Cost-Effectiveness of Routine Screening for Sexually Transmitted Diseases Among Inmates in United States Prisons and Jails

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Introduction

> *When the famous bank robber Willie Sutton was asked why he robbed banks, he answered, "Because that's where the money is." Well, jails are where infectious diseases are that most threaten public health.*
>
> —Thomas J. Conklin, M.D.
> Director of Health Services for the
> Hampden County Correctional Center,
> Ludlow, Massachusetts

The above quote expresses the sentiments of sexually transmitted disease (STD) prevention and treatment specialists regarding the need for routine screening programs for inmates of corrections facilities in the United States. Sexually transmitted diseases are among the group of infectious diseases whose prevalence is estimated to be higher among inmates than in the general U.S. population.[1] These high prevalence rates are due to a concentration of STD risk behaviors and factors in incarcerated populations. These include substance abuse, high-risk sexual activity (including commercial sex work), and the limited access to health care that is associated with poverty. Although the National STD Surveillance Program of the Centers for Disease Control and Prevention (CDC) does not flag cases identified in corrections facilities, CDC's STD division started an annual Jail STD Prevalence Monitoring Project in 1997 to develop a national picture of STD prevalence in these facilities. In addition, there have been numerous local studies of STD prevalence within these institutions. These studies have found prevalence of the three most commonly reported bacterial STDs—chlamydia, gonorrhea, and syphilis—to be much greater among inmates than in the general U.S. population.[2] The rate of infectious syphilis in Los Angeles County's main jail facility was found to be more than 11 times higher than the rate in the county's general population.[3] In jailed women in New York City, the prevalence of chlamydia was as high as 27 percent, and that of gonorrhea was as high as 8 percent. The prevalence of chlamydia and gonorrhea in asymptomatic male detainees in New Orleans was 6 percent. A recent study of the prevalence of chlamydial and gonococcal infections in women entering jails found that in Chicago, 13 percent screened positive for chlamydia and 9 percent screened positive for gonorrhea; in Birmingham, Alabama, 11 percent screened positive for chlamydia and 8 percent screened positive for gonorrhea; and in San Francisco, 10 percent screened positive for chlamydia and 5 percent screened positive for gonorrhea.[4] In contrast, in 1996, 1.7–8.4 percent of women age 15–34 who were tested at family planning clinics screened positive for chlamydia, and 3.3 percent screened positive for gonorrhea.

Among women age 15–34 who were screened at STD clinics, about 15.2–17.7 percent screened positive for chlamydia and 1.8–22.4 percent screened positive for gonorrhea.[5] Family planning clinics tend to screen both symptomatic and asymptomatic individuals, whereas STD clinics screen and treat only symptomatic individuals. Therefore, STD prevalence rates are expected to be higher in STD clinic populations than in family planning clinic populations or in any other population that is screened routinely (i.e., symptomatic and asymptomatic individuals). The high prevalence of STDs in the incarcerated population has implications not only for the personal health of the individual inmates but also for the general public. The population in corrections facilities has been growing rapidly over the past decade, and many of these inmates are released back into the community each year. If inmates are released without treatment, they increase the prevalence of disease in a community and may promote further transmission of STDs to their sex partners.

The National Commission on Correctional Health Care (NCCHC) has recommended offering universal, routine screening to all inmates in corrections facilities regardless of behavioral risk profile for STD for two reasons. First, many individuals with sexually transmitted infections may be asymptomatic and therefore unaware that they are infected. A recent study found high rates of asymptomatic bacterial sexually transmitted infections in a high-risk STD cohort: 62 percent of chlamydia infections were unrecognized in both men and women, 28 percent of gonorrhea infections in men and 51 percent in women were unrecognized, and 40 percent of syphilis infections in men and 100 percent of syphilis infections in women were unrecognized.[6] Second, most of the population that enters the corrections system does not have continuous access to quality primary health care outside of these institutions. Therefore, routine screening would enable an underserved population at high risk for STDs to receive health care that otherwise might be unavailable.

Despite NCCHC's recommendation, many facilities, particularly jails, do not routinely screen all inmates.[7] Some facilities screen inmates only if signs or symptoms are present or an inmate requests testing. Even in facilities that fully implement routine screening policies, routine screening may be delayed for up to 14 days past intake. Many jail inmates are released back into the community within 48 hours, so the opportunity to screen and treat those inmates is lost. Therefore, earlier screening, particularly routine screening on intake, may be a more effective strategy to decrease morbidity and the transmission of STDs.

Questions remain about which of the many strategies for STD prevention and control activities in jails and prisons is most cost effective: testing on an inmate's request only, testing only if signs or symptoms are present or there is a sexual contact with a partner suspected to be infected, routine screening any time before release, routine screening within 12–48 hours after intake, or presumptive treatment without testing of persons with signs or symptoms. The higher prevalence of STDs in incarcerated populations and the need for routine screening are widely documented, but information on the economic feasibility of routine STD screening programs within corrections facilities is limited. This report examines the cost-effectiveness of providing routine screening *on intake* of inmates in U.S. prisons and jails for syphilis, gonorrhea, and chlamydia as compared with a presumptive treatment strategy, often found in many corrections facilities.[8] Because the following analyses are based on jails and prisons, the focus is on adult inmates as distinguished from incarcerated adolescents, who generally reside in juvenile detention facilities that follow different rules and policies.

Methods

An intervention may reduce adverse health outcomes and the medical costs associated with these outcomes. For the purposes of this study, the net cost of an intervention is the difference

between the intervention's costs and the averted medical costs. If the averted medical costs exceed the intervention's costs, then the intervention is cost saving. Conversely, if the averted medical costs are less than the intervention's costs, then the intervention is not cost saving. An intervention that is not cost saving may be cost effective if the reduction in adverse health outcomes is judged to be worth the net cost of the program. An intervention is considered cost effective if the benefits it will achieve are worth the costs, even if those costs are greater than the money that is saved as a result of averted illness.

Decision tree analysis models[9] are used to examine the cost-effectiveness of routine screening for syphilis, gonorrhea, and chlamydia. Disease-specific analyses are conducted because each infection requires different testing and treatment approaches and results in different medical sequelae. Each set of analyses uses a health care system perspective that considers all medical costs associated with a screening program (i.e., testing and treatment). This perspective was used because most, if not all, of this population has little or no access to continuing primary health care outside of the corrections facility.[10] Inmates who are released from corrections facilities with undiagnosed or untreated illnesses may compete with other members of their communities for limited public-sector funds (e.g., Medicaid, publicly funded hospital emergency rooms), shifting the costs to facilities outside the prison or jail. Therefore, each model considers all disease-related costs and health events that occur over the lifetimes of the members of the cohort as they move into or out of a corrections facility. A health care system perspective differs from a societal perspective, which includes *all* benefits of a program and *all* costs: direct medical, nonmedical, indirect (e.g., employment productivity losses), and intangible (e.g., pain and suffering) costs.

A modified health-care system perspective was adopted because this is most useful for decisionmakers in corrections and public health. Productivity losses of incarcerated populations were not addressed because these populations experience high rates of unemployment and illegal employment that are difficult to quantify. Intangible costs of STDs were not addressed because these costs have not been quantified in the economic or health literature. Outcomes and costs associated with primary infection of inmates were addressed, but not the costs of secondary transmission of STDs because their associated costs are difficult to quantify. All analyses were conducted on hypothetical cohorts of 10,000 inmates.

Syphilis

Syphilis is a sexually transmitted infection caused by *Treponema pallidum*. The disease has both acute and chronic manifestations that typically occur in distinct, sequential disease stages. Syphilis is transmitted by direct contact with infectious exudates from skin lesions, mucous membranes, and genital secretions of infected individuals. Ten days to 3 months after exposure to the agent, an infected person may develop a lesion at the site of the initial inoculum. The primary lesion resolves spontaneously in 1–5 weeks. This stage, characterized by genital lesions, is referred to as primary syphilis.[11]

After the primary lesion has healed, the organism spreads through the body, leading to mild signs and symptoms such as malaise, low-grade fever, and a generalized rash (with lesions) on the palms and soles. The stage characterized by these generalized signs or symptoms is known as secondary syphilis. Without treatment, these symptoms resolve spontaneously within 2–6 weeks, although they may recur as long as 4 years after infection. Secondary syphilis is generally followed by a symptom-free stage, or latency. This stage generally lasts from 10 to 20 years and is characterized by a lack of signs or symptoms. Transmission may occur during primary, secondary, and, although rarely, in the early latent stage. During the later stage of latency, it is not infectious. The infection may remain latent in individuals until death.[12]

Clinical complications may occur after this latent stage in about one-third of persons, possibly because of waning immunity. They include

complications in the cardiovascular system, in the central nervous system (neurosyphilis), on the skin, in the mucous membranes, and in the skeletal system (benign). These late-stage complications can cause mild to severe morbidity and premature mortality. Central nervous system and cardio-vascular system complications can lead to expensive treatment, surgery, hospitalization, or long-term care.[13] Late-stage complications rarely develop because the infection is often diagnosed and treated during an earlier stage or because undiagnosed syphilis is cured when the person takes a course of penicillin for another purpose that is also effective in treating syphilis.

Syphilis infections present serious risks during pregnancy.[14] Congenital transmission can occur before or at delivery regardless of a woman's stage of disease. Infection may lead to spontaneous abortion, stillbirth, preterm birth, or congenital infection. Congenital syphilis may result in blindness, deafness, or other nervous and musculoskeletal abnormalities in the infant.

Primary and secondary syphilis can facilitate the transmission of HIV in sexual partnerships involving individuals of discordant HIV serostatus.[15] Therefore, the incidence of HIV transmission is directly linked to syphilis rates.

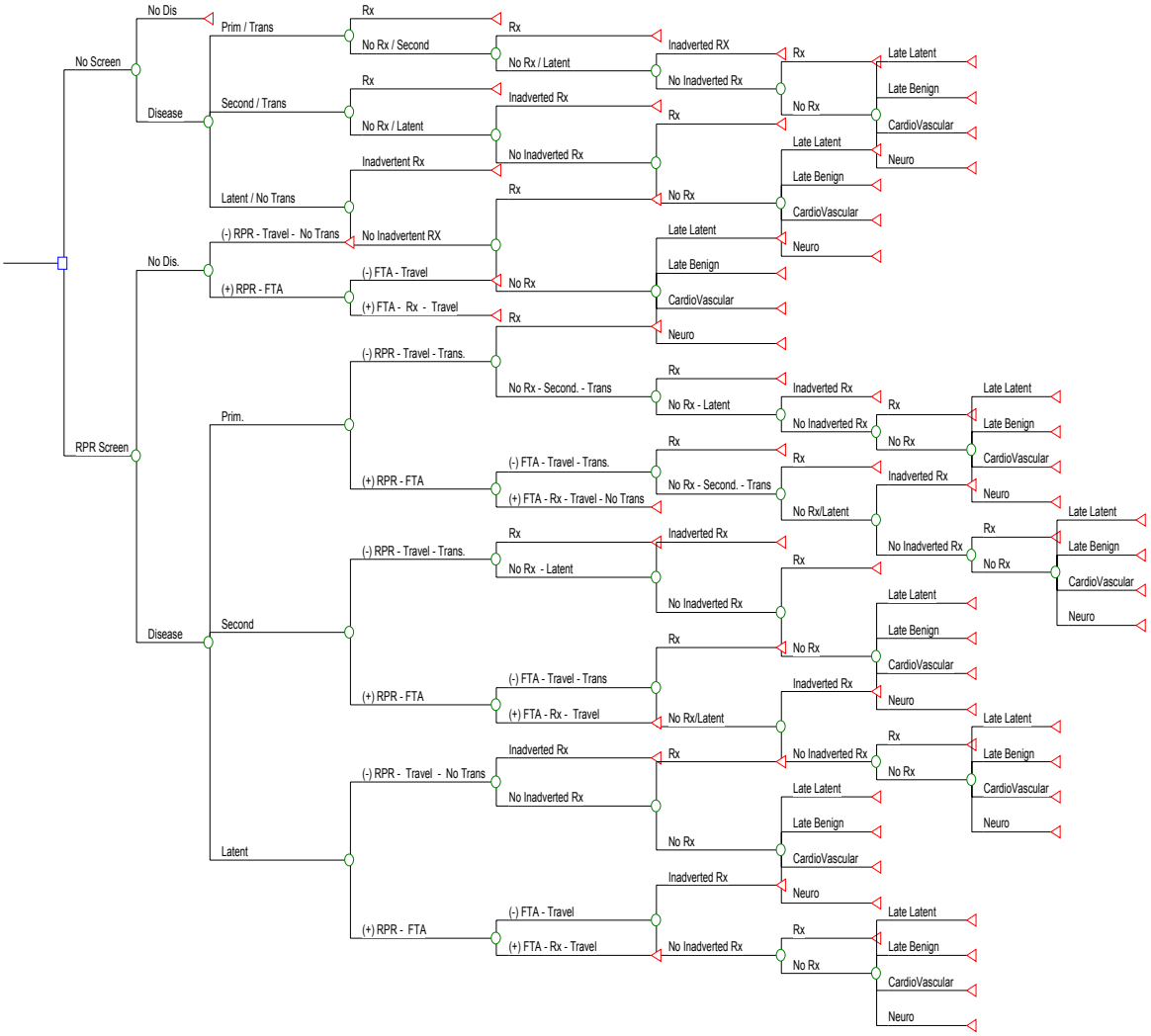
In most prison settings that test for syphilis, individuals are first tested with either the rapid plasma reagin (RPR) or the Venereal Disease Research Laboratory (VDRL) test. Because of the large number of false positive results with these tests, positive tests are confirmed with more specific tests such as the Fluorescent Treponemal Antibody Absorption test (FTA–ABS).[16] Persons with positive confirmatory tests are offered antibiotic treatment.[17] In jails, effective screening policies have been altered to account for the probability that detainees will be released before confirmed test results are available. In these settings, detainees are tested upon admission with the STAT RPR (a 15-minute onsite test of a detainee's blood). Detainees with a reactive test are treated. In some jails that have onsite laboratory facilities, such as the Cook County Jail in Chicago, a routine quantitative RPR is performed on samples that are reactive to STAT RPR. Jail personnel then review an online syphilis registry to determine whether detainees with reactive serologies are in the registry and require treatment.[18] All positive STAT RPR tests are confirmed and staged with RPRs and FTAs, which allows appropriate entry into the syphilis registry. Because most jails do not have onsite laboratories and immediate access to registries, the model assumes that detainees are treated based only on results of the STAT RPR without additional testing to prevent persons with syphilis from being released before they get treatment.

Decision tree

A decision tree is a graphic representation of how all possible events relate (stochastically) to possible outcomes.[19] The decision tree used to analyze the cost-effectiveness of routine syphilis screening in jails and prisons compares the health effects and costs of two options: (1) no routine universal screening for syphilis on intake, and (2) routine universal screening on intake. The decision tree used for the prison setting is shown in figure 1.[20] In the prison setting, the screening is done with an RPR test on intake, followed by a FTA–ABS confirmation of positive RPR tests and treatment of inmates with confirmed tests. In jails, screening is done with a STAT RPR, followed by treatment of inmates with reactive serologies. The models include FTA–ABS confirmation of positive tests, but do not include costs associated with entry into and verification with the syphilis registry. Because clinical manifestations of the disease are similar for men and nonpregnant women, a single model was developed for both sexes. Pregnant women were not considered here.

The decision tree follows a hypothetical cohort of 10,000 individuals throughout their lifetimes. The model was based on several assumptions. The first assumption was that at any point during infection, syphilis might be diagnosed and an infected person treated for it after release from jail or prison. The second assumption was that all inmates who tested positive with either the STAT RPR alone (jail) or both the RPR and FTA (prison) tests would receive treatment before release and that the treatment had a 100-percent

Figure 1. Decision Analysis Tree for Examining the Cost-Effectiveness of Screening Men and Women in Prisons for Syphilis



cure rate. The third assumption was that infected individuals in whom syphilis was not diagnosed because those persons were not screened or were screened but had a false-negative test would develop the standard stages of syphilis. The fourth assumption was that inadvertent treatment of syphilis with an antibiotic prescribed for other reasons might cure the syphilis infection in some infected individuals.

Because the length of the interval between infection and onset of complications affects the present value of the costs, certain assumptions were made about time of onset of primary infection and when complications might occur. The model assumes that cardiovascular syphilis requiring surgery or neurosyphilis with general paresis would result in death 10 years earlier than without the complication. The model assumes also that patients with cardiovascular syphilis or neurosyphilis would require extended medical followup ranging from 9 to 42 years and that 2 percent of those with neurosyphilis would require nursing home care over the remainder of their lifetimes.

All persons in the hypothetical cohort progress through the decision tree from the point at which

they enter a jail or prison until their deaths. Persons with untreated syphilis are followed throughout the course of the disease, including latent infection without clinical manifestations, benign latency, infection with cardiovascular complications, and infection with central nervous system complications. The health outcome in the decision models is the number of undetected syphilis infections by stage of disease in inmates after they have passed through intake in the jail or prison. The model is used also to calculate the number of persons with syphilis at the time of intake into the jail or prison whose syphilis eventually would develop into late-stage clinical disease.

Key parameters

The probabilities used in the syphilis decision tree are in table 1. Probabilities include the prevalence of syphilis in jail and prison inmates at the time of intake. The base-case scenario uses a prevalence of 8 percent (primary, secondary, and early latent). Because this prevalence estimate is likely to vary in different jail and prison settings, this value was varied in sensitivity analyses.

The model also includes the probability of the stage of disease in infected persons and probabilities of progression to different stages of disease. The tree includes the probability of diagnosis and treatment at all stages of the disease during an individual's lifetime, regardless of incarceration status. The program option that includes routine universal screening considers the sensitivity and specificity of STAT RPR (jail model only), RPR, and confirmatory FTA–ABS testing for detecting the following three stages of infection: primary, secondary, and latent.

One-way sensitivity analyses, in which the value of only one parameter at a time was changed, were performed on all variables in the model to determine the effect of small changes in parameter estimates on the cost-effectiveness of the two program options. Sensitivity analyses on the prevalence of syphilis infection in the hypothetical cohort of inmates were reported to allow the results to be generalized to jail and prison settings with different prevalence levels.

Key costs

Table 2 shows the costs (in 1996 dollars) used in the syphilis decision analyses. Future costs are discounted to present value at an annual rate of 3 percent. The models include the cost of routine universal screening with the STAT RPR and RPR tests; confirmation testing of positive RPRs with FTA–ABS tests; and treatment of individuals who test positive with STAT RPR (jail model) or RPR and FTA–ABS (prison model). Treatment costs include all components of treatment specific to each stage of infection of persons with primary, secondary, early latent, late latent, late benign, cardiovascular, and neurosyphilis. Because the models do not consider pregnant women or transmission to sex partners, costs associated with congenital syphilis and new syphilis cases in sex partners are not included. Also, costs of HIV infections acquired as a result of the increased susceptibility to HIV caused by syphilis are not included.

Treatment costs were estimated by constructing a clinical treatment plan for each stage of the disease and then applying costs to each health care service utilized. Costs for health care services are based on the Medicare reimbursement rate reported in the *Physicians' Fee and Coding Guide* published by HealthCare Consultants of America.[21]

Results

Syphilis—males and females. Tables 3 and 4 show the results of routinely screening all male and female inmates upon intake in jails and prisons. At an 8-percent prevalence rate of syphilis in the hypothetical cohort of 10,000 inmates, a routine universal screening program would detect and treat 774 inmates with syphilis, and 542 with infectious primary or secondary disease. Of the 774 inmates whose syphilis was detected by the screening program, 42 would have eventually developed late-stage clinical disease; 4 persons would have developed cardiovascular syphilis and 3 persons would have developed neurosyphilis (not shown). With the routine universal screening program, 26 inmates would pass through intake with undetected

Table 1. Parameter Estimates for Syphilis Screening Decision Tree			
Variable	**Estimate (%)**	**Range (%)**	**References**
Prevalence	8	0.05–25	
Stage of Infection on Intake			
Primary infection	30		Assumption[a]
Secondary infection	40		Assumption
Latent infection	30		Assumption
Risk of Progression of Latent Syphilis Without Treatment			
No progression (late latent)	72	50–100	Clark and Danbolt 1964
CV, late benign	21.5	15–30	Clark and Danbolt 1964
Neurosyphilis	6.5	2–10	Clark and Danbolt 1964
Infected Individual Seeks Treatment			
Primary infection	10	5–15	Assumption
Secondary infection	60	40–80	Assumption
Late latent infection	10	5–15	Assumption
Late benign, CV, CNS infection	100	80–100	Assumption
Inadvertent Treatment	70	60–80	Assumption
Treatment Success	100	80–100	Assumption
Sensitivity of STAT RPR[b]	94	93–97	Blank et al. 1997
Specificity of STAT RPR	88	86–90	Blank et al. 1997
Sensitivity of RPR			
Primary infection	86	84–88	Larsen et al. 1995
Secondary infection	100	98–100	Larsen et al. 1995
Latent infection	98	96–100	Larsen et al. 1995
Specificity of RPR	98	96–100	Larsen et al. 1995
Sensitivity of FTA			
Primary infection	84	82–86	Larsen et al. 1995
Secondary infection	100	98–100	Larsen et al. 1995
Latent infection	100	98–100	Larsen et al. 1995
Specificity of FTA	97	95–99	Larsen et al. 1995

[a] The assumptions in this table are based on personal communication with Vicki Pope, CDC.
[b] Sensitivity and specificity of tests do not vary by disease stage in this model.
Sources: Blank, S., D.D. McDonnell, S.R. Rubin, J.J. Neal, M.W. Brome, M.B. Masterson, and J.R. Greenspan, "New Approaches to Syphilis Control: Finding Opportunities for Syphilis Treatment and Congenital Syphilis Prevention in a Women's Correctional Setting," *Sexually Transmitted Diseases* 24(1997): 218–228; Clark, E.G., and N. Danbolt, "The Oslo Study of the Natural Course of Untreated Syphilis: An Epidemiologic Investigation Based on a Restudy of the Boeck-Brusgaard Material," *Medical Clinic North America* 48(1964): 613; Larsen, S.A., B.M. Steiner, and A.H. Rudolph, "Laboratory Diagnosis and Interpretation of Tests for Syphilis," *Clinical Microbiology Review* 8(1995); 1–21.

Table 2. Undiscounted Costs of Syphilis Screening and Treatment of Initial Infection and Complications	
Cost	**Estimate[a] (1996 $)**
Screening Program Costs	
Blood draw	$10.00
STAT RPR	3.00
RPR screening test	3.00
FTA confirmation test	4.50
Treatment (at intake)	33.00
Disease Costs by Stage of Infection[b]	
Primary and secondary stage	331.00
Late latent stage	422.00
Late benign stage	1,491.00
Cardiovascular syphilis	
Initial treatment—no surgery	3,900.00
Initial treatment—surgery	32,641.00
Annual followup	740.00
Neurosyphilis	
Initial treatment	8,899.00
Meningovascular complications	213,615.00
General paresis	159,470.00

[a] All cost estimates were varied 20% higher and lower in sensitivity analyses.
[b] Costs are for diagnosis and treatment outside the jail or prison setting.

Table 3. Number of Syphilis Infections After Intake Into Jails and Prisons With and Without Routine Universal Screening			
	No-Screening Option	**Routine Universal Screening Option**	**Infections Treated***
Primary syphilis infections	240	8	232
Secondary syphilis infections	320	10	310
Latent syphilis infections	240	8	232
Total	**800**	**26**	**774**

* Infections Treated = No-Screening Option – Routine Universal Screening Option.

Table 4. Costs of Screening and No-Screening Options for Syphilis in Prisons and Jails			
Cost	**No-Screening Option**	**Routine Universal Screening Option**	**Additional Cost/Savings of Routine Universal Screening Option***
Prisons			
Program cost	$0	$160,648	$160,648
Disease costs	1,975,087	140,065	–1,835,022*
Total costs	**1,975,087**	**300,713**	**–1,674,374**
Jails			
Program cost	$0	$196,600	$196,600
Disease costs	1,975,087	140,065	–1,835,022
Total costs	**1,975,087**	**336,665**	**–1,638,422**

* Negative value indicates savings.

syphilis, 18 of whom would have primary or secondary infections. Only 1 person whose syphilis was not detected on intake into the jail or prison would eventually develop late-stage clinical disease, with a 16-percent chance of developing either cardiovascular or neurosyphilis.

In the prison setting with no routine universal screening program, the lifetime cost of syphilis in the hypothetical cohort would approach $2 million (see table 4). Implementing a routine universal screening program that included treatment of persons identified as infected would cost $160,648. Disease costs associated with routine universal screening would be only $140,065. Thus, a routine universal screening program might save almost $1.7 million compared to the no-screening option (see table 4).

In jail settings, the cost of a routine universal screening program might be slightly higher because of overtreatment associated with the low specificity (88 percent) of the STAT RPR test. The cost of the routine universal screening option would be $196,600. Approximately 1,104 inmates who tested positive for syphilis but who were not infected would receive treatment for an added cost of $30,360. Savings associated with the jail program also would approach $1.7 million (see table 4).

Sensitivity analyses indicate that the finding that routine universal screening saves costs is stable under reasonable variations in parameter estimates. Results indicate that routine universal screening programs would save money in both jails and prisons in which the prevalence of syphilis in new inmates was greater than 1 percent. In jails, where release before treatment can result from delayed diagnosis, overtreatment costs would be offset by savings in disease costs if immediate treatment based on a positive STAT RPR prevented at least five inmates with syphilis from being released untreated and lost to followup.

Discussion. Routine universal screening for syphilis upon intake in jails and prisons is a cost-saving strategy for identifying and treating disease in high-risk populations. Although such programs require initial investments, the savings in downstream medical costs of syphilis should more than pay for the program. Although the cost-effectiveness of routine universal screening only for costs borne by government was not analyzed, such an analysis would likely have a similar result. This population may have limited access to private health insurance, therefore, government programs will pay much of the downstream medical costs.

The syphilis analyses have several limitations. First, the analysis did not account for the transmission of syphilis during pregnancy. Thus, the costs and health outcomes associated with spontaneous abortions, stillbirths, neonatal mortality, neonatal treatment, and long-term complications of congenital syphilis were not included. These costs and health consequences can be significant. In a 1993 study of female inmates in the New York City Jail, of the 727 women examined upon admission, more than 2 percent were pregnant and had syphilis.[22] Infants born with congenital syphilis remain hospitalized 7–9 days longer than uninfected infants, at an additional cost of $5,000–$9,000.[23] If costs associated with congenital syphilis had been included, the routine universal screening option would have saved even more money.

The analysis also did not include the cost of HIV infections attributable to syphilis in inmates. Identifying and treating syphilis in inmates in jails and prisons before release has the potential to prevent transmission of new HIV infections. Using the model developed by Chesson and colleagues,[24] it was estimated that the jail and prison screening programs modeled in this paper also would prevent 10–11 new HIV infections attributable to syphilis. The lifetime medical cost of HIV is an estimated $195,188 per infected person.[25] Including these costs would increase the cost savings of a routine universal screening program.

Finally, the model did not include transmission of syphilis to sex partners of members of the hypothetical cohort. The cost-saving nature of a routine universal screening program results overwhelmingly from medical costs prevented

by detecting infection before it progresses to another stage or late-stage disease. The benefits of interrupting transmission in the community have not been captured. Public health benefits of a routine screening program are likely to be far greater than those projected in this study.

Gonorrhea and Chlamydia

The same decision tree model was used for both gonorrhea and chlamydia because the only significant difference between these diseases for purposes of this study is the treatment regimen. The model was applied to men and women separately because men and women experience different health outcomes and sequelae. Undiagnosed or untreated gonorrhea and chlamydia may lead to epididymitis in men and pelvic inflammatory disease (PID) in women. Therefore, separate gonorrhea and chlamydia models were devised for men and women.

Each model considers two program options: (1) universal, routine screening at intake followed by treatment of inmates who test positive and (2) no routine screening, but an offer of presumptive treatment to inmates who request it because of symptoms. Each model follows individuals in the cohort as they are diagnosed and treated before release or as they progress undiagnosed or untreated for the disease. The models are used to estimate the difference between a routine screening program and a program in which inmates are treated presumptively for an STD. The difference between the programs is expressed in terms of total and incremental (moving from presumptive treatment to routine screening) health care costs and two health outcomes: (1) the number of cases of sequelae and (2) the number of inmates with cases of undiagnosed or uncured gonorrhea or chlamydia. The first health outcome shows the benefit of the routine screening program in terms of the number of cases of sequelae prevented (i.e., the difference between the number of resulting cases of sequelae with a presumptive treatment program and a routine screening program). The second health outcome shows the benefits of a routine screening program in terms of the number of gonorrhea and chlamydia infections detected.

Decision tree models

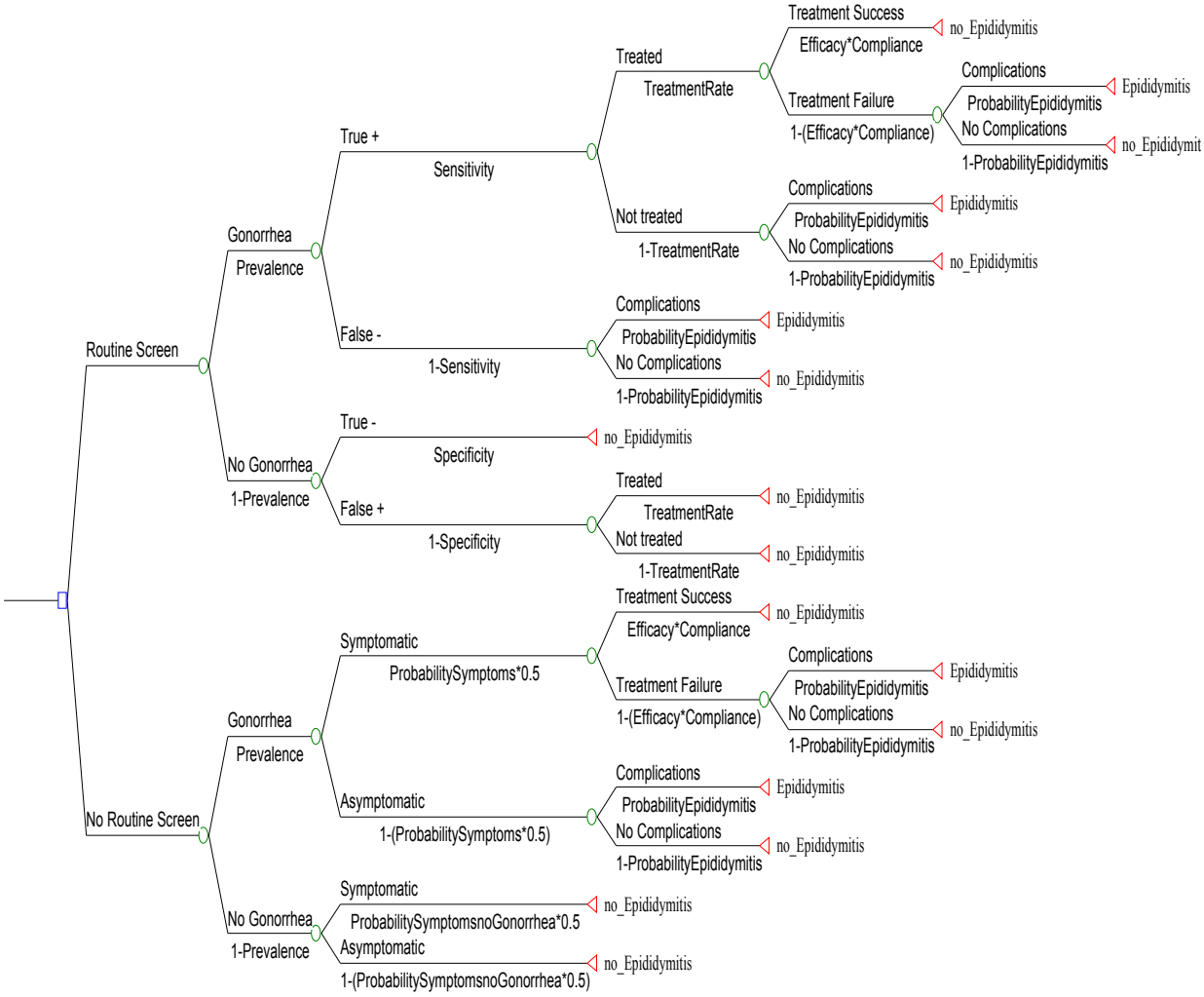
Figures 2 and 3 show the decision models used to examine gonorrhea screening in men and women. Figures 4 and 5 show the models used to examine chlamydia screening in men and women. The structure of each model is described before the data chosen for each probability and cost value is discussed. This is because even though the same model structure is used to describe the programs in prisons and jails, the environments in these two types of corrections facilities vary, causing different probabilities to be used.

Data on the probabilities of events and the costs of the STD tests, treatment, and sequelae were collected from a variety of sources, including published studies, working papers, and expert opinion. All costs are expressed in 1996 dollars. Costs that were collected from reports before or after 1996 were adjusted using the Medical Component of the Consumer Price Index.[26] To check the robustness of the assumptions, sensitivity analyses were conducted to assess the effect of varying values of uncertain parameters on the results in all of the models.

Decision tree models—men. Figures 2 and 4 show the decision trees for screening male inmates in prisons and jails for gonorrhea and chlamydia. There are two program options: (1) routine screening on intake or (2) no routine screening on intake, instead presumptively treating based on symptoms. The tree is further divided between those who are and those who are not truly infected with gonorrhea or chlamydia to consider all of the different outcomes for each of these groups. Those who are truly infected may or may not display symptoms, but with the first program option, all inmates will be screened.

Starting with the routine-screening-on-intake program option, the results of a test of truly infected men may be either positive (true positive) or negative (false negative). If the test results are positive and those tested receive treatment, the

Figure 2. Decision Analysis Tree for Examining the Cost-Effectiveness of Screening Men for Gonorrhea

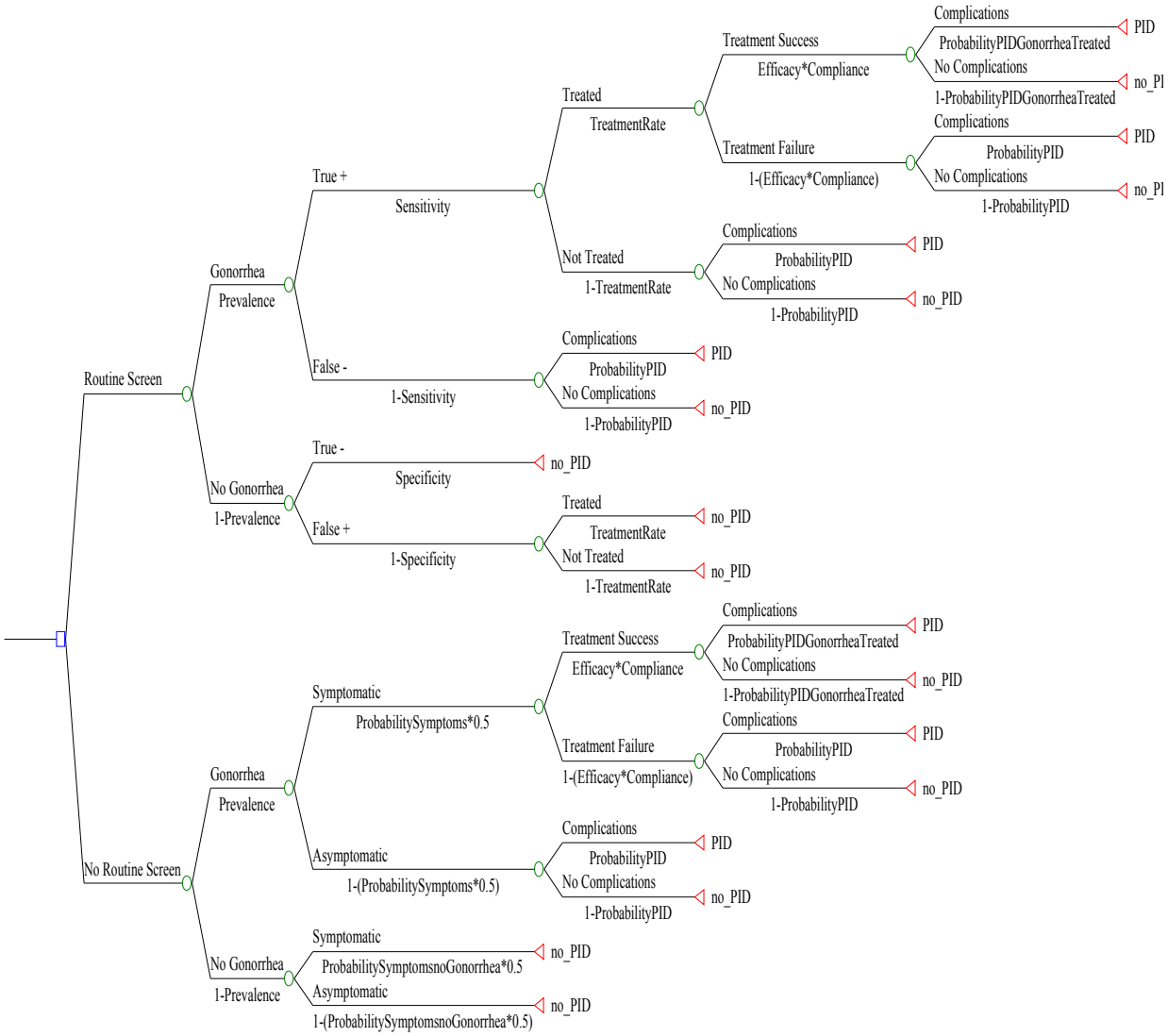


treatment either does or does not treat the infection. If the treatment fails to cure the infection, men may develop epididymitis, a sequela of both gonorrhea and chlamydia. If a man has a positive test result and is not treated for some reason (e.g., he is no longer incarcerated when test results are received), then it is assumed that he has a probability of developing epididymitis. If men are truly infected, but their test results are negative, then they are not treated and may develop epididymitis.

Truly uninfected men also will be tested with a routine screening on intake. If the test results are negative (true negative), then there is no more interaction between the health staff and the inmates. If the test results are positive (false positive) and the inmates are still incarcerated at the time of test results, then they will be treated. Since these men are truly uninfected, there is no chance of developing sequelae of gonorrhea or chlamydia.

In the absence of a routine screening program, treatment is administered only if inmates have symptoms and request it. It is assumed that one-half of symptomatic inmates will request treatment, but that inmates will not request treatment in the absence of symptoms. The truly infected may be either symptomatic or asymptomatic. The truly infected who are symptomatic and who request treatment are treated, and the treatment is successful or not successful. If the treatment fails, there is a possibility of developing sequelae of

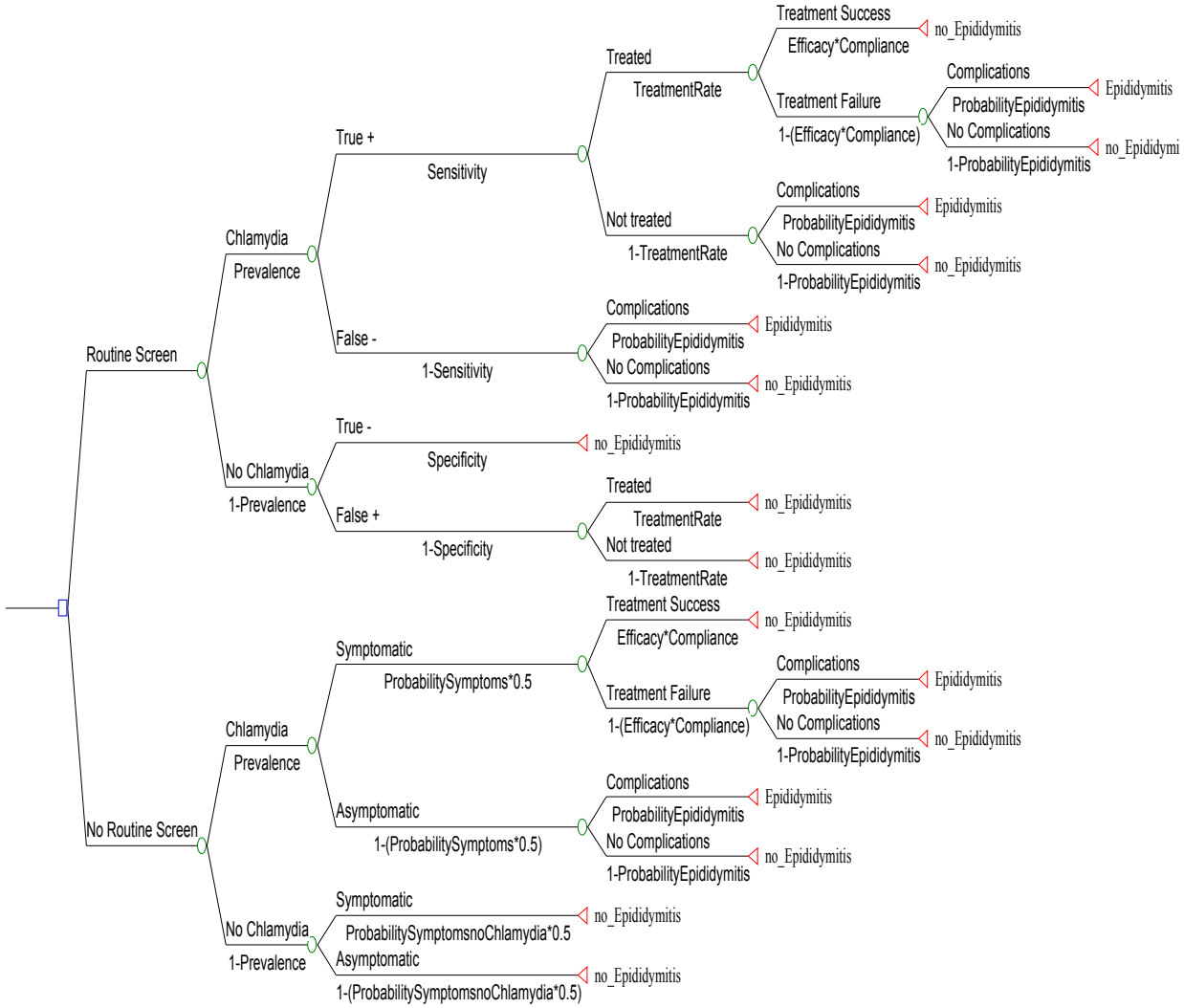
Figure 3. Decision Analysis Tree for Examining the Cost-Effectiveness of Screening Women for Gonorrhea



gonorrhea or chlamydia. The truly infected who are asymptomatic are not tested or treated and may or may not develop epididymitis. The truly uninfected inmates may have nonspecific symptoms that cause them to present for treatment for gonorrhea or chlamydia. They may present painful urination in women and men, and vaginal discharge in women, which may be nonspecific and indicate infections other than gonorrhea and chlamydia. Because these inmates would be symptomatic, it is assumed that they would be treated presumptively. Since they are truly uninfected, they will not develop sequelae. The uninfected who do not have symptoms are assumed never to present or request treatment.

Decision tree models—women. Figures 3 and 5 show the decision trees for gonorrhea and chlamydia applied to female inmates. These decision trees are similar to those applied to male inmates except for two differences. First, undiagnosed, untreated, or undertreated gonorrhea and chlamydia can lead to PID in women. Second, for men, it is assumed that if treatment is provided and successful, then men are cured of gonorrhea or chlamydia and have no chance of developing

Figure 4. Decision Analysis Tree for Examining the Cost-Effectiveness of Screening Men for Chlamydia



sequelae. For women, there is a slight risk of developing PID even if they are treated successfully for gonorrhea or chlamydia, if treatment is provided after the infection has already ascended to the uterus and fallopian tubes.

Key parameters—men and women. Table 5 shows the data values used as probabilities in base case (column 2) and sensitivity (column 3) analyses. Based on previous site- and sex-specific studies, the models assume a 6-percent prevalence of symptomatic or asymptomatic gonorrhea infection and an 8-percent prevalence of symptomatic or asymptomatic chlamydia infection in both the male and female cohorts. These assumptions are varied in sensitivity analyses. Although many gonorrheal and chlamydial infections may be asymptomatic, when symptoms are present they are much more noticeable to men than to women. The models include probabilities associated with the development of sequelae for inmates that are undiagnosed and untreated (including treatment failures).

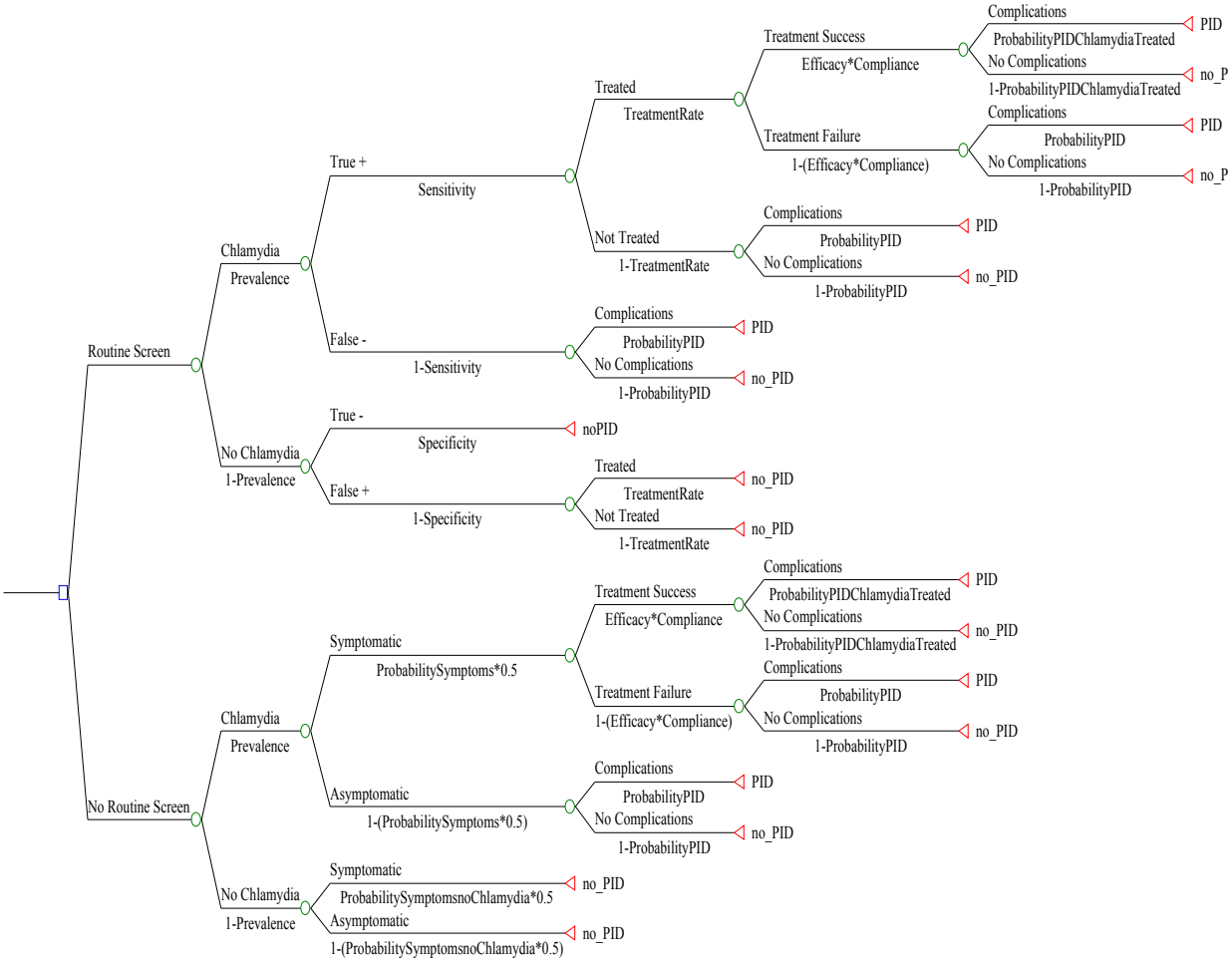
The routine screening program for gonorrhea and chlamydia includes the use of a nucleic acid amplification test, Ligase Chain Reaction (LCR).[27] LCR is an FDA-approved urine test that is highly sensitive and specific. An additional advantage is a noninvasive specimen collection process.

Table 5. Probabilities Used in Baseline and Sensitivity Analyses			
Parameter	**Probabilities***	**Probability Ranges***	**Sources**
Prevalence			
Gonorrhea	0.06	0.01–0.20	Glaser and Greifinger 1993
Chlamydia	0.08	0.01–0.30	Glaser and Greifinger 1993
Progression to Adverse Sequelae			
Epididymitis	0.02	0.01–0.04	Holmes et al. 1993; Washington, Johnson, and Sanders 1987
PID			
If disease is untreated			
Gonorrhea	0.15	0.10–0.20	Holmes et al. 1993
Chlamydia	0.15	0.10–0.40	Haddix, Hillis, and Kassler 1995
If disease is treated	0.06	0.01–0.10	
Probability of Symptoms			
Truly infected			
Gonorrhea	0.95 (M), 0.35 (W)	0.90–0.99 (M), 0.20–0.80 (W)	Holmes et al. 1993
Chlamydia	0.67 (M), 0.30 (W)	0.15–0.80 (M), 0.30–0.50 (W)	Washington, Johnson, and Sanders 1987
Uninfected			
Gonorrhea	0.07 (M), 0.07 (W)	0.10–1.00 (M), 0.10–1.00 (W)	Haddix, Hillis, and Kassler 1995
Chlamydia	0.07 (M), 0.07 (W)	0.10–1.00 (M), 0.10–1.00 (W)	Haddix, Hillis, and Kassler 1995
LCR Urine Test			
Sensitivity			
Gonorrhea	0.98 (M), 0.96 (W)	0.96–1.00 (M), 0.72–1.00 (W)	Koumans et al. 1998; Black 1997
Chlamydia	0.86 (M), 0.90 (W)	0.83–0.95 (M), 0.86–0.96 (W)	VanDoornum et al. 1995
Specificity			
Gonorrhea	0.99 (M), 0.99 (W)	0.98–1.00 (M), 0.96–1.00 (W)	Koumans et al. 1998
Chlamydia	0.98 (M), 0.99 (W)	0.97–1.00 (M), 0.99–1.00 (W)	VanDoornum et al. 1995
Treatment Before Release			
Jail	0.50	0.01–1.00	Glaser and Greifinger 1993
Prison	1.00	—	Glaser and Greifinger 1993
Treatment			
Efficacy			
Cefixime (GC)	0.97	0.94–1.00 (M), 0.50–1.00 (W)	Friedland et al. 1996
Azithromycin (CT)	0.97	0.93–0.98 (M), 0.97–1.00 (W)	Martin et al. 1992 Haddix, Hillis, and Kassler 1995
Compliance	1.00	0.50–1.00	Glaser and Greifinger 1993

* M = Men, W = Women

Sources: Glaser, J.B., and R.B. Greifinger, "Correctional Health Care: A Public Health Opportunity," *Annals of Internal Medicine* 118(2)(1993): 139–145; Holmes, M.D., S.M. Safyer, N.A. Bickell, S.H. Vermund, P.A. Hanff, and R.S. Phillips. "Chlamydial Cervical Infection in Jailed Women," *American Journal of Public Health* 83(4)(1993): 551–55; Washington, A.E., R.E. Johnson, and L.L. Sanders, "*Chlamydia trachomatis* Infections in the United States: What Are They Costing Us?" *Journal of the American Medical Association* 257(15)(1987): 2070–2072; Haddix, A.C., S.D. Hillis, and W.J. Kassler, "The Cost-Effectiveness of Azithromycin for *Chlamydia trachomatis* Infections in Women," *Sexually Transmitted Diseases* 22(1995): 274–280; Koumans, E.H., R.E. Johnson, J.S. Knapp, and M.E. St. Louis, "Laboratory Screening for *Neisseria gonorrhoeae* by Recently Introduced Non-Culture Tests: A Performance Review With Clinical and Public Health Considerations," *Clinical Infectious Diseases* 27(1998): 1171–1180; Van Doornum, G.J.J., M. Buimer, M. Prins, C.J.M. Henquet, R.A. Coutinho, P.K. Plier, S. Tomazic-Allen, H. Hu, and H. Lee, "Detection of *Chlamydia trachomatis* Infection in Urine Samples From Men and Women by Ligase Chain Reaction," *Journal of Clinical Microbiology* 33(1995): 2042–2047; Friedland, L.R., R.M. Kulick, F.M. Biro, and A. Patterson, "Cost-Effectiveness Decision Analysis of Intramuscular Ceftriaxone Versus Oral Cefixime in Adolescents With Gonococcal Cervicitis," *Annals of Emergency Medicine* 27(1996): 299–304; Martin, D.H., T.F. Mroczkowski, Z.A. Dalu, J. McCarty, R.B. Jones, S.J. Hopkins, and R.B. Johnson, "A Controlled Trial of a Single Dose of Azithromycin for the Treatment of Chlamydial Urethritis and Cervicitis," *New England Journal of Medicine* 327(13)(1992): 921–925.

Figure 5. Decision Analysis Tree for Examining the Cost-Effectiveness of Screening Women for Chlamydia



The substantially shorter sentences in jail settings may have an important effect on the effectiveness of routine STD screening upon intake. The turnaround for test results is typically longer than 48 hours, but more than one-half of jail inmates are released within 48 hours of intake. Given these constraints, it was assumed that jail inmates who tested positive upon intake would be present in the corrections facility for test results and treatment less than 50 percent of the time, whereas those in prisons would be in the correctional facility 100 percent of the time.

The model includes also the efficacy and compliance associated with specific treatments for gonorrhea and chlamydia. Following the 1998 CDC STD Treatment Guidelines, the use of a single-dose oral treatment regimen of cefixime for gonorrhea and a single-dose oral treatment regimen of azithromycin for chlamydia to ensure full compliance was assumed. Dispensing single-dose treatments may be considered safer and more feasible than multiple-dose regimens in jails and prisons.

Key costs—men and women

Table 6 shows the costs used in base case (column 2) and sensitivity (column 3) analyses. All costs are valued in 1996 dollars. Costs and benefits that would be incurred after the first year are discounted at an annual rate of 3 percent. The costs of gonorrhea and chlamydia urine testing, the treatment of cases diagnosed at intake, and the lifetime costs of disease not detected upon intake or treated during a late stage of disease have been included.

Table 6. Costs Used in Baseline and Sensitivity Analyses			
Component	**Cost per Inmate***	**Cost Ranges***	**Sources**
Program Costs (public sector prices)			
Urine test	$8.18	$5.00–15.00	Walsh 1998
Cefixime (Gonorrhea)	5.45	2.00–10.00	Friedland et al. 1996
Azithromycin (Chlamydia)	9.50	5.00–20.00	Haddix, Hillis, and Kassler 1995
Lifetime Costs of Sequelae			
Epididymitis	527.00	300–1,000	Washington, Johnson, and Sanders 1987
Pelvic inflammatory disease (PID)	1,430.00	1,100–5,500	Rein et al. 2000

* Valued in 1996 dollars

Sources: Walsh, C., "Model for Resource Allocation to Prevent Pelvic Inflammatory Disease Due to Infection with *Chlamydia trachomatis,*" Ph.D. diss., University of North Carolina, Chapel Hill, 1998; Friedland, L.R., R.M. Kulick, F.M. Biro, and A. Patterson, "Cost-Effectiveness Decision Analysis of Intramuscular Ceftriaxone Versus Oral Cefixime in Adolescents With Gonococcal Cervicitis," *Annals of Emergency Medicine* 27(1996): 299–304; Haddix, A.C., S.D. Hillis, and W.J. Kassler, "The Cost-Effectiveness of Azithromycin for *Chlamydia trachomatis* Infections in Women," *Sexually Transmitted Diseases* 22(1995): 274–280; Washington, A.E., R.E. Johnson, and L.L. Sanders, "*Chlamydia trachomatis* Infections in the United States: What Are They Costing Us?" *Journal of the American Medical Association* 257(15)(1987): 2070–2072; Rein, D., W. Kassler, K. Irwin, and L. Rabiee, "Direct Medical Cost of Pelvic Inflammatory Disease and its Sequelae: Decreasing, but Still Substantial," *Obstetrics and Gynecology* 95(2000): 397–402.

The program costs include testing and treatment costs. In particular, the testing costs include costs of the LCR urine test materials and labor for processing these tests.[28]

The expected lifetime costs of a case of epididymitis[29] and a case of PID[30] were derived from the literature. The cost of PID includes the direct medical costs of PID and three of its most common sequelae: chronic pelvic pain, ectopic pregnancy and tubal-factor infertility. Because of the controversy over the representativeness of medical claims data on which Rein and colleagues' estimate is based, the estimate for the baseline amount for PID was increased by 30 percent.

Results

Gonorrhea—men

Table 7 shows the results of routinely screening male inmates at intake for gonorrhea. For a hypothetical cohort of 10,000 male prison inmates with a prevalence of 6 percent, a routine screening program would prevent 5 cases of epididymitis and detect 296 cases of undiagnosed or untreated gonorrhea. A routine screening program for men in prisons and jails would not be cost saving in terms of cases of epididymitis averted. An important concern with gonorrhea and chlamydia infections in men is ensuring treatment of men in order to prevent transmission to their sex partners, especially female sex partners who experience more serious and costly sequelae than men. Therefore, the most important outcome among men is the number of untreated infectious gonorrhea cases that may be detected by routinely screening on intake.

This program would detect a substantial number of untreated infectious cases of gonorrhea and perhaps decrease rates of transmission to sex partners. It would cost approximately $267 to detect a case of gonorrhea. This is not cost saving but may be considered cost effective.

A routine screening program costs more in jails because the health care system may invest substantially in testing but may not be able to treat all detected cases of gonorrhea owing to the high rate and quick turnover of the inmates. Therefore, the full benefits of screening may not be realized.

Table 7. Cost-Effectiveness of a Program to Screen Men Routinely for Gonorrhea, by Setting			
	Total Costs	**Number of Cases of Epididymitis Averted**	**Number of Cases of Untreated Infectious Gonorrhea Detected**
Prisons			
Additional costs of routine screening on intake*	$78,900	—	—
Number of cases averted/detected by routine screening on intake	—	5	296
Net cost per case averted/detected	**—**	**$15,780**	**$267**
Jails			
Additional costs of routine screening on intake*	$80,100	—	—
Number of cases averted/detected by routine screening on intake	—	0.19	10
Net cost per case averted/detected	**—**	**$421,579**	**$8,010**

* As compared with presumptive treatment strategy option.

Table 8. Cost-Effectiveness of a Program to Screen Women Routinely for Gonorrhea, by Setting			
	Total Costs	**Number of Cases of Pelvic Inflammatory Disease (PID) Averted**	**Number of Cases of Untreated Infectious Gonorrhea Detected**
Prisons			
Additional costs of routine screening on intake*	$24,000	—	—
Number of cases averted/detected by routine screening on intake	—	41	458
Net cost per case averted/detected	**—**	**$585**	**$52**
Jails			
Additional costs of routine screening on intake*	$58,200	—	—
Number of cases averted/detected by routine screening on intake	—	16	178
Net cost per case averted/detected	**—**	**$3,638**	**$327**

* As compared with presumptive treatment strategy option.

Gonorrhea—women

Routinely screening women for gonorrhea on intake into prisons and jails is not cost saving in terms of detecting cases of gonorrhea or preventing cases of PID (table 8). A routine screening program, however, detects many cases of gonorrhea and, in turn, averts sequelae. This program may be considered cost effective when considering that it costs the health care system approximately $585 to prevent a case of PID in prison and $3,638 to prevent a case of PID in jail.

Sensitivity analyses

One-way sensitivity analyses were conducted on all parameters in the prison and jail gonorrhea screening models to determine which parameters of the model most influenced the final results. Sensitivity analyses are conducted to determine whether the model results change if uncertain parameter values are changed. One-way sensitivity analyses include varying one parameter value in the decision trees at a time. In prisons and jails, it did not save money to screen routinely a hypothetical cohort of 10,000 male inmates for gonorrhea, in terms of the number of cases of epididymitis or the number of untreated infectious cases of gonorrhea detected, regardless of which parameters were varied.

For a hypothetical cohort of 10,000 women, the models were sensitive to the following variables (by setting): prevalence of gonorrhea (prisons and jails), probability of progression to PID whether a woman was or was not treated for gonorrhea (in prison), lifetime direct medical cost of a case of PID (prison), and the cost of the testing materials and labor processing time (prison). It would save money to screen female inmates routinely for gonorrhea on intake if prevalence rates were at least 22 percent in jails (figure 6) and at least 8 percent in prisons (figure 7). In addition, a two-way sensitivity analysis (an analysis that involves changing two parameter values in the decision trees simultaneously) of gonorrhea prevalence and treatment rates in the jail setting shows that it would save money to implement a routine screening program if the prevalence rate were at least 8 percent and the treatment rate is 100 percent (not shown). As the treatment rate declines, the prevalence rate must be higher in order for the routine screening program to save money. If the treatment rate is about 40 percent, then for a routine screening program to save money, the prevalence rate must be at least 30 percent.

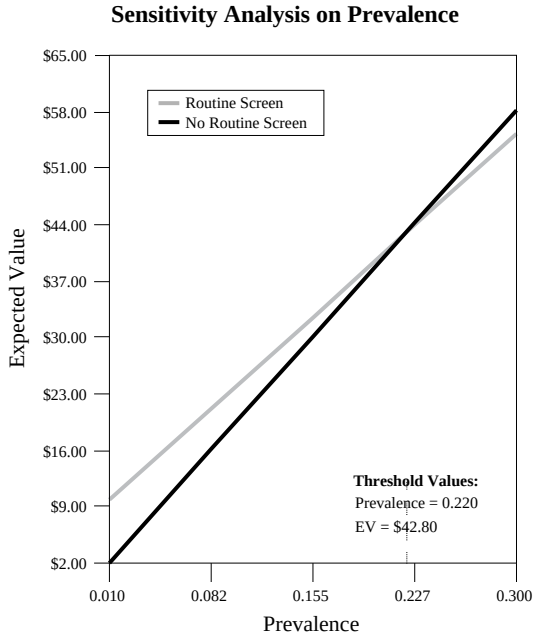
If the probability of progression to PID for women not treated for gonorrhea is at least 19 percent, instead of 15 percent as in the baseline model, then routine screening in prison will save money. If women are treated for gonorrhea, a routine screening program in prison will save money as long as the probability of progression to PID is less than 2.5 percent.

If the lifetime direct medical cost of a case of PID is at least $2,000, then a routine screening program for gonorrhea in prison will save money. If the cost of a case of PID exceeds $5,000, then a routine screening program in jail will also save money. If the cost of the test materials and labor time to conduct a single test does not exceed $6, then a routine screening program in prison will save money.

Chlamydia—men

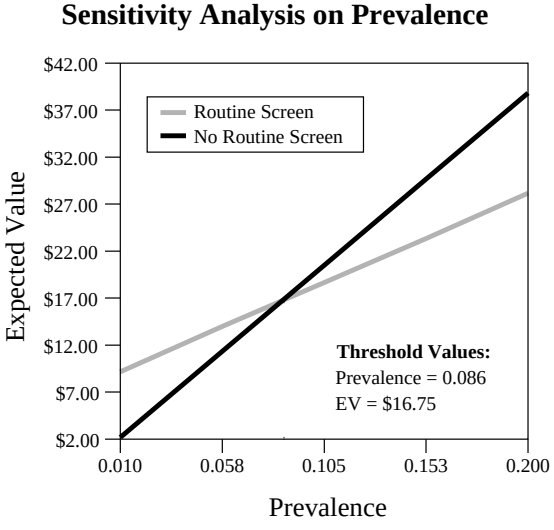
Table 9 shows that a program of routinely screening for chlamydia among men on intake to prisons and jails does not save money in terms of cases of untreated, infectious chlamydia or epididymitis. This program, however, would detect a substantial number of undiagnosed cases of chlamydia and perhaps decrease transmission from men to women. It would cost the health care system approximately $198 in the prison setting and almost $1,100 in the jail setting to detect a case of uncured chlamydia. It may be considered cost effective.

Figure 6. Sensitivity Analysis: Variations in Expected Value with Variations in Prevalence of Gonorrhea in Women—Jail Setting



* Expected Value = Program Cost per Person

Figure 7. Sensitivity Analysis: Variations in Expected Value with Variations in Prevalence of Gonorrhea in Women—Prison Setting



* Expected Value = Program Cost per Person

Table 9. Cost-Effectiveness of a Program To Screen Men Routinely for Chlamydia, by Setting			
	Total Costs	Number of Cases of Epididymitis Averted	Number of Cases of Untreated Infectious Chlamydia Detected
Prisons			
Additional costs of routine screening on intake*	$80,300	—	—
Number of cases averted/ detected by routine screening on intake	—	8	405
Net cost per case averted/ detected	—	**$10,038**	**$198**
Jails			
Additional costs of routine screening on intake*	$79,600	—	—
Number of cases averted/ detected by routine screening on intake	—	2	73
Net cost per case averted/ detected	—	**$39,800**	**$1,090**

* As compared with presumptive treatment strategy option.

Chlamydia—women

For a hypothetical cohort of 10,000 women with a prevalence rate of 9 percent, a routine-screening-on-intake program in prison would cost approximately $10,000 more than a presumptive treatment program (table 10). This program, however, would result in a substantially lower number of cases of PID and untreated or undiagnosed cases of chlamydia. It would cost the health care system only $198 in the prison setting to prevent a case of PID and $18 to detect a case of untreated infectious chlamydia.

Because the rate of treatment before release from jails is lower than in prisons, a routine screening program for women in jails does not save money. The cost per case of PID prevented is approximately $2,450, which may be considered cost effective.

Sensitivity analyses

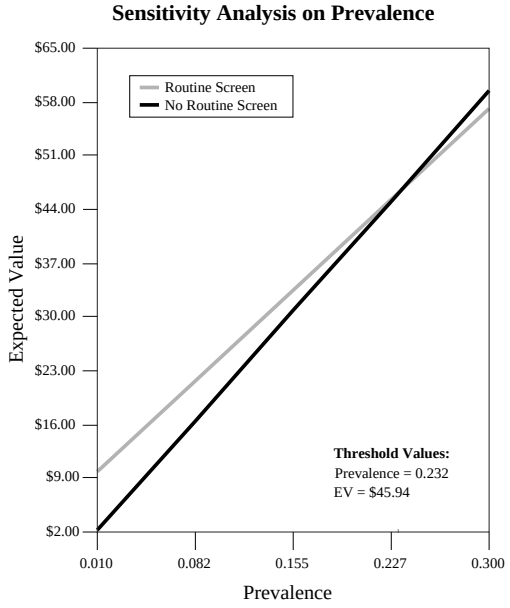
One-way sensitivity analyses were conducted on all parameters in the prison and jail chlamydia screening models. In prisons and jails, it does not save money to screen a hypothetical cohort of 10,000 male inmates routinely for chlamydia, in terms of the number of cases of epididymitis averted or the number of untreated, infectious cases of chlamydia detected, regardless of which parameters are varied.

For a hypothetical cohort of 10,000 women, the models were sensitive to the following variables (by setting): prevalence of chlamydia (prison and jail), probability of progression to PID if treated (prison) or untreated for chlamydia (prison and jail), lifetime direct medical cost of a case of PID (prison and jail), and the cost of the testing materials and labor time (prison). It saves money to screen routinely for chlamydia on intake if prevalence rates are at least 23 percent in jails (figure 8) and about 9 percent in prisons (figure 9). A two-way sensitivity analysis of chlamydia prevalence and treatment rates in jails shows that it would save costs to implement a routine screening program if the prevalence rate were at least 9 percent and the treatment rate were 100 percent (not shown). As the treatment rate declines, the prevalence rate must be higher in order for the routine screening program to save costs. If the treatment rate is about 40 percent, the prevalence rate must be at least 30 percent for a routine screening program to save costs.

Table 10. Cost-Effectiveness of a Program To Screen Women Routinely for Chlamydia, by Setting			
	Total Costs	**Number of Cases of Pelvic Inflammatory Disease (PID) Averted**	**Number of Cases of Untreated Infectious Chlamydia Detected**
Prisons			
Additional costs of routine screening on intake*	$10,300	—	—
Number of cases averted/ detected by routine screening on intake	—	52	576
Net cost per case averted/ detected	**—**	**$198**	**$18**
Jails			
Additional costs of routine screening on intake*	$51,400	—	—
Number of cases averted/ detected by routine screening on intake	—	21	230
Net cost per case averted/ detected	**—**	**$2,448**	**$223**

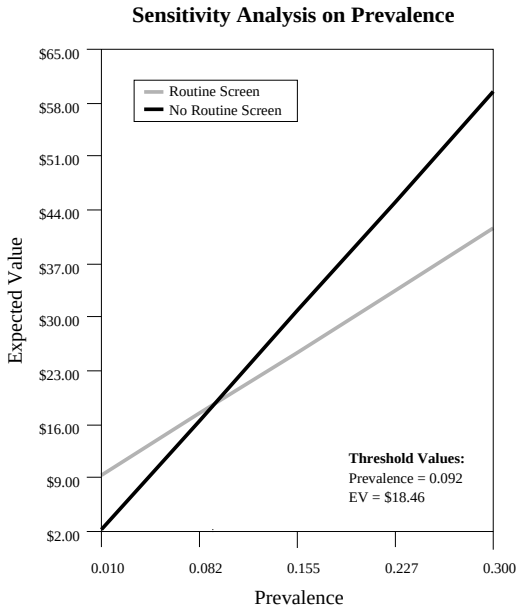
* As compared with presumptive treatment strategy option.

Figure 8. Sensitivity Analysis: Variations in Expected Value with Variations in Prevalence of Chlamydia in Women—Jail Setting



* Expected Value = Program Cost per Person

Figure 9. Sensitivity Analysis: Variations in Expected Value with Variations in Prevalence of Chlamydia in Women—Prison Setting



* Expected Value = Program Cost per Person

If the probability of progression to PID for those women not treated for chlamydia is at least 31 percent, instead of 15 percent as in the baseline model, then routine screening will save costs in jail. For the routine screening program to save costs in prison, the probability of progression to PID must be at least 16 percent, instead of 15 percent as in the baseline model. Conversely, a routine screening program will save money in prisons as long as the probability of progression to PID is less than 5 percent for women treated for chlamydia.

If the lifetime direct medical cost of a case of PID is at least $1,600, then a routine screening program for chlamydia will save money in prison. If the cost of a case of PID exceeds $3,900, then a routine screening program will save money in jail. If the cost of the test materials and labor time to process the test does not exceed $7.20, then a routine screening program will save money in prison.

Discussion—gonorrhea and chlamydia

The cost-effectiveness of routine screening for gonorrhea and chlamydia in jails and prisons, as examined using many and diverse data sources, had variable results. Screening is most cost effective in women with a high prevalence of disease and for whom high treatment rates before release can be achieved. Screening does not appear to be cost effective in preventing epididymitis in men, but the net costs of detecting infections in men are reasonable. Thus, screening in male populations may be considered a valid strategy for preventing transmission to women. In jail settings, screening programs should be designed to test as early as feasible after intake to enable treatment before release and to coordinate with local public health facilities to ensure treatment of inmates who require treatment after release.

The gonorrhea and chlamydia analyses have several limitations. The baseline estimates of averted costs or savings results are sizable underestimates. The benefits of routine screening on intake for each disease are understated because they exclude some specific direct medical costs that might be prevented as a result of a routine screening program. In particular, this model did not consider the potential role of gonorrhea and chlamydia infections in facilitating the transmission of HIV and the increased susceptibility to HIV. The model did not include morbidity and costs associated with the transmission of gonorrhea and chlamydia from index cases to secondary partners. This model also did not consider the issue of reinfection of an index patient by a partner who is infected and does not receive effective treatment. The costs of gonorrhea and chlamydia infections during pregnancy that lead to endometritis (infection of the uterine lining or endometrium), chorioamnionitis (infection of the fetal sac), or congenital infection of the infant that may cause serious eye and respiratory infections were not included. The benefits of preventing these costs, regardless of how minimal the costs may be, would favor implementing a routine screening program. If any of the averted costs mentioned above were included in the models, then the results would show the routine-screening-on-intake programs to be more cost effective and possibly cost saving, even at low to moderate prevalence rates.

Conversely, these models may have underestimated the program costs. In particular, none of the costs of counseling, partner elicitation, notification and referral, or recontacting inmates who are released before they get their test results were included. These costs were not considered because it may not be feasible in many jail settings to provide individual or group counseling or partner elicitation services during the short time many inmates are in jail. In addition, only the single-dose treatments for gonorrhea and chlamydia recommended by CDC were considered because these are readily administered in corrections settings (e.g., directly observed therapy). Use of slightly less expensive multiple-dose antibiotic regimens, if they could be administered in a way that would ensure reasonable adherence, may be an option in some facilities. Dual treatment for gonorrhea and chlamydia when only one such infection is detected on screening for a single disease also was not considered; this treatment approach may be cost effective in some settings.[31] Adverse reactions to cefixime and azithromycin were not considered because they have been found to be minimal.[32] Furthermore, the costs associated with urine-based screening may be lower than use of tests not based on urine testing, which require time of a health care provider and physical examination rooms to obtain a urethral specimen from a man or an endocervical specimen from a woman. Finally, program costs may be underestimated because treatment of asymptomatic persons who request treatment owing to sexual contact with an infected partner was not considered.

Second, the results presented here may not lend themselves to generalization. Key parameter values, such as prevalence data, may vary tremendously among facilities and geographic regions.

Third, separate models were estimated for each disease, ignoring the possibility that economies of scale could be achieved by screening for multiple diseases at once. For example, one urine sample may be collected to test for both gonorrhea and chlamydia. Therefore, the program test costs for each disease may be slightly lower than the estimates used in the models. This would change the results only slightly, however, since the only difference would be with the urine specimen collection materials (i.e., the time of the person who explains the purpose of the test and requests a urine sample and the container for the urine sample).

Finally, prisons and jails were treated as separate institutions. Realistically, many inmates in jail move to prisons later, but the hypothetical cohorts that were used did not consider double counting of inmates who move directly from jails to prisons.

Conclusion

Given the high prevalence of STDs among incarcerated populations and the cost-effectiveness of routine screening on intake for some STDs, corrections facilities provide an opportunity to test and treat people who are at high risk for STDs and who may have little access to care outside such institutions. All 3 diseases examined in this paper—syphilis, gonorrhea, and chlamydia—can be substantially reduced by jails and prisons employing STD screening on intake programs. Although the cost-saving nature of syphilis screening and the cost-effective nature of gonorrhea and chlamydia screening programs in some settings do not depend on the assumption that inmates transmit infection to sex partners, jail and prison screening programs have the potential to decrease STD transmission rates to inmates' sex partners and to the community at large through future generations of transmission. Routine screening for syphilis among men and women in both prisons and jails will ultimately result in financial savings by preventing expensive disease treatment. Routine screening for gonorrhea and chlamydia may not generate savings, but this approach is likely to be cost effective in both male and female populations in prisons and jails because of the serious nature of sequelae in women.

In jails, this study suggests that cost-effectiveness of STD screening can be improved and the disease burden lowered if infected inmates are identified and receive treatment before they are released. Because there is a quick turnaround in jails, efforts to test and treat as quickly as is practical, preferably within the first 24 hours of intake, may be both more effective and more cost effective. Collaborations among corrections facilities, community-based organizations, and health care providers in the public and private sectors are needed to facilitate the treatment of inmates who are released before the return of test results. If this can be accomplished, STD screening in jails and prisons can be a cost-effective strategy for reducing the overall burden of STDs in a community.

Notes

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