estimate of \$186,900 for our base model and a range of \$107,000 to \$267,000 for sensitivity analysis.

RESULTS

Our baseline model shows that offering testing and counseling to 10,000 prison inmates (acceptance rate of 50% and excluding those known to be infected) would identify 50 infected persons who did not know they were infected and would prevent almost 4 future cases of HIV. To the prison system, this would cost \$12.50 per inmate who is offered CT or \$25 per inmate tested and counseled. From a societal perspective, offering no CT services would result in 35 future cases of HIV and would cost society \$6.6 million in medical treatment costs alone. Offering CT results in 4 fewer future cases and saves society more than \$500,000 (Table 2). We also found that, when HIV prevalence is less than 5%, most of the future cases averted come from effective counseling of uninfected inmates. At 1% HIV prevalence, 80% of the future cases averted are from uninfected inmates who did not acquire HIV in the following year, and 20% are among potential future partners of infected inmates.

TABLE 2. Results of cost-effectiveness analysis: Baseline result and sensitivity analysis of offering counseling and testing (CT) to 10,000 inmates in US prisons

Description of variable (baseline value)	Range	Cases averted*	Total societal savings, \$	Total provider cost, \$
Prevalence of HIV (1%)	0.1	3.07	450,181	123,418
	3	5.07	947,692	131,181
	15	13.35	2,331,810	163,350
Inmates who accept HIV counseling/testing CT (50%)	10	1.48	225,534	50,331
	90	6.64	1,014,901	226,489
Risk of HIV transmission from HIV-infected inmates with no CT (7%)	5	3.47	522,716	125,287
	30	5.97	989,966	125,287
Effectiveness of counseling in reducing risk behavior in HIV-infected persons (25%)	10	3.25	481,598	125,287
	50	4.37	690,926	125,287
Effectiveness of counseling in reducing risk behavior in uninfected persons (20%)	10	2.21	286,288	125,287
	50	8.15	1,396,474	125,287
Lifetime treatment cost of HIV (\$187,000)	\$107,000	3.69	269,003	125,287
	\$267,000	3.69	859,403	125,287
Provider cost of HIV CT, HIV-infected (\$78.17); uninfected (\$24.63)	\$98.17 &	3.69	513,334	176,327
	\$34.63			
Baseline		3.69	563,834	125,287

*Compared to no CT.

The one-way sensitivity analysis (changing the value of one parameter at a time) shows that societal savings are sensitive to HIV prevalence, risk of HIV transmission, and effectiveness of counseling; total savings range from \$225,000 to over \$2 million (Table 2). Effectiveness in terms of future cases prevented increases with increase in HIV prevalence (13 cases prevented when HIV prevalence is 15%), followed by increase in effectiveness of counseling (8 cases prevented if 50% of uninfected inmates change behavior), and increase in acceptance rate (7 cases prevented when 90% of inmates accept CT) (Table 2). Total provider cost also increases with increase in either prevalence or acceptance rates, but is unchanged with improved counseling (not considering training costs) (Table 2). For the prison systems, providing quality client-centered counseling would be a cost-effective way to prevent future infections.

Counseling and testing for HIV in prisons would save money for society as long as

1. HIV testing and counseling prevented 1.45 cases of HIV.
2. Lifetime treatment cost of HIV infection is more than \$40,000.
3. Risk of HIV transmission from infected to uninfected individuals is greater than 1% per year and risk of acquiring HIV for the uninfected is greater than 0.05% per year.

DISCUSSION

Our study shows that voluntary HIV testing with quality prevention counseling in prisons would prevent future cases of HIV and save societal dollars. Given the high treatment cost of HIV, the average provider cost of \$34,000 to prevent a future case of HIV seems reasonable. The average cost to the prison system decreases with an increase in HIV prevalence among persons tested, increase in risk of transmission without counseling, or increased effectiveness of counseling. Most state prisons in the Northeast and a few in the South report HIV prevalence greater than 3%. In 1996, state prisons in these regions housed almost 87% of all infected inmates.⁹ Testing and counseling programs in such prisons with high HIV prevalence (assuming similar prevalence among those not tested) can prevent many future cases of HIV at a minimal cost to the prison system.

In addition, our model also shows that, when HIV prevalence is less than 5%, a larger proportion of the future cases prevented comes from prevention counseling of uninfected inmates who do not acquire infection rather than from preventing secondary transmission from HIV-infected inmates. Therefore, HIV CT programs are not only beneficial to HIV-infected inmates in that they know their status, do not transmit HIV to uninfected partners, and obtain care (we do not address that in this study), but also to uninfected inmates in that they know their status and take steps to avoid becoming infected. Comprehensive HIV education and prevention programs that include client-centered counseling sessions are recommended to better educate and help inmates change risk behaviors.⁹

It may be difficult for prison health care providers to accept the cost of a prevention intervention such as HIV counseling and testing when the benefits are averted future cases. These benefits of prevention mostly accrue to society, and therefore it is reasonable to expect most of the funding for prevention programs to come from society. HIV prevention programs for the community are set up using

societal dollars (both federal and state funds); therefore, these programs should consider funding HIV prevention in prisons. Prison officials could also approach these groups to help set up prevention programs in prisons. Given the high recidivism rates among HIV-infected inmates,³ HIV prevention programs will also benefit prison systems.

Models that use epidemiologic data are useful for estimating the benefits of prevention, but the quality of the estimates is dependent on data that are accurate and representative. For lack of data, we have used HIV transmission rates among heterosexual couples, which probably underestimates the combined risk for sexual and needle transmission of HIV and thus underestimates the number of future infections averted. We based our cost estimates on data from clinics as there was a lack of data from prison populations. Also, we did not include treatment costs associated with finding new HIV-positive individuals, which increases the cost to the prison system. The lifetime treatment cost of \$187,000 per case of HIV infection is almost certainly a conservative estimate given the new therapies, thus underestimating the benefits of prevention. Also, we have not included the morbidity and mortality costs associated with HIV infection, thus resulting in an underestimation of societal savings obtainable through prison HIV counseling and testing. As relevant and more reliable estimates for various model parameters become available, required changes can be made to our model to increase the accuracy of these estimates.

One of the limitations of this and all other models is that results should be considered within the context of the probabilities and information used in the analysis. A second important limitation is the lack of information on effectiveness of counseling and cost estimates for prison populations, leading to probable underestimation of benefits. The third limitation is the use of risk of HIV infection for 1 to 2 years, resulting in the missing second- and third-generation transmission of HIV, thus underestimating the societal cost savings. However, underestimation of benefits biases our results away from cost savings and cost-effectiveness, making our conclusions more robust. Finally, our model is a prevention model and does not estimate the benefits and costs associated with treating HIV-infected persons who are identified by prison counseling and testing.

In summary, our analysis shows that HIV testing with quality counseling of prison inmates, under the given model assumptions, is a cost-saving HIV prevention program that prevents many future cases of HIV and saves societal dollars.

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