

Cost-Effectiveness of HIV Counseling and Testing in U.S. Prisons

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Introduction

U.S. correctional facilities are becoming increasingly important in the control of the human immunodeficiency virus (HIV) epidemic. Since the first cases of acquired immunodeficiency syndrome (AIDS) were reported in the early 1980s, the U.S. jail and prison population has tripled.¹ The HIV prevalence rate is markedly higher in this population than in other parts of the community. The correctional setting can provide easier access to this high-risk population.² Prisons, therefore, can provide important public health opportunities for identifying HIV-infected persons, getting them appropriate care, and providing counseling to prevent further HIV transmission. They also may enable high-risk, uninfected persons to be identified and counseled to reduce their risk of acquiring and then transmitting HIV infection.

Earlier studies have provided valuable information on the prevalence rates and risk factors of HIV in jails and prisons and have discussed the importance of HIV prevention among inmates.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 have proven to be cost effective in clinic settings.⁴ This study evaluates the cost-effectiveness of HIV counseling and testing among prison inmates at or near their time of release.

Methods

Standard methods of cost-effectiveness analysis were used, relying on 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 morbidity costs. Given that the study populations are prison inmates, the patient time cost and productivity loss were not calculated in the model.

Cost estimates for counseling and testing services in prison were not available. Cost estimates collected from HIV/STD clinics at the Michigan Department of Community Health were used and time estimates and estimates of lifetime treatment costs were taken from the literature.⁶ All cost figures are expressed in 1997 dollars. These are additional costs that are required to add a unit of counseling and testing services to an existing program that offers serologic tests and voluntary counseling in prisons. No fixed costs are included.

Estimates included the number of future HIV infections prevented, the total and additional costs or savings for society, and the total cost to the prison system. Sensitivity and threshold analyses were conducted to test the robustness of model parameters.

Model Probabilities

Figure 1 shows a simplified decision-tree model comparing counseling and testing with no counseling and testing in U.S. prisons. Hammett, Harmon, and Rhodes estimate the HIV seroprevalence for the Federal Bureau of Prisons in 1996 to be 1.5 percent.⁷ The average State and regional prevalence rates ranged from 0.3 to 13.6 percent. Therefore, an HIV seroprevalence rate of 1.5 percent was used for the base-case model and a range of 0.2–15 percent was used in the sensitivity analysis (table 1).

Figure 1. Simplified Decision Tree Model Comparing HIV Prevention Programs in U.S. Prisons

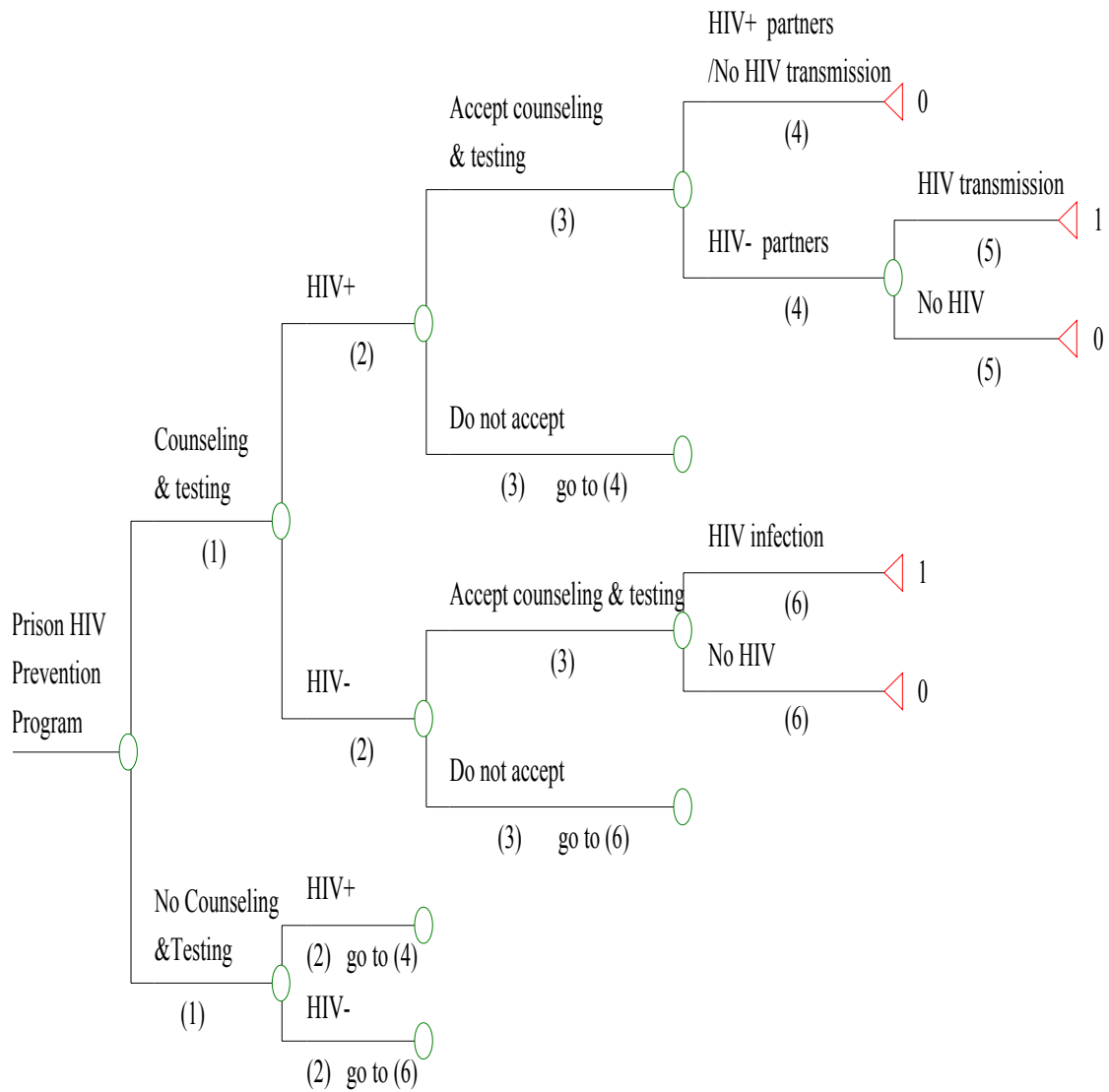


Table 1. Model Probabilities and Input Cost		
Inputs	Probability, Percentage (range)	Source
HIV prevalence	1.5 (1–15)	Hammett, Harmon, and Rhodes 2000
Accept voluntary counseling and testing (CT) in prison		
HIV-infected	60 (30–90)	Baseline assumption
Uninfected	50 (30–90)	
Partners of infected individuals who are HIV infected	20 (15–40)	Rutherford et al. 1991 Hoffman, Spencer, and Miller 1995 Toomey et al. 1998
Risk of HIV transmission from infected to the uninfected partner		
No counseling	7 (5–30)	Mastro and DeVincenzi 1996
With counseling	5.2 (3.75–22.5)	DeVincenzi 1994 McKay and Phillips 1991 Holtgrave et al. 1993 Power, Hartnoll, and Daviaud 1988 Casadonte et al. 1990 Van den Hoek, van Haastrecht, and Couhtino 1990 Roggenburg et al. 1990 Farley, Carter, and Hadler 1990
Risk of acquiring HIV infection for uninfected person		
No counseling	0.35 (0.20–1.05)	Kamb et al. 1998
With counseling	0.315 (0.180–0.945)	Power, Hartnoll, and Daviaud 1991 Casadonte et al. 1990 van den Hoek, van Haastrecht, and Couhtino 1990 Roggenburg et al. 1990 Farley, Carter, and Hadler 1990
Inputs	Cost	Source
Lifetime treatment cost of HIV	\$175,000 (\$100,000–250,000)	Holtgrave and Pinkerton 1997 Hellinger 1993 Gable et al. 1996
Provider cost of counseling and testing		
HIV-infected	\$67.43	Farham et al. 1996 Varghese and Branson 2000
Uninfected	\$22.74	

Correctional facilities in 16 States have mandatory HIV testing. The rest have some form of voluntary or on-request HIV testing. The acceptance level among inmates is not known but Hammett, Harmon, and Rhodes have suggested that some inmates will not accept voluntary HIV testing as they already know their HIV status.⁸ Others might be unsure of the confidentiality of the test results. Therefore, it was assumed that 60 percent of HIV-infected inmates and 50 percent of uninfected inmates would accept the voluntary counseling and testing offered to them, with a range of 30–90 percent for sensitivity analysis.

Several partner notification studies found that 18–40 percent of the partners of HIV-infected individuals are infected.⁹ Although a similar estimate for the prison population is not known, based on these studies it was assumed that 20 percent of the partners of HIV-infected inmates would be HIV positive. Therefore, HIV may be transmitted among the remaining 80 percent of their partners.

Racial and ethnic minorities and injection drug users (IDUs) are overrepresented in U.S. correctional systems. A recent survey found that 35 percent of male and 30 percent of female inmates have injected drugs.¹⁰ Information is not available, however, on the risk of HIV transmission for this population.¹¹ The risk of HIV transmission from a released, infected inmate to an uninfected person in the community was therefore assumed to be similar to the risk of HIV transmission among discordant couples. Cross-sectional studies of heterosexual couples with an infected male index patient have reported that 10–30 percent of their female partners were infected with HIV at the time of the test.¹² A longitudinal study of sexually active, HIV-seropositive persons reported that transmission to the partner occurred in 7 percent of cases within 2 years.¹³ For the analysis, a no-counseling transmission rate of 7 percent was used for the base model, with a range of 5–30 percent in the sensitivity analysis.

Studies have shown that 20–80 percent of people will reduce their risk behaviors when they learn they are HIV seropositive.¹⁴ Another study used point estimates of 20 and 50 percent for its model to measure the benefits of counseling and knowledge of seropositivity on reducing risk behavior.¹⁵ Studies have reported conflicting evidence on the effectiveness of counseling in risk reduction. Some have reported significant risk reduction following counseling,¹⁶ although others have found no significant benefits.¹⁷ Therefore, for the analysis, given the nature of the population, a lower estimate of 25 percent was used for the effectiveness of counseling in reducing risk behavior and a range of 10–50 percent was used for the sensitivity analysis. The risk of acquiring HIV infection in a sexually transmitted disease (STD) clinic patient was found to be 0.35 percent in the year following enrollment in a randomized controlled prevention trial.¹⁸ In that study, client-centered counseling resulted in a 20 percent reduction in risk of acquiring a sexually transmitted infection by the 12-month followup. Based on that finding, it was estimated that counseling uninfected prison inmates in prison would reduce their risk of acquiring HIV infection by 10 percent in 1 year, with a range of 5–20 percent for sensitivity analysis.

Estimates of Future HIV Infections Averted

To estimate the number of HIV infections that can be prevented through counseling, information on the risk of HIV transmission among heterosexual couples was used,¹⁹ combined and coupled with estimates of the effectiveness of counseling on risk reduction.²⁰ A value of one was assigned for the outcome of HIV transmission and zero was assigned for no HIV transmission. Therefore, the expected value obtained from the analysis gives the total number of HIV infections that would occur by following a particular path of the decision tree. The difference between the number of future HIV infections resulting with and without counseling and testing intervention yields the number of infections that can be prevented by the intervention (see figure 1).

Input Costs

Cost estimates for counseling and testing in a prison setting are not available in the literature. Therefore costs in 1997 dollars of adding counseling and testing services to an existing HIV/STD clinic were used (see table 1). For infected inmates, the costs of counseling and testing include wages for administrators, counselors, phlebotomists, and laboratory staff; and costs of serum collection kits, EIA and Western Blot tests, and controls.²¹ To the provider, these add up to a total of \$67.43 for each seropositive inmate. Seronegative inmates cost the provider only \$22.74 each because they do not need a Western Blot test and post-test counseling requires less time.

The societal costs include these provider costs plus the lifetime treatment costs for HIV infection. Studies have estimated that the lifetime

treatment costs for HIV range from \$154,000 to \$250,000, at a 3 percent discount rate.²² An estimate of \$175,000 was used for the base model, with a range of \$100,000–250,000 for sensitivity analysis.

Results

The baseline model shows that offering counseling and testing to 10,000 prison inmates (an acceptance rate of 50–60 percent and HIV prevalence of 1.5 percent) would prevent three future cases of HIV at a net cost of \$12 per inmate to the prison system. From a societal perspective, offering no counseling and testing services would result in 43 future cases of HIV at a cost of \$7,500,000. Offering voluntary counseling and testing services would prevent three future cases of HIV and result in societal savings of more than \$410,000 (table 2).

Table 2. Cost and Benefits of HIV Counseling and Testing (CT) in U.S. Prisons: Baseline Result and Sensitivity Analysis

Description of Variable (baseline value)	Range	Cases Averted	Societal Cost		Societal Savings	Provider Cost
			No CT	CT		
Prevalence of HIV (1.5%)	0.2	2	\$6,310,000	\$6,090,000	\$220,000	\$112,734
	15	14.5	\$19,910,000	\$17,540,000	\$2,370,000	\$156,014
Inmates who accept HIV counseling and testing (CT) (50-60%)	30	2.4	\$7,500,000	\$7,200,000	\$300,000	\$113,502
	90	3.7	\$7,500,000	\$6,980,000	\$520,000	\$119,570
Risk of HIV transmission from HIV- infected inmates to their partners, with no CT (7%)	5	2.6	\$7,080,000	\$6,740,000	\$340,000	\$116,536
	30	7.1	\$12,830,000	\$11,200,000	\$1,630,000	\$116,536
Effectiveness of counseling in reducing risk behavior for HIV-infected persons (25%)	10	2.3	\$7,500,000	\$7,230,000	\$270,000	\$116,536
	50	4.3	\$7,500,000	\$6,880,000	\$620,000	\$116,536
Effectiveness of counseling in reducing risk behaviors for HIV-uninfected persons (10%)	5	2.3	\$7,500,000	\$7,220,000	\$280,000	\$116,536
	20	4.8	\$7,500,000	\$6,790,000	\$710,000	\$116,536
Lifetime treatment cost of HIV (175,000)	100,000	3	\$4,290,000	\$4,100,000	\$190,000	\$116,536
	250,000	3	\$10,720,000	\$10,080,000	\$640,000	\$116,536
Baseline		3	\$7,500,000	\$7,090,000	\$410,000	\$116,536

The one-way sensitivity analysis (changing the value of one parameter at a time) for the model parameters shows that offering counseling and testing to prison inmates will remain beneficial to society under a wide range of parameter values, with savings ranging from \$200,000 to more than \$2 million (see table 2). On the other hand, total costs to the prison system are affected by HIV prevalence and acceptance rate of counseling among prisoners.

A threshold analysis was also conducted to estimate specific parameter values at which prison counseling and testing would not be a cost saving to society. This would occur if: (1) lifetime treatment cost of HIV infection decreased to less than \$40,000; (2) risk of HIV transmission from infected to uninfected persons decreased to 1 percent (from 7 percent); or (3) risk of infection among the uninfected decreased to 0.1 percent (from 0.35 percent).

Discussion

The study shows that offering HIV counseling and testing services in prisons prevents future cases of HIV and saves society money. Given the high societal costs of HIV infection, the average provider cost of \$39,000 to prevent a future case of HIV seems reasonable. The cost to the prison system decreases with an increase in HIV prevalence, increased risk of transmission, or increased effectiveness of counseling. Most State prisons in the Northeast and a few in the South report HIV prevalence of at least 3 percent. The State prison systems with HIV prevalence rates in excess of 3 percent house almost 31 percent of all State prisoners in the United States.²³ These State prison systems are ideal for HIV counseling and testing programs.

The model also shows that when HIV prevalence is less than 5 percent, most of the benefits in terms of future cases prevented come from prevention counseling of uninfected inmates who do not acquire infection rather than from preventing secondary transmission from infected inmates. Therefore, HIV counseling and testing programs are beneficial not only because they inform infected inmates of their status, prevent

transmission to uninfected partners, and help infected inmates get care (this study does not address the benefits of providing care to HIV-infected inmates), but also because they inform uninfected inmates of their status and protect them from becoming infected.

It may be difficult for a prison system to accept the cost of a prevention intervention such as HIV counseling and testing where the benefits are averted future cases. Funding prevention programs that result in decreased future costs to society may seem too altruistic to some, but given the high recidivism rates among HIV-infected inmates, the benefits of prevention will more than likely accrue to prison systems.

Models that use epidemiological data to quantify benefits of prevention are highly dependent on accurate and representative data. The lack of relevant cost and epidemiological data among prison populations is a concern for this study. The decision model has used HIV transmission and infection rates between heterosexual couples and based its estimates on effectiveness of counseling on studies of heterosexual populations. Given that many prison inmates are IDUs and are suspected of having higher than normal HIV transmission rates due to dual modes of transmission (needles and sex), cost savings would increase with higher transmission rates.

Studies on the effectiveness of counseling on reducing risk behavior among IDUs are limited and contradictory, so counseling has been assumed to be half as effective in this group as in the heterosexual groups studied. As relevant information on transmission rates becomes available, required changes can be made to this model to increase the accuracy of the estimates. Because of the lack of estimates for prison populations, cost estimates for HIV treatment have been based on data from clinics. The lifetime treatment cost of \$175,000 per case of HIV infection is almost certainly a conservative estimate, in part because of the increase in life expectancy provided by new therapies. A higher lifetime treatment cost would increase the societal savings per case prevented. Also, the morbidity and mortality costs associated with HIV infection

were not included, resulting in an underestimate of societal savings obtainable through prison HIV counseling and testing.

One limitation 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, which will probably lead to an underestimate of benefits. The third limitation is the underestimate of benefits from HIV prevention due to the use of a 1- to 2-year risk period of HIV infection instead of a lifetime risk, and the decision not to account for second- and third-generation transmission of HIV. This leads to underestimating the societal cost savings. Finally, the model is a prevention model that does not estimate the benefits and costs associated with treating HIV-infected persons who are identified by prison counseling and testing.

In summary, the analysis shows that quality HIV counseling and testing of prison inmates, under the given model assumptions, is a cost-saving prevention program that would prevent many future cases of HIV and save society money. Even from the prison perspective, the average cost of this prevention intervention seems reasonable.

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