The Estimated Direct Medical Cost of Sexually Transmitted Diseases Among American Youth, 2000

CONTEXT: *Each year, millions of U.S. youth acquire sexually transmitted diseases (STDs). Estimates of the economic burden of STDs can help to quantify the impact of STDs on the nation's youth and on the payers of the cost of their medical care.*

METHODS: *We synthesized the existing literature on STD costs to estimate the lifetime medical cost per case of eight major STDs—HIV, human papillomavirus (HPV), genital herpes simplex virus type 2, hepatitis B, chlamydia, gonorrhea, trichomoniasis and syphilis. We then estimated the total burden of disease by multiplying these cost-per-case estimates by the approximate number of new cases of STDs acquired by youth aged 15–24.*

RESULTS: *The total estimated burden of the nine million new cases of these STDs that occurred among 15–24-year-olds in 2000 was $6.5 billion (in year 2000 dollars). Viral STDs accounted for 94% of the total burden ($6.2 billion), and nonviral STDs accounted for 6% of the total burden ($0.4 billion). HIV and HPV were by far the most costly STDs in terms of total estimated direct medical costs, accounting for 90% of the total burden ($5.9 billion).*

CONCLUSIONS: *The large number of infections acquired by persons aged 15–24 and the high cost per case of viral STDs, particularly HIV, create a substantial economic burden.*

Perspectives on Sexual and Reproductive Health, 2004, 36(1):11–19

By Harrell W. Chesson, John M. Blandford, Thomas L. Gift, Guoyu Tao and Kathleen L. Irwin

Harrell W. Chesson, John M. Blandford and Thomas L. Gift are economists, Guoyu Tao is a health services researcher and Kathleen L. Irwin is chief, Health Services Research and Evaluation Branch, Division of STD Prevention, Centers for Disease Control and Prevention, Atlanta.

Sexually transmitted diseases (STDs) have a considerable impact on the health of adolescents and young adults in the United States. In 2000, an estimated nine million cases of STDs occurred among persons aged 15–24.[1] In addition, STDs impose a substantial economic burden: The direct cost of STDs, including HIV, among all age-groups was estimated to be $9.3–15.5 billion in the United States in the mid-1990s, adjusted to year 2000 dollars.[2]

Assessing the economic burden of STDs is important for two main reasons. First, estimates of the cost of treating STDs among adolescents and young adults can help quantify the impact of STDs on the nation's youth and on those who pay for their medical care. In many cases, the payers are public programs; for example, one study of patients receiving care for HIV found that 47% were covered by Medicaid or Medicare, 33% had private insurance and 20% were uninsured.[3] Second, information on the medical expenses involved in treating STDs is needed for cost-effectiveness evaluations of prevention programs.

The costs associated with STDs can be divided into three main categories: direct, indirect and intangible.[4] Direct costs may be either medical or nonmedical. Direct medical costs of STDs generally refer to the expenses of treating acute STDs and the sequelae of untreated or inadequately treated acute STDs. Examples are the cost of clinician visits, hospitalization, diagnostic testing, drug treatments and therapeutic procedures. Other expenses associated with receiving medical treatment, such as the cost of transportation to and from medical services, are classified as direct nonmedical costs. Indirect costs of STDs generally refer to productivity losses (lost wages) attributable to STD-related illness. Intangible costs of STDs are related to the pain and suffering associated with STDs.

In this article, we present estimates of the direct medical costs of STDs, including HIV. We synthesize the existing literature to estimate the lifetime cost of STDs that were acquired in 2000 by Americans aged 15–24. To our knowledge, this is the first study of the economic burden of STDs among youth in the United States.

METHODS AND RESULTS

We focused on eight major STDs—HIV, human papillomavirus (HPV), genital herpes simplex virus type 2 (HSV-2), hepatitis B virus, chlamydia, gonorrhea, trichomoniasis and syphilis. Although we used common guidelines in estimating the cost of each of these STDs, our methods varied because of STD-specific differences in the probability and cost of long-term sequelae and in the availability of cost estimates.

All costs (including those obtained from previous studies) were adjusted for inflation to year 2000 dollars, using the medical care component of the Consumer Price Index for All Urban Consumers.[5] We examined the lifetime cost of new STD cases occurring among young Americans in 2000 (incidence costs) rather than the total cost in 2000 of existing cases of STDs and their sequelae among persons who were 15–24 years old at the time of infection (prevalence costs).

Estimates of incidence costs, based on information available in the literature, include the more immediate expenses of treating acute infections as well as the future costs of sequelae, such as pelvic inflammatory disease (PID), that might develop if an infection is not treated or if treatment is delayed or inappropriate. Following conventional methods of cost analysis, we used discounting to convert future costs into present value equivalents.[6] Future costs were discounted by 3% annually.[7]

When cost-per-case estimates were not available in the literature or could not be derived readily from published data, we describe our methods in more detail. We calculated sex-specific estimates when sex-specific data on cost per case were available or could be derived from existing data and when sex-specific costs differed substantially. Costs of neonatal complications attributable to STDs were not included in this analysis, because available cost data were limited and the inclusion of neonatal complications would have added complexity to the analysis.

To calculate the total direct medical cost for each STD, we multiplied the estimated cost per case by the estimated number of new cases that occurred in 2000 among persons aged 15–24 (Table 1).[8]

TABLE 1. Estimated lifetime cost per case, number of new cases among persons aged 15–24 and total direct medical costs of eight major STDs, United States, 2000

STD	Average lifetime cost per case* ($)	No. of new cases in 2000†	Total direct medical cost* ($)
Total	**na**	**9.1 million**	**6.5 billion**
HIV	199,800	15,000	3.0 billion
HPV	1,228 (women) 27 (men)	4.6 million	2.9 billion
Genital herpes	417 (women) 511 (men)	640,000	292.7 million
Hepatitis B	779	7,500	5.8 million
Chlamydia	244 (women) 20 (men)	1.5 million	248.4 million
Gonorrhea	266 (women) 53 (men)	431,000	77.0 million
Trichomoniasis	18	1.9 million	34.2 million
Syphilis	444	8,200	3.6 million

*In year 2000 dollars. †Excludes infections that were not sexually acquired. *Notes:* To calculate total costs, we assumed that men accounted for 50% of new HPV infections, 43% of new cases of genital herpes, 35% of new chlamydial infections and 41% of new cases of gonorrhea in this age-group (references 1, 2, 26 and 58). Totals may not match sum of individual items because of rounding. na=not applicable. *Source:* For incidence estimates, see reference 1.

HIV

Estimates of the discounted lifetime medical cost per new case of HIV were obtained from an existing study.[9] We applied the midpoint ($199,800) of the two estimates ($176,500 and $223,300) from that study's intermediate cost scenario, which included the following assumptions: Persons with HIV live for 16 years after becoming infected; each infected person is unaware of his or her infection in the first two years and begins viral load monitoring (but not treatment) in the third year; and in years 4–16 after infection, the person receives antiretroviral therapy, prophylaxis and treatment for opportunistic infections, as well as other medical care associated with progression to AIDS.

This estimated lifetime cost ($199,800) is consistent with the findings of a study that indicated that the average annual cost of care was approximately $20,900 for adults receiving care for HIV in 1998.[10] For example, when a 3% annual discount rate is applied, the cost of 12 years of care at $20,900 per year would be about $214,000 if care began immediately after infection, and would be about $174,000 if care began seven years after infection. This example is conservative, however, in assuming that only 12 years of care would be required; estimated life expectancy following HIV infection is 22–26 years for persons receiving antiretroviral treatment.[11] Thus, the estimated cost per case of HIV that we apply may be a lower-bound estimate of the true cost.

HPV

Our estimate of the total medical cost attributable to an HPV infection in youth focused on costs associated with cervical abnormalities in women and external anogenital warts in both men and women.* We first calculated the average cost of a new HPV infection in the general population, then made an adjustment based on the likelihood that the infection occurred by the age of 24.

• *Cervical abnormalities.* For adolescent and young adult women, we based the analysis on reported costs associated with diagnosis and management of cytologic abnormalities, preinvasive cervical neoplasia and invasive cervical cancer, and then retrospectively estimated the portion of the costs of these conditions attributable to HPV.†

Because published estimates of the cost per case were not available, we constructed a decision analysis model to calculate the expected cost of an abnormal cervical cytology finding in women. Potential management strategies following an abnormal Pap test result were based on the 2001 Bethesda guidelines, a set of evidence-based recommendations developed in a consensus conference sponsored by the American Society for Colposcopy and Cervical Pathology.[12] For all atypical Pap test findings, we attributed fully to HPV the costs associated with the diagnosis and treatment of histologically confirmed findings of cervical intraepithelial neoplasia grades 1–3 and of invasive cervical cancer (details available from the author).

We drew cost estimates for physician visits, follow-up Pap and HPV tests, colposcopy and treatment of cervical neoplasia from a previous study,[13] subtracting indirect costs

*Other medical costs that may be attributable to HPV infection—such as those associated with cancers of the anus, penis, vulva and vagina—are not included, because the proportion of these cancers that may be attributed to HPV has not been well established.

†We used this approach because of the high rate of clearance of incident HPV infection without treatment and the difficulty of predicting the likelihood of progression from incident infection to particular manifestations of disease (sources: Ho GY et al., Natural history of cervicovaginal papillomavirus infection in young women, *New England Journal of Medicine,* 1998, 338(7):423–428; Moscicki AB et al., The natural history of human papillomavirus infection as measured by repeated DNA testing in adolescent and young women, *Journal of Pediatrics,* 1998, 132(2):277–284; and Woodman CB et al., Natural history of cervical human papillomavirus infection in young women: a longitudinal cohort study, *Lancet,* 2001, 357(9271):1831–1836).

for patient time.[14] We assumed that cervical intraepithelial neoplasia occurs, on average, three years after initial HPV infection, and discounted treatment costs accordingly.[15] The decision analysis model estimated the discounted HPV-attributable cost per abnormal Pap test at $1,281. With the estimated 2.8 million abnormal Pap test results per year, direct HPV-attributable costs of recommended follow-up to abnormal cervical cytology and treatment of related neoplasia totaled $3.6 billion among women of all ages.

We projected 12,800 cases of invasive cervical cancer annually, distributed as 57.5% localized to the cervix, 34.0% with pelvic involvement and 8.5% with more distant spread.[16] When the costs of patient time were excluded, estimated invasive cervical cancer costs were $20,255 for localized disease, $21,678 for pelvic disease and $36,912 for distant disease.[17] We discounted the cost estimates based on the assumption that diagnosis of invasive cancer occurs, depending on stage, 21–25 years after initial HPV infection.[18] On the basis of these figures, the total discounted annual cost of invasive cervical cancer among all age-groups in the United States (i.e., including women aged 25 or older) was estimated at $146.4 million.

• *HPV and anogenital warts.* The average cost of treatment after a new diagnosis of external anogenital warts was $446 (details available from the author). Approximately 20–30% of episodes of anogenital warts resolve without treatment.[19] Because not all persons with such warts seek or require therapy to remove them, we adjusted our estimates according to the assumption that 25% of cases resolve without treatment. Estimates of annual incidence of anogenital warts vary widely, from 250,000–500,000 to 500,000–1,000,000.[20] To estimate the economic burden of HPV, we assumed an incidence of 500,000. Given these assumptions, the annual total direct cost associated with anogenital warts for all age-groups is $167.4 million.

• *Economic burden of infection acquired during youth.* To estimate the burden of HPV infection in adolescents and young adults, we adjusted total cost figures to reflect the proportion of persons infected between ages 15 and 24. The attributable total costs of HPV infection among women were adjusted to reflect the results of a model of the natural history of HPV infection and progression, which found that 74% of incident cervical HPV infections occur among women in this age-group.[21] We assumed that the cumulative incidence of HPV infection was comparable among young men[22] and assigned the economic burden of treatment for anogenital warts accordingly.

This adjustment implies that costs attributable to HPV infection in youth include $2.7 billion for the follow-up of abnormal Pap results and treatment of cervical neoplasia, $108.3 million for direct medical costs associated with invasive cervical cancer and $123.9 million for the treatment of external anogenital warts. The total annual cost of HPV infection attributable to infections acquired through age 24 is $2.8 billion for women and $62 million for men. This total cost estimate is more than twice that of an earlier study;[23] much of the difference results from the incorporation of costs linked to diagnosis and management of cytologic abnormalities. Assuming 4.6 million infections among those aged 15–24, distributed equally between the sexes,[24] the expected cost per HPV infection is $1,228 for women and $27 for men.

Genital Herpes

Estimates of the annual prevalence cost of genital herpes (excluding neonatal herpes) among persons who were aged 15–24 at the time of infection have ranged from $78–112 million (based on medical claims data) to $450 million (based on expert opinion), assuming that roughly 40% of HSV-2 infections occur between ages 15 and 24.[25]

To estimate the incident cost of genital herpes, we needed estimates of the discounted, lifetime cost per new case. These estimates were based on a study of the direct and indirect costs of HSV-2 infection.[26] We obtained the estimates of direct costs per case ($417 for women and $511 for men, including suppressive therapy for some patients) from the study's lead author.[27] In that study, the author assumed that 17% of infected individuals would develop symptomatic genital herpes, and estimated that infected men and women would experience an average of 19 and 16 lifetime symptom days, respectively.[28]

Hepatitis B

The estimated cost per case was based on an existing study of the costs of treatment for acute hepatitis B infection and its sequelae.[29] In that study, the investigators estimated that 60% of initial infections in adults or adolescents were asymptomatic and did not require treatment. Among symptomatic infections, an estimated 88% would require outpatient treatment at a cost of $272 per occurrence, and 12% would require hospitalization at a cost of $8,080 per hospitalization. The investigators estimated that 0.9% of all infections would result in chronic liver disease, with related costs averaging $59,308 before discounting.[30] When we conservatively assumed that the average latent period before onset is 20 years,[31] the discounted cost per case of chronic liver disease was $32,837. These assumptions yielded an average cost per case of $779.

Chlamydia

The average cost per case of chlamydia was based on costs of diagnosis and treatment of acute infections, screening tests that yielded positive test results and sequelae resulting from untreated acute infections or from delayed or improper treatment.

• *Diagnostic and treatment costs of acute infection.* The estimated costs of acute care per case, which were drawn from four sources, ranged from $23 to $109.[32] These expenses include costs for office visits (including treatment visits, where appropriate), diagnostic testing and treatment.[33] The low end represented case detection through urine-based nucleic acid amplification testing (NAAT) in men in a correctional setting; the high end was for cases in women detected using NAAT on cervical specimens during diagnostic visits in a privately insured population. Intermediate estimates reflected the cost per case detected through diagnostic visits or screening in publicly funded family planning clinics ($37–53) and STD clinics ($48–73).[34]

An estimate of $73, close to the midpoint of the range of estimates (excluding those for cases detected in correctional settings), reflects the fact that chlamydia is detected and treated in a variety of settings. This estimate includes treatment with single-dose therapy, which may be preferred for adolescents because it avoids the compliance problems associated with multidose therapies.[35] In women, cases detected by urine NAAT may be less costly because pelvic exams are not needed.

A proportion of acute chlamydial infections are asymptomatic. Estimates of the proportion of acute infections in men that are asymptomatic or that lack recognized symptoms range from 82% to 98%; rates of asymptomatic infection in women range from 74% to 92%.[36] Without screening, asymptomatic infections are unlikely to be treated. Because screening of women is far more common than screening of men, the proportion of asymptomatic, infected persons treated is higher among women than among men.[37]

• *Costs of sequelae.* We included the possible costs of epididymitis in men and PID in women, two of the primary sequelae of acute chlamydial infection. Estimated rates of progression to epididymitis vary from 1% to 5%,[38] and published estimates of the cost per case range from $144 to $684.[39] Because the lowest estimate was based on the most recent data and may best reflect current care practices, we used it as the cost per case. The expected expense of epididymitis for each acute chlamydial infection in men was calculated by multiplying the cost per case by the midpoint of the range of rates of progression (3%).

The rate of progression to PID following acute chlamydial infection in women varies, depending on whether the initial infection is successfully treated. When an acute chlamydial infection is not diagnosed or treated, PID develops in an estimated 10–40% of cases.[40] PID may also develop in 3–6% of acute cases that are treated, in part because it can occur before treatment is received.[41] On the basis of these estimates, we used rates of 20% in untreated cases and 4% in treated cases to generate our estimate of PID-associated costs per case of chlamydia in women.

Estimated costs per case of PID, including those associated with acute PID, chronic pelvic pain, ectopic pregnancy and treated infertility, range from $1,060 to $3,626.[42] Using insurance claims taken from a national database, we applied a conservative estimate of $1,334 for the cost per case of PID.[43]

• *Average cost per case of chlamydia.* The expected costs per case for men ($20) and women ($244) were calculated by assuming that acute infections were asymptomatic or untreated in 78% of men and 32% of women.[44] In women, 82% of the estimated cost per case is attributable to sequelae, whereas in men, 78% of the estimated cost per case is attributable to acute infection.

Gonorrhea

The average cost per case of gonorrhea was based on costs of diagnosis and treatment of acute infections, screening tests that yielded positive test results and sequelae resulting from untreated acute infections or from delayed or improper treatment.

• *Diagnostic and treatment costs of acute infection.* The estimated cost of care per acute case was drawn from three sources.[45] As with the cost of chlamydia, the cost of gonorrhea depends on the care setting, on the type of specimen used for testing and on whether the case is detected through a diagnostic visit initiated by patients with symptoms or through visits for non–gonorrhea-related issues in which gonorrhea screening is provided. The costs for cases detected through screening, covering expenses for office visits (including treatment visits, where appropriate), diagnostic testing and treatment, range from $36 to $69.[46] The lower estimate is for screening in a correctional setting, and the higher estimate reflects a private setting. For cases detected through diagnostic visits, the costs range from $69 to $125.[47] The cost per case would be lower if most symptomatic men were treated on the basis of symptoms or a clinic-performed gram stain (without laboratory-based testing), but research has found high rates (83–92%) of diagnostic testing among private providers.[48] We used $69 as an estimate of the average cost per acute asymptomatic or symptomatic case treated.

Untreated acute infections for which patients never seek care entail no direct costs (although treating their sequelae can be costly). Data on the proportion of gonorrheal infections that are asymptomatic or that do not have recognized symptoms vary. Women are generally more likely than men to have asymptomatic infections, but even among men, asymptomatic infections and infections without recognized symptoms are estimated at 34–100% of all infections.[49]

• *Costs of sequelae.* We included the costs of treating epididymitis in men and PID in women. Because there is no evidence that epididymitis costs vary significantly according to the organism involved, we used the data for chlamydia to estimate epididymitis costs attributable to gonorrhea.[50] We also used the estimated rates of progression from chlamydial infection to epididymitis to calculate those for acute gonorrhea.

PID develops an estimated 10–40% of the time following cervical gonococcal infection.[51] One study found that 4% of women with incident gonococcal infections of less than six months' duration developed symptomatic PID, but 9% had lower abdominal tenderness, a symptom consistent with PID.[52] We estimated that PID develops in 20% of women with untreated acute gonococcal infections and in 6% of those with successfully treated infections.[53] The estimates of the cost per case of PID resulting from chlamydial infection were used to calculate the cost per case of gonococcal PID.

• *Average cost per case of gonorrhea.* The expected costs per case for men ($53) and women ($266) were calculated by assuming that acute infections were asymptomatic or untreated in 29% of men and 27% of women.[54] In women, 81% of the cost per case is attributable to sequelae, whereas in men, 92% of the cost per case is attributable to acute infection.

Trichomonas vaginalis

The literature related to the costs of infection with *Trichomonas vaginalis* is minimal. Therefore, the estimated cost per case was based on the treatment estimates for gonorrhea and chlamydia, adjusted for the expected differences in medication and laboratory costs. We assumed that the vast majority (90%) of diagnostic testing relied on wet-mount preparation conducted during the patient visit, because reliable data were not found on use of the InPouch™ diagnostic culture, a relatively new test for trichomoniasis. Assuming the cost of a diagnostic visit that includes wet-mount materials, preparation and reading during the patient visit is similar to that for gonorrhea or chlamydia, we estimated the visit cost at $40, exclusive of medications.[55] Treatment with the recommended regimen of a single 2 g dose of metronidazole (average wholesale price of $2) yields a total diagnosis and treatment cost of $42. Use of the InPouch kit adds $2.40 per test, plus the costs of laboratory time for multiple readings of the specimen and a return treatment visit for those with positive results. The estimated additional cost of InPouch culture is $44. Given a weighted average of diagnosis by 90% wet-mount and 10% InPouch culture, we estimated the cost per treated case of trichomoniasis at $46. An estimated 20–50% of infections are symptomatic; we assumed that 40% would be treated, and that 60% would not be treated and would incur no costs, thus leading to an average cost per case of $18.[56]

Syphilis

Syphilis cost estimates were based on an earlier decision analysis of the natural course of syphilis infection.[57] We assumed that each new case of syphilis would first be detected and treated in the primary, secondary or early latent stage; first be detected and treated in the late latent stage; be treated inadvertently by antibiotics taken for reasons unrelated to syphilis; or lead to long-term sequelae such as late benign syphilis, cardiovascular syphilis or neurosyphilis. Our estimates reflect the probability of and costs associated with each of these scenarios.

We made three adjustments to the probabilities and costs from the previous analysis. First, we assigned a higher value (0.61 rather than 0.49) to the probability of receiving treatment in the primary, secondary or early latent stage of syphilis. This choice ensured that the ratio of treated primary, secondary and early latent cases to the treated late latent cases in the decision tree model would be consistent with the ratio reported to the national surveillance system of the Centers for Disease Control and Prevention (CDC) from 1980 to 1999. Second, we used a lower cost of treatment of primary, secondary or early latent syphilis ($53 rather than $380). The difference arises because we used a more conservative estimate of the cost of screening and CDC-recommended treatment, and excluded the costs of possible follow-up visits.[58] Third, a lower cost of neurosyphilis ($56,806 rather than $166,374) was applied, assuming that initial treatment would cost $4,857, long-term care would cost $51,949 and 25 years would elapse between infection and initial treatment.[59] Because information about the long-term cost of neurosyphilis is scarce, we used the average cost of care for Alzheimer's patients over a 10-year period (including the costs of informal care)[60] as an approximation. These adjustments to the probability of treatment and costs of treatment for early syphilis and neurosyphilis resulted in a more conservative cost estimate than the one previously reported.[61] The other inputs used in this decision analysis model were quite similar to those used in recent evaluations of syphilis screening programs in the United States.[62] The estimated cost per case of syphilis was $444.*

Total Economic Burden

For the eight STDs considered here, the total estimated cost of the nine million cases that occurred among 15–24-year-olds in 2000 is $6.5 billion (Table 1). Viral STDs accounted for 94% of the total burden ($6.2 billion), and nonviral STDs for 6% ($0.4 billion). HIV and HPV were by far the most costly STDs in terms of total estimated direct medical costs, accounting for 90% of the total burden ($5.9 billion). Genital herpes and chlamydia were the third and fourth most costly STDs, accounting for total costs of $293 million and $248 million, respectively.

DISCUSSION AND CONCLUSIONS

The estimated economic burden of STDs among youth is substantial, both because of the large number of infections acquired by persons aged 15–24 and because of the high cost per case of viral STDs, particularly HIV. Without existing STD prevention efforts, the incidence cost of STDs would be even greater than our estimate of $6.5 billion. Additional STD prevention activities may avert some of the cost of treating STDs among the nation's adolescents and young adults.

The overall cost burden of STDs is so great that even small reductions in incidence could lead to considerable reductions in treatment costs. However, prevention activities (such as HIV counseling and testing, STD screening and treatment, and sex partner notification) also have economic costs. Cost-effectiveness studies of STD prevention programs for adolescents and young adults can help determine the best use of limited STD and HIV prevention resources.[63]

*This cost per case was estimated as the expected cost of the following clinical outcomes of syphilis: primary, secondary or early latent stage syphilis (probability, 0.61; treatment cost, $53); late latent stage syphilis with no lumbar puncture (probability, 0.199; treatment cost, $467); late latent stage syphilis, including a lumbar puncture (probability, 0.041; treatment cost, $675); inadvertent treatment (probability, 0.134; treatment cost, $0); late benign syphilis (probability, 0.007, treatment cost, $1,094); cardiovascular syphilis, including the need for cardiac surgery in some cases (probability, 0.005; treatment cost, $13,931); and neurosyphilis, including the need for long-term nursing home care (probability, 0.004; treatment cost, $56,806).

Certain bacterial and viral STDs can facilitate the transmission of HIV, and HIV costs can be an important component of their cost.[64] Because we included HIV costs as a separate category, however, we did not include them as a cost component for other STDs. Prevention of STDs other than HIV might result in reductions in HIV and its associated costs. For example, a published mathematical model[65] of the effects of STDs on HIV transmission suggests that about 2,100 of the estimated 15,000 new HIV infections among young Americans in 2000 might be attributable to coinfection with syphilis, gonorrhea or chlamydia.

Limitations

These estimated lifetime costs per case are subject to considerable uncertainty and should be viewed as ballpark figures rather than precise calculations. Our estimates depend on the numerous assumptions we made in our analysis. In calculating HPV costs, for example, we assumed that patients with atypical Pap test results would be managed in strict adherence to the Bethesda Guidelines. If management is less rigorous, the expected cost per abnormal Pap result will be lower, though this reduction might be offset in part by increased costs of treating invasive cancer in later years. The estimated total burden of STDs ($6.5 billion) is based on the cost-per-case estimates as well the estimated number of cases of each STD. As with the cost-per-case estimates, the incidence estimates are subject to considerable uncertainty.

The estimated cost per case of HIV (the most costly STD in our analysis) is based on a 1997 study, and the lifetime cost may have changed substantially since then. Nonetheless, the estimate we used is the most current one available, and is widely used in cost-effectiveness evaluations of HIV prevention programs. In addition, the lifetime cost ($199,800) we applied appears to be consistent with a more recent estimate of the annual cost of care for persons with HIV.[66]

As with our estimates for HIV, our cost estimates for other STDs are affected by the limitations of the studies on which our estimates are based. For example, cost estimates used in the decision analyses might be from one clinical setting where costs are not readily applicable to other settings. Drug treatment costs based on wholesale prices might underestimate the actual cost of treatment for some purchasers of these drugs. Furthermore, the cost of STDs can change over time. Although we adjusted existing cost estimates for inflation, such adjustment might not fully capture changes in diagnosis, treatment and management in recent years or future years. Such changes might include broader use of urine-based amplification testing for gonorrhea and chlamydia, new guidelines for cervical neoplasia and cancer screening, HPV DNA testing, new treatments for HIV and trichomoniasis, herpes type-specific serology testing and its potential influence on the proportion of persons with genital herpes who receive treatment, and modification of treatment regimens in the face of changing antimicrobial resistance patterns.[67]

With some exceptions, our cost-per-case estimates are not age-specific. Rather, we based them on existing studies that typically reflect STD costs among adults rather than adolescents. For example, we assumed that the distribution of high- and low-risk HPV types is independent of the age at infection. If the distribution of HPV types varies by age, we may have overestimated or underestimated the true cost of HPV infection in adolescents and young adults. In addition, the estimated costs of HIV and HSV include long-term drug therapy. If young people require more years of such treatment than was estimated for the adult populations on which our sources are based, the actual cost of HIV and HSV among youth could exceed our estimates.

In calculating the costs by STD, we may have double-counted certain costs in instances in which a person was infected with more than one STD at a given time. For example, a person infected with both gonorrhea and chlamydia might have both infections diagnosed at the same doctor visit. However, some patients presenting with gonorrhea alone (or chlamydia alone) may be presumptively treated for the other infection as well because coinfection is common. Thus, any overestimation of the cost of diagnostic visits for a person infected with both chlamydia and gonorrhea would be offset, at least in part, by the added costs of presumptive dual treatment for persons who are not infected with both organisms. Data are not available to determine the net effect of these two possibilities on our cost estimates for gonorrhea and chlamydia; it likely is far less than the impact of our use of conservative estimates of the rates of progression to PID and cost of PID attributable to gonorrhea and chlamydia.

We did not consider every possible direct medical cost of each STD. For example, we limited estimates of the economic burden of HPV among youth to management of cervical manifestations among women and anogenital warts among both sexes. To the extent that HPV is an important factor in other male and female genital cancers and internal genital warts, we underestimated the economic burden of HPV infection. STD infections in pregnant women can cause pregnancy complications and medical problems for infants who are infected during the perinatal period. Because we did not include these costs, we likely underestimated the cost of STDs among young women.

We did not include the cost of primary STD and HIV prevention activities (for example, finding and notifying partners of infected persons) or the cost of protecting the nation's blood supply from these diseases. Similarly, we did not include the cost of large-scale screening for STDs that often lack symptoms or have symptoms or signs that are not easily recognized. For example, the costs of routine prenatal syphilis and HIV screening programs and routine chlamydia screening programs for sexually active adolescent and young adult women were not included. However, costs associated with screening tests that yield a positive result, as well as subsequent diagnostic tests required because of the positive screening result, were included because these costs must be incurred to detect and treat infection. Although these screening costs would have been incurred regardless of test outcome, the inclusion of these costs for positive tests has little effect on the estimated burden of STDs.

Our cost estimates did not include either the indirect costs or the intangible costs associated with STDs; the estimated burden of STDs would be substantially higher if these costs were included. Even though we included eight major STDs, we excluded other important STDs, such as hepatitis C, human cytomegalovirus and bacterial vaginosis, because of limited cost information. We did not include the cost of genital herpes attributable to HSV-1.

These numerous limitations likely result in an underestimation of the cost of STDs among adolescents and young adults. If we included every known STD and every possible associated cost, the estimated cost burden of STDs would be greater. Furthermore, the estimated cost would be about 10% higher if expressed in current dollars rather than year 2000 dollars. And prevalence costs of STDs could be even higher than the incidence costs we estimated here, because prevalence costs include current costs of STDs acquired in previous years and are not discounted.

Our analysis provides only point estimates of the cost of eight major STDs. Although this is an important first step in examining the cost of STDs among adolescents, more research is needed. Most important, future studies should include detailed sensitivity analyses to examine how the cost-per-case estimates change when key inputs (cost of treatment, probability of long-term sequelae, etc.) are varied. Incorporating sensitivity analyses was beyond the scope of this study, and any subsequent users of the point estimates we have provided should address the inherent uncertainty in these estimates.

Despite its limitations, our cost analysis provides practical estimates of the direct medical costs of STDs among America's youth. These figures underscore the enormous burden of STDs and illustrate the potential savings that could be achieved through successful STD prevention activities.

REFERENCES

1. Weinstock H, Berman S and Cates W, Jr., Sexually transmitted diseases among American youth: incidence and prevalence estimates, *Perspectives on Sexual and Reproductive Health*, 2004, 36(1):6–10.

2. Siegel JE, Estimates of the economic burden of STDs: review of the literature with updates, in: Eng TR and Butler WT, eds., *The Hidden Epidemic: Confronting Sexually Transmitted Diseases*, Washington, DC: National Academy Press, 1997, pp. 330–356; and American Social Health Association (ASHA), *Sexually Transmitted Diseases in America: How Many Cases and at What Cost?* Menlo Park, CA: Kaiser Family Foundation, 1998.

3. Cunningham WE et al., Prevalence and predictors of highly active antiretroviral therapy use in patients with HIV infection in the United States, *Journal of Acquired Immune Deficiency Syndromes*, 2000, 25(2): 115–123.

4. Seigel JE, 1997, op. cit. (see reference 2); and Haddix AC, Teutsch SM and Corso PS, eds., *Prevention Effectiveness: A Guide to Decision Analysis and Economic Evaluation*, New York: Oxford University Press, 2003.

5. *Economic Report of the President: Transmitted to the Congress February 2002*, Table B-60: Consumer price indexes for major expenditure classes, 1958–2001, p. 389, <http://w3.access.gpo.gov/usbudget/fy2003/pdf/2002_erp.pdf>, accessed Sept. 10, 2003.

6. Corso PS and Haddix AC, Time effects, in: Haddix AC, Teutsch SM and Corso PS, 2003, op. cit. (see reference 4); and Gold MR et al., eds., *Cost-Effectiveness in Health and Medicine*, New York: Oxford University Press, 1996.

7. Corso PS and Haddix AC, 2003, op. cit. (see reference 6).

8. Weinstock H, Berman S and Cates W, Jr., 2004, op. cit. (see reference 1).

9. Holtgrave DR and Pinkerton SD, Updates of cost of illness and quality of life estimates for use in economic evaluations of HIV prevention programs, *Journal of Acquired Immune Deficiency Syndromes & Human Retrovirology*, 1997, 16(1):54–62.

10. Bozzette SA et al., Expenditures for the care of HIV-infected patients in the era of highly active antiretroviral therapy, *New England Journal of Medicine*, 2001, 344(11):817–823.

11. Walensky RP et al., Treatment for primary HIV infection: projecting outcomes of immediate, interrupted, or delayed therapy, *Journal of Acquired Immune Deficiency Syndromes*, 2002, 31(1):27–37.

12. Wright TC, Jr., et al., 2001 consensus guidelines for the management of women with cervical cytological abnormalities, *Journal of the American Medical Association*, 2002, 287(16):2120–2129.

13. Kim JJ, Wright TC and Goldie SJ, Cost-effectiveness of alternative triage strategies for atypical squamous cells of undetermined significance, *Journal of the American Medical Association*, 2002, 287(18):2382–2390.

14. Goldie SJ, Harvard School of Public Health, Boston, personal communication, Aug. 7, 2002.

15. Kulasingam SL and Myers ER, Department of Obstetrics and Gynecology, Duke University, Durham, NC, personal communication, Oct. 29, 2002; and Myers ER et al., Mathematical model for the natural history of human papillomavirus infection and cervical carcinogenesis, *American Journal of Epidemiology*, 2000, 151(12):1158–1171.

16. National Cancer Institute, Surveillance, Epidemiology and End Results (SEER) Program, *SEER Cancer Statistics Review, 1973–1999,* Table V-1, <http://seer.cancer.gov/csr/1973_1999/cervix.pdf>, accessed June 28, 2002.

17. Kim JJ, Wright TC and Goldie SJ, 2002, op. cit. (see reference 13); and Goldie SJ, 2002, op. cit. (see reference 14).

18. Kulasingam SL and Myers ER, 2002, op. cit. (see reference 15); and Myers ER et al., 2000, op. cit. (see reference 15).

19. Wiley DJ et al., External genital warts: diagnosis, treatment, and prevention, *Clinical Infectious Diseases*, 2002, 35(S2):S210–S224; and Centers for Disease Control and Prevention (CDC), 1993 sexually transmitted disease guidelines, *Morbidity and Mortality Weekly Report*, 1993, Vol. 42, No. RR-14, p. 83.

20. Richwald GA and Langley PC, Cost of care and treatment patterns for external genital warts (EGWs) in ob/gyn practices in the United States, *International Journal of STD & AIDS*, 2001, 12(S2):126; Beutner KR et al., External genital warts: report of the American Medical Association Consensus Conference, *Clinical Infectious Diseases*, 1998, 27(4):796–806; and Strauss MJ et al., The cost of treating genital warts, *International Journal of Dermatology*, 1996, 35(5):340–348.

21. Weinstock H, Berman S and Cates W, Jr., 2004, op. cit. (see reference 1); and Myers ER et al., 2000, op. cit. (see reference 15).

22. Weinstock H, Berman S and Cates W, Jr., 2004, op. cit. (see reference 1).

23. ASHA, 1998, op. cit. (see reference 2).

24. Weinstock H, Berman S and Cates W, Jr., 2004, op. cit. (see reference 1).

25. Tao G, Kassler WJ and Rein DB, Medical care expenditures for genital herpes in the United States, *Sexually Transmitted Diseases*, 2000, 27(1):32–38; Szucs TD et al., The estimated economic burden of genital herpes in the United States: an analysis using two costing approaches, *BMC Infectious Diseases*, 2001, Vol. 1, No. 5; and Armstrong GL et al., Incidence of herpes simplex virus type 2 infection in the United States, *American Journal of Epidemiology*, 2001, 153(9):912–920.

26. Fisman DN et al., Projection of the future dimensions and costs of the genital herpes simplex type 2 epidemic in the United States, *Sexually Transmitted Diseases*, 2002, 29(10):608–622.

27. Fisman DN, Drexel University School of Public Health, Philadelphia, personal communication, Dec. 9, 2002.

28. Fisman DN et al., 2002, op. cit. (see reference 26).

29. Margolis HS et al., Prevention of hepatitis B virus transmission by immunization: an economic analysis of current recommendations, *Journal of the American Medical Association*, 1995, 274(15):1201–1208.

30. Ibid.; and ASHA, 1998, op. cit. (see reference 2).

31. ASHA, 1998, op. cit. (see reference 2).

32. Shafer MAB, Pantell RH and Schachter J, Is the routine pelvic examination needed with the advent of urine-based screening for sexually transmitted diseases? *Archives of Pediatrics & Adolescent Medicine*, 1999, 153(2):119–125; Begley CE, McGill L and Smith PB, The incremental cost of screening, diagnosis, and treatment of gonorrhea and chlamydia in a family planning clinic, *Sexually Transmitted Diseases*, 1989, 16(2): 63–67; Howell MR et al., Screening women for *Chlamydia trachomatis* in family planning clinics, *Sexually Transmitted Diseases*, 1998, 25(2): 108–117; and Gift TL et al., The cost-effectiveness of jail-based STD and HIV prevention programs and their impact on inmate and community health, paper presented at the 2002 National STD Prevention Conference, San Diego, Mar. 4–7, 2002.

33. Shafer MAB, Pantell RH and Schachter J, 1999, op. cit. (see reference 32); and Gift TL et al., 2002, op. cit. (see reference 32).

34. Begley CE, McGill L and Smith PB, 1989, op. cit. (see reference 32); and Howell MR et al., 1998, op. cit. (see reference 32).

35. CDC, Sexually transmitted diseases treatment guidelines 2002, *Morbidity and Mortality Weekly Report*, 2002, Vol. 51, No. RR-6.

36. Marrazzo JM et al., Community-based urine screening for *Chlamydia trachomatis* with a ligase chain reaction assay, *Annals of Internal Medicine*, 1997, 127(9):796–803; Oh MK et al., Sexual behavior and sexually transmitted diseases among male adolescents in detention, *Sexually Transmitted Diseases*, 1994, 21(3):127–132; Oh MK et al., Urine-based screening of adolescents in detention to guide treatment for gonococcal and chlamydial infections, *Archives of Pediatrics and Adolescent Medicine,* 1998, 152(1):52–56; Turner CF et al., Untreated gonococcal and chlamydial infection in a probability sample of adults, *Journal of the American Medical Association*, 2002, 287(6):726–733; Farley TA, Cohen DA and Elkins W, Asymptomatic sexually transmitted diseases: the case for screening, *Preventive Medicine*, 2003; 36(4):502–509; and Mertz KJ et al., Findings from STD screening of adolescents and adults entering corrections facilities, *Sexually Transmitted Diseases*, 2002, 29(12): 834–839.

37. CDC, 2002, op. cit. (see reference 35); and St. Lawrence JS et al., STD screening, testing, case reporting, and clinical and partner notification practices: a national survey of US physicians, *American Journal of Public Health*, 2002, 92(11):1784–1788.

38. Marrazzo JM et al., Cost-effectiveness of urine-based screening for *Chlamydia trachomatis* with ligase chain reaction in asymptomatic males, poster presentation prepared for the annual meeting of the International Society for Sexually Transmitted Disease Research, Seville, Spain, Oct. 19–22, 1997; Washington AE, Johnson RE and Sanders LL, Jr., *Chlamydia trachomatis* infections in the United States: what are they costing us? *Journal of the American Medical Association*, 1987, 257(15): 2070–2072; and Magid D, Douglas JM, Jr., and Schwartz JS, Doxycycline compared with azithromycin for treating women with genital *Chlamydia trachomatis* infections: an incremental cost-effectiveness analysis, *Annals of Internal Medicine*, 1996, 124(4):389–399.

39. Marrazzo JM et al., 1997, op. cit. (see reference 38); Washington AE, Johnson RE and Sanders LL, Jr., 1987, op. cit. (see reference 38); Magid D, Douglas JM, Jr., and Schwartz JS, 1996, op. cit. (see reference 38); and Ginocchio RHS et al., The clinical and economic consequences of screening young men for genital chlamydial infection, *Sexually Transmitted Diseases*, 2003, 30(2):99–106.

40. Washington AE, Johnson RE and Sanders LL, Jr., 1987, op. cit. (see reference 38); Tait IA, Duthie SJ and Taylor-Robinson D, Silent upper genital tract chlamydia infection and disease in women, *International Journal of STD & AIDS*, 1997, 8(5):329–331; CDC, Recommendations for the prevention and management of *Chlamydia trachomatis* infections, *Morbidity and Mortality Weekly Report*, 1993, Vol. 42, No. RR-12; Rees E, The treatment of pelvic inflammatory disease, *American Journal of Obstetrics and Gynecology*, 1980, 138(7, part 2):1042–1047; Douglas JM, Jr., et al., Low rate of pelvic inflammatory disease (PID) among women with incident *Chlamydia trachomatis* (CT) infection, *International Journal of STD & AIDS*, 2001, 12(S2):65–67; Haddix AC, Hillis SD and Kassler WJ, The cost effectiveness of azithromycin for *Chlamydia trachomatis* infections in women, *Sexually Transmitted Diseases*, 1995, 22(5):274–280; and Wiesenfeld HC et al., Lower genital tract infection and endometritis: insight into subclinical pelvic inflammatory disease, *Obstetrics & Gynecology*, 2002, 100(3):456–463.

41. Douglas JM, Jr., et al., 2001, op. cit. (see reference 40); Haddix AC, Hillis SD and Kassler WJ, 1995, op. cit. (see reference 40); Hook EW 3rd et al., Use of cell culture and a rapid diagnostic assay for *Chalmydia trachomatis* screening, *Journal of the American Medical Association*, 1994, 272(11):867–870; and Bachmann L et al., Patterns of *Chlamydia trachomatis* testing and follow-up at a university hospital medical center, *Sexually Transmitted Diseases*, 1999, 26(9):496–499.

42. Shafer MAB, Pantell RH and Schachter J, 1999, op. cit. (see reference 32); Magid D, Douglas JM, Jr., and Schwartz JS, 1996, op. cit. (see reference 38); Yeh JM, Hook EW 3rd and Goldie SJ, A refined estimate of the average lifetime cost of pelvic inflammatory disease, *Sexually Transmitted Diseases*, 2003, 30(5):369–378; and Rein DB et al., Direct medical cost of pelvic inflammatory disease and its sequelae: decreasing, but still substantial, *Obstetrics & Gynecology*, 2000, 95(3):397–402.

43. Rein DB et al., 2000, op. cit. (see reference 42).

44. Magid D, Douglas JM, Jr., and Schwartz JS, 1996, op. cit. (see reference 38); and Marrazzo JM et al., Performance and cost-effectiveness of selective screening criteria for *Chlamydia trachomatis* infection in women, *Sexually Transmitted Diseases*, 1997, 24(3):131–141.

45. Shafer MAB, Pantell RH and Schachter J, 1999, op. cit. (see reference 32); Begley CE, McGill L and Smith PB, 1989, op. cit. (see reference 32); and Gift TL et al., 2002, op. cit. (see reference 32).

46. Shafer MAB, Pantell RH and Schachter J, 1999, op. cit. (see reference 32); and Gift TL et al., 2002, op. cit. (see reference 32).

47. Shafer MAB, Pantell RH and Schachter J, 1999, op. cit. (see reference 32); and Begley CE, McGill L and Smith PB, 1989, op. cit. (see reference 32).

48. Ratelle S et al., Management of urethritis in health maintenance organization members receiving care at a multispecialty group practice in Massachusetts, *Sexually Transmitted Diseases*, 2001, 28(4):232–235.

49. Turner CF et al., 2002, op. cit. (see reference 36); Mertz KJ et al., 2002, op. cit. (see reference 36); Oh MK et al., Urine-based screening of adolescents in detention to guide treatment for gonococcal and chlamydial infections, *Archives of Pediatrics & Adolescent Medicine*, 1998, 152(1):52–56; and Farley TA, Cohen DA and Elkins W, 2003, op. cit. (see reference 36).

50. Marrazzo JM et al., 1997, op. cit. (see reference 38); Washington AE, Johnson RE and Sanders LL, Jr., 1987, op. cit. (see reference 38); and Ginocchio RHS et al., 2003, op. cit. (see reference 39).

51. Washington AE, Johnson RE and Sanders LL, Jr., 1987, op. cit. (see reference 38); Tait IA, Duthie SJ and Taylor-Robinson D, 1997, op. cit. (see reference 40); Rees E, 1980, op. cit. (see reference 40); Douglas JM, Jr., et al., 2001, op. cit. (see reference 40); Haddix AC, Hillis SD and Kassler WJ, 1995, op. cit. (see reference 40); Wiesenfeld HC et al., 2002, op. cit. (see reference 40); Westrom L and Eschenbach D, Pelvic inflammatory disease, in: Holmes KK et al., eds., *Sexually Transmitted Diseases*, New York: McGraw-Hill, 1999, pp. 783–809; and Gutman LT, Gonococcal diseases in infants and children, in: ibid., pp. 1145–1154.

52. Douglas JM, Jr., et al., 2001, op. cit. (see reference 40).

53. Ibid.; and Haddix AC, Hillis SD and Kassler WJ, 1995, op. cit. (see reference 40).

54. St. Lawrence JS et al., 2002, op. cit. (see reference 37); and Farley TA, Cohen DA and Elkins W, 2003, op. cit. (see reference 36).

55. Shafer MAB, Pantell RH and Schachter J, 1999, op. cit. (see reference 32); Begley CE, McGill L and Smith PB, 1989, op. cit. (see reference 32); Howell MR et al., 1998, op. cit. (see reference 32); and Gift TL et al., 2002, op. cit. (see reference 32).

56. Krieger JN and Alderete JF, *Trichomonas vaginalis* and trichomoniasis, in: Holmes KK et al., 1999, op. cit. (see reference 51), pp. 587–604; and Bowden FJ and Garnett GP, *Trichomonas vaginalis* epidemiology: parameterising and analysing a model of treatment interventions, *Sexually Transmitted Infections*, 2000, 76(4):248–256.

57. Chesson HW et al., Direct medical costs of syphilis in the United States: the potential for a cost-saving national elimination program, paper presented at the 1998 National STD Prevention Conference, Dallas, Dec. 6–9, 1998.

58. Ibid.; Division of STD Prevention, CDC, *Sexually Transmitted Disease Surveillance, 2000*, Atlanta: CDC, 2001; and Kraut JR et al., Cost-effectiveness of routine screening for sexually transmitted diseases among inmates in United States prisons and jails, in: National Commission on Correctional Health Care (NCCHC), *The Health Status of Soon-to-Be-Released Inmates: A Report to Congress,* Chicago: NCCHC, 2002, pp. 81–108.

59. Kraut JR et al., 2002, op. cit. (see reference 58); and Sparling PF, Natural history of syphilis, in: Holmes KK et al., 1999, op. cit. (see reference 51), pp. 473–478.

60. Kinosian BP et al., Predicting 10-year care requirements for older people with suspected Alzheimer's disease, *Journal of the American Geriatrics Society*, 2000, 48(6):631–638.

61. Chesson HW et al., 1998, op. cit. (see reference 57).

62. Kraut JR et al., 2002, op. cit. (see reference 58); and Silberstein GS et al., Effectiveness and cost-benefit of enhancements to a syphilis screening and treatment program at a county jail, *Sexually Transmitted Diseases*, 2000, 27(9):508–517.

63. Kahn JG et al., Cost-effectiveness of the Mpowerment Project, a community-level intervention for young gay men, *Journal of Acquired Immune Deficiency Syndromes*, 2001, 27(5):482–491; Pinkerton SD, Holtgrave DR and Jemmott JB 3rd, Economic evaluation of HIV risk reduction intervention in African-American male adolescents, *Journal of Acquired Immune Deficiency Syndromes*, 2000, 25(2):164–172; Tao G and Remafedi G, Economic evaluation of an HIV prevention intervention for gay and bisexual male adolescents, *Journal of Acquired Immune Deficiency Syndromes & Human Retrovirology*, 1998, 17(1):83–90; Wang LY et al., Economic evaluation of Safer Choices: a school-based human immunodeficiency virus, other sexually transmitted diseases, and pregnancy prevention program, *Archives of Pediatrics & Adolescent Medicine*, 2000, 154(10):1017–1024; and Wang LY, Burstein GR and Cohen DA, An economic evaluation of a school-based sexually transmitted disease screening program, *Sexually Transmitted Diseases*, 2002, 29(12):737–745.

64. Wasserheit JN, Epidemiological synergy: interrelationships between human immunodeficiency virus infection and other sexually transmitted diseases, *Sexually Transmitted Diseases*, 1992, 19(2):61–77; and Chesson HW and Pinkerton SD, Sexually transmitted diseases and the increased risk for HIV transmission: implications for cost-effectiveness analyses of sexually transmitted disease prevention interventions, *Journal of Acquired Immune Deficiency Syndromes*, 2000, 24(1):48–56.

65. Chesson HW and Pinkerton SD, 2000, op. cit. (see reference 64).

66. Bozzette SA et al., 2001, op. cit. (see reference 10).

67. CDC, 2002, op. cit. (see reference 35); and Saslow D et al., American Cancer Society guideline for the early detection of cervical neoplasia and cancer, *CA: A Cancer Journal for Clinicians*, 2002, 52(6):342–362.

Acknowledgments

The authors thank J. Thomas Cox, Eileen Dunne, David N. Fisman, Sue J. Goldie, Shalini Kulasingam, Herschel W. Lawson, Evan Myers, Katherine M. Stone, James Trussell and Hillard Weinstock for helpful suggestions and additional information. We are also grateful for recommendations and comments from the following members of the University of North Carolina School of Journalism and Mass Communication Panel on Youth, Sexually Transmitted Diseases and the Media, which was supported by the William T. Grant Foundation: Tracey A. Adams, Jane D. Brown, Virginia Caine, Joan R. Cates, Willard Cates, Jr., Richard A. Crosby, Jacqueline E. Darroch, Ralph DiClemente, Nancy Herndon, Lloyd J. Kolbe, Felicia E. Mebane, Susan L. Rosenthal, Laura F. Salazar, Susan Schulz, Jonathan Stacks and Felicia Stewart.

Author contact: *hbc7@cdc.gov*