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An Updated Spreadsheet Tool to Estimate the Health and Economic Benefits of STI and HIV Prevention Activities

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Abstract

Background: This manuscript describes an updated spreadsheet tool that sexually transmitted infection (STI) prevention programs in the United States can use to estimate the health and economic benefits of their STI and HIV prevention activities.

Methods: The development of the updated tool, STIC (Sexually Transmitted Infection Costs) Figure 2.0, involved two main components. First, we revised the tool to be more useful and user-friendly based on feedback from focus groups and usability testing. Second, we updated the mathematical model behind the calculations by (1) revising the model to reflect current STI and HIV prevention activities in the United States, (2) updating the epidemiological and economic parameters in the model using the best available evidence, and (3) including ranges (not just point estimates) in the model output. To demonstrate the use of STIC Figure 2.0, we applied it to estimate the impact of a hypothetical prevention program, consistent with that of a health department or large STI clinic in a metropolitan area.

Results: STIC Figure 2.0 incorporated new features, including an interactive user interface to explore findings and create customized charts for use in reports and presentations. The hypothetical example we analyzed illustrated how providing STI treatment to 2,680 people and

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HIV prevention services to 325 people could avert 1,253 adverse outcomes and save over \$2 million in medical costs and productivity costs.

Conclusions: Although subject to important limitations, STIC Figure 2.0 allows state and local programs, including STI clinics, to calculate evidence-based estimates of the impact of their program activities.

Summary:

We describe an updated spreadsheet tool that programs can use to estimate the health and economic impact of STI and HIV prevention activities, such as the number of STIs averted and the number of HIV infections averted, as well as the associated medical costs and productivity costs saved.

Keywords

cost; cost analysis; sexually transmitted infections; HIV; prevention; control; program evaluation

Like other public health entities, sexually transmitted infection (STI) programs are held accountable to demonstrate performance of their required duties and appropriate use of federal, state, and local funding.^{1,2} STI programs are frequently asked by decisionmakers to demonstrate the value of STI prevention services relative to their costs.³ In 1992, to help STI programs quantify the direct medical costs saved by their program activities, the Centers for Disease Control and Prevention (CDC) published a 6-page document of “cost savings formulas.”³ This list of equations made it easier for STI programs in the United States to use their routinely collected data to estimate the economic benefit of their activities. For example, the equations showed how data on the number of women treated for chlamydia could be used to estimate the direct medical costs saved by preventing pelvic inflammatory disease (PID), based on factors such as the direct medical cost per case of PID and the probability of PID in the absence of treatment.³

In 2008, at the request of state and local STI programs, CDC researchers (1) updated these “cost savings formulas” to reflect more current data on the probability and cost of STI sequelae, (2) expanded the scope of the formulas to include both direct medical costs saved and productivity costs saved, and (3) developed a spreadsheet tool to facilitate the use of these updated formulas.⁴ This tool, STIC (Sexually Transmitted Infection Costs) Figure, has since been used by STI programs and researchers to estimate the direct medical costs and productivity costs saved by STI prevention activities.⁵

Given that the original STIC Figure tool is now more than 15 years old, the purpose of this project was to develop an updated version of the tool (STIC Figure 2.0) with the most current and highest quality epidemiologic and health economic data available for the United States. We incorporated feedback from focus groups to make STIC Figure 2.0 more user-friendly and more reflective of current STI and program activities, including two HIV-related services: referrals for HIV pre-exposure prophylaxis for those at risk for HIV and linkage to care of persons newly diagnosed with HIV. Additionally, we conducted usability testing on a prototype to identify bugs in the model and improve ease of use. The tool is intended for use by state, tribal, local, and territorial health departments of any size,

STI clinics, or any other program that provides at least one of the STI or HIV prevention activities included in the tool.

Methods

Overview of the STIC Figure 2.0 spreadsheet tool

Like the original STIC Figure 1.0 tool, the updated STIC Figure 2.0 tool allows users to enter information about their prevention activities and then generates estimates of the health impact (e.g., number of STI and HIV infections averted) and economic benefits (direct medical costs saved and productivity costs saved) of these activities. Productivity costs reflect the effects of STI and HIV morbidity and mortality on a person's ability to perform economically productive tasks, including market productivity (paid work) and non-market productivity (e.g., non-paid activities such as childcare, housework, and grocery shopping).

To use STIC Figure 2.0, the user enters annual data for one or more of their STI or HIV prevention activities (Table 1, which includes hypothetical data for illustrative purposes as described below). With this input, STIC Figure 2.0 generates estimates of the effect of these prevention activities on a wide range of possible health outcomes, including number of cases of pelvic inflammatory disease (PID) averted in women treated for chlamydia or gonorrhea; number of cases of epididymitis averted in men treated for chlamydia or gonorrhea; number of cases of long-term sequelae of syphilis averted in men and women treated for primary and secondary (P&S) syphilis; number of STI infections averted in the population through treatment of chlamydia, gonorrhea, and P&S syphilis; number of STI-attributable HIV infections averted in the population through treatment of chlamydia, gonorrhea, and P&S syphilis; number of HIV infections averted through linkage or re-linkage to care among those with HIV; and the number of HIV infections averted through use of HIV pre-exposure prophylaxis (PrEP) (Table 2). To estimate these health impacts, STIC Figure 2.0 employs a range of data-based assumptions and parameter values (Table 2, Table 3, Appendix).^{4,6–20} The economic benefits of the STI and HIV prevention activities are then calculated by multiplying the estimated number of adverse outcomes averted by the estimated lifetime cost per outcome (Table 4, Appendix).^{4,9,10,21–24}

Updating the tool

The development of the updated tool (STIC Figure 2.0) involved two main components. The first was to use focus groups and usability testing to help us revise the tool to be more useful and user-friendly. The second main component was to update the underlying mathematical model behind the calculations.

Focus groups and usability testing to inform the updated STIC Figure 2.0 tool

Focus group sessions were conducted in parallel for two STI-related health economic tools: STIC Figure 2.0 and the SPACE (STI Prevention Allocation Consequence Estimator) Tool 2.0,²⁵ which allows users to estimate the impact of changes to their STI prevention budget in terms of changes in STI incidence and related costs. The focus group sessions for these two tools are described in more detail elsewhere in an article about the updating of SPACE Tool 2.0.²⁵ Briefly, we conducted 5 focus groups (2–3 people per group) and 2

interviews (1 person per interview) with 15 public health professionals from national, state, and local organizations regarding their knowledge and experiences with STIC Figure 1.0. Based on their feedback, we then developed a prototype STIC Figure 2.0 tool to share for usability testing among a smaller group of 6 professionals from state and local organizations. Feedback from the usability testing was incorporated into the final version of STIC Figure 2.0.

Updates to the underlying mathematical model behind the STIC Figure 2.0 tool

The underlying mathematical model behind the STIC Figure calculations was updated and revised in three main ways. First, we expanded the model scope to include more current STI and HIV prevention activities in the United States, such as the number of patients with chlamydia and gonorrhea provided with expedited partner therapy (EPT), the number of people with HIV linked to HIV care, and the number of people provided with referrals for HIV PrEP (Table 1). Second, we updated epidemiological and economic parameters in the model to reflect the most recent available evidence (Table 3, Table 4, Appendix). Third, whereas the original STIC Figure 1.0 calculated point estimates of the number of health outcomes averted and costs saved, STIC Figure 2.0 calculates point estimates and ranges. The ranges reflect the joint uncertainty in all the model parameter values and assumptions (see Appendix).

Illustrative application of STIC Figure 2.0

To demonstrate the use of the STIC Figure 2.0 tool, we used the tool to calculate the predicted impact of STI and HIV prevention activities in a hypothetical STI program in the United States, using the assumed program activity data in Table 1. To generate the number of confirmed STI cases treated in this hypothetical example, we divided the number of cases reported nationally in 2022 by 50 to represent the average state and then divided again by 20 to represent an entity that accounts for about 5% of STI treatment in an average state (see Appendix for details). This example is meant to reflect entities such as STI clinics or health departments in large metropolitan areas, given that STI clinics can diagnose about 25% of gonorrhea cases, 35% of P&S syphilis cases, and 12% of chlamydia cases in large metropolitan areas,²⁶ and large metropolitan areas can account for a substantial portion of the STI cases reported in their respective states.⁶

Results

Focus group suggestions incorporated in STIC Figure 2.0

STIC Figure 2.0 incorporated three main changes suggested by the focus groups to improve the usefulness of the tool. First, user inputs were condensed to a single screen, in contrast to STIC Figure 1.0 in which users entered data over a series of four screens. Second, the output screen of STIC Figure 2.0 was modified to include not only tabular results as in STIC Figure 1.0, but also a chart summarizing the direct medical costs saved and the productivity costs saved. Further, the updated STIC Figure 2.0 allows the user to explore the output in an interactive user interface and make customizable versions of the output table and chart for exporting into common software applications. Third, the spreadsheet tool now provides more details of the mathematical model behind the calculations, including an

“interpretation guide” screen which provides not only a high-level overview of the model but also a “three-sentence summary” of the model that users can copy and paste into documents and presentations.

Results of illustrative application of the tool

STIC Figure 2.0 estimated that the annual activities of the hypothetical STI prevention program described in Table 1 resulted in \$2,027,650 (range: \$1,057,860–\$2,683,610) in total cost savings, including \$1,429,790 (range: \$754,590–\$1,906,270) in direct medical costs saved and \$597,860 (range: \$303,270–\$777,340) in productivity costs saved (Table 5). The estimated health impacts of STI treatment included benefits to those treated for STIs and population-level benefits of interrupting STI and HIV transmission. Treatment of STIs was estimated to avert 72 (range: 44–89) cases of sequelae in those treated, to avert 1 (range: 1–1) case of congenital syphilis through treatment of women with syphilis, and to avert 1,177 (range: 763–1,447) STIs in the population. An estimated 2 (range: 1–3) HIV infections were averted through referrals for HIV PrEP, through linkage to care of persons with HIV, and by preventing STI-attributable HIV infections through treatment of STIs.

Discussion

STIC Figure 2.0 allows users to generate evidence-based estimates of the health and economic impact of their STI and HIV prevention activities, using routinely collected data. STIC Figure 2.0 improves upon STIC Figure 1.0 by incorporating new features and updated data for most key model parameters. In addition to these modeling updates, we revised STIC Figure 2.0 to be more user-friendly using focus groups with model users and a usability evaluation in parallel with revisions that we made to the SPACE Tool 2.0 model (<https://www.cdc.gov/sti/php/sti-program-resources/space-tool.html>).²⁵

STI prevention directors and other personnel are often asked to provide evidence of the impact of their program activities.³ The tool can be used to generate estimates of program impact quickly and easily in order to facilitate prompt responses to inquiries about program effectiveness. Similarly, the tool can help to inform reports on program accountability, by helping to quantify the benefits of program expenditures in terms of medical costs and productivity costs averted.

There are three key challenges to developing a tool like STIC Figure 2.0 to estimate the health and economic impact of STI and HIV prevention activities. First, the calculations apply numerous assumptions and can require over 40 parameter values, all of which are subject to uncertainty. Uncertainty in the epidemiologic parameters, such as the probability of PID due to chlamydia or gonorrhea, highlights the need for additional research to improve our understanding of the natural history of STIs. To address the uncertainty in the epidemiologic and cost parameters, the model generates ranges that reflect the simultaneous uncertainty in all the parameter values applied in the calculations. Second, in addition to the uncertainty in our inputs, there is likely a high degree of correlation across these inputs as well. We addressed this issue by assuming a high degree of correlation when calculating the ranges for the results, as described in the Appendix. Third, the calculations require estimates of the benefits of interrupting STI and HIV transmission in the population. Such

estimates require a tradeoff between simple, more practical modeling approaches and more complex, data-intensive modeling approaches.²⁷ To minimize data requirements to the user and to help make the model easier to describe and understand, we applied a simplified yet evidence-based characterization of complex STI and HIV transmission dynamics.

STIC Figure 2.0 does not account for potential diminishing marginal returns of program activities. For example, the benefit per person referred for HIV PrEP is constant in STIC Figure 2.0, regardless of the number of people referred. However, if HIV PrEP were expanded beyond the populations at highest risk for HIV, the benefit per person referred for HIV PrEP would likely begin to decline, and the benefits of HIV PrEP referral would be overestimated. For this reason, STIC Figure 2.0 is more suitable for estimating the health and economic benefits of program activities rather than for determining the optimal mix of program activities.

STIC Figure 2.0 does not account for STI and HIV program costs when estimating the costs saved by STI and HIV program activities. Thus, the estimated cost savings are not net savings, i.e., they do not reflect savings above and beyond the cost of performing the program activities. Instead, the estimated cost savings reflect only the benefits of program activities. Estimates of the cost of delivering the STI and HIV services would be needed in addition to the STIC Figure 2.0 output in order to generate estimates of program cost-effectiveness. Similarly, STIC Figure 2.0 does not account for all possible health outcomes of program activities. For example, the tool does not consider the potential impact of EPT on antimicrobial resistance.

Despite these challenges and limitations, STIC Figure 2.0 allows STI and HIV prevention personnel, researchers, and other users to calculate evidence-based estimates of the impact of program activities. The evidence base for the model behind the tool's calculations is described in this manuscript and is documented extensively in the Appendix. The improved interactive user interface makes it easier to generate and explore the results and to incorporate the results into reports and presentations for audiences interested in data on the health and economic impact of STI and HIV prevention activities, such as national, state, and local public health leaders. The STIC Figure 2.0 tool and User Guide are included in the supplemental digital content. Dissemination plans are ongoing and include providing a notification of the availability of STIC Figure 2.0 to all jurisdictions that are directly funded by CDC for STI prevention.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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User Inputs (Number of People Treated for STIs and Number of People Receiving HIV-related Services) for the STIC Figure 2.0 Tool, with Hypothetical Data for Illustration

Table 1:

STI/HIV	Program activity*	Number receiving treatment or service in past year in hypothetical STI prevention program	
		Males	Females
Chlamydia	Confirmed cases treated [†]	600	1,045
	Persons receiving epi-treatment [‡]	20	30
	EPT referrals or prescriptions distributed to patients for partners [§]	60	100
	Persons receiving other presumptive treatment [¶]	5	10
Gonorrhea	Confirmed cases treated [†]	390	255
	Persons receiving epi-treatment [‡]	10	10
	EPT referrals or prescriptions distributed to patients for partners [§]	40	25
	Persons receiving other presumptive treatment [¶]	5	5
P&S syphilis	Confirmed cases treated [†]	45	15
	Persons receiving epi-treatment [‡]	5	5
HIV	Persons with newly diagnosed HIV linked to care [§]	30	5
	Persons with previously-diagnosed HIV linked or relinked to care [§]	15	5
	Persons provided with referral for HIV-PrEP [§]	265	5
	Persons receiving direct provision of HIV-PrEP [§]	0	0

* Users may enter values for up to all 28 of the user inputs shown but must enter at least one value for the STIC Figure 2.0 tool to generate estimates of program impact. The hypothetical prevention program treats about 5% of reported chlamydia, gonorrhea, and syphilis cases in an average state and provides HIV services as shown (see Appendix for details).

[†] Refers to confirmed or probable cases, as per STI case definitions (<https://www.cdc.gov/std/statistics/2022/case-definitions.htm>, accessed 4/30/2024) that have documented treatment.

[‡] In STIC Figure 2.0, epi-treatment refers to the documented treatment of persons who are sex partners or associates of an infected person but are not considered confirmed cases treated.

[§] These STIC Figure 2.0 user inputs were not included in the previous version (STIC Figure 1.0).

[¶] Refers to presumptive treatment other than epi-treatment of sex partners and associates (e.g., presumptive treatment of chlamydia in a patient with gonorrhea).

STIC Figure 2.0 is the name of the spreadsheet tool that allows users to estimate the impact of their STI and HIV prevention activities. The STIC Figure 2.0 tool and User Guide are included in the supplemental digital content.

Table 2:
Overview of STIC Figure 2.0 User Inputs, Model Outputs, and Key Assumptions

User inputs	Model outputs	Key assumptions used in calculations*
Number of people treated for chlamydia [†]	- Number of PID cases averted and costs saved among women treated for chlamydia - Number of epididymitis cases averted and costs saved among men treated for chlamydia - Number of chlamydial infections averted and costs saved in the population - Number of chlamydia-attributable HIV infections averted and costs saved in the population	0.06 cases of PID are prevented for each woman treated for chlamydia 0.02 cases of epididymitis are prevented for each man treated for chlamydia 0.5 subsequent chlamydial infections are averted in the population for each person treated for chlamydia - The probability of a chlamydia-attributable HIV infection is 0.00022 per chlamydial infection in women and MSW and 0.00439 per chlamydial infection in MSM
Number of people treated for gonorrhea [†]	- Number of PID cases averted and costs saved among women treated for gonorrhea - Number of epididymitis cases averted and costs saved among men treated for gonorrhea - Number of gonococcal infections averted and costs saved in the population - Number of gonorrhea-attributable HIV infections averted and costs saved in the population	0.06 cases of PID are prevented for each woman treated for gonorrhea 0.02 cases of epididymitis are prevented for each man treated for gonorrhea 0.5 subsequent gonococcal infections are averted in the population for each person treated for gonorrhea - The probability of a gonorrhea-attributable HIV infection is 0.00022 per gonococcal infection in women and MSW and 0.00439 per gonococcal infection in MSM
Number of people treated for syphilis [†]	- Number of long-term syphilis sequelae cases averted and costs saved in people treated for syphilis - Number of congenital syphilis cases averted and costs saved through treatment of women with syphilis - Number of syphilitic infections averted and costs saved in the population - Number of syphilis-attributable HIV infections averted and costs saved in the population	0.001 cases of long-term sequelae (cardiovascular syphilis, tabes dorsalis, meningovascular syphilis, or general paresis) are prevented for each person treated for syphilis 0.5 subsequent syphilitic infections are averted in the population for each person treated for syphilis - The probability of a syphilis-attributable HIV infection is 0.00462 per syphilitic infection in women, MSW, and MSM
Number of people with HIV linked or re-linked to HIV care	Number of HIV infections averted and costs saved in partners of those with HIV through achieving viral suppression	For each person linked or re-linked to care, 0.011 HIV infections are averted
Number of people referred for HIV-PrEP	Number of HIV infections averted and costs saved in persons referred to HIV-PrEP	- For each person referred to HIV-PrEP, 0.049 will initiate PrEP - For each person initiating HIV-PrEP, 0.74 person-years on PrEP are gained - The number of HIV infections averted per person-year on PrEP is 0.0006 for women and MSW and 0.0060 for MSM
Number of people receiving direct provision of HIV-PrEP	Number of HIV infections averted and costs saved in persons provided with HIV-PrEP	- For each person initiating HIV-PrEP, 0.74 person-years on PrEP are gained - The number of HIV infections averted per person-year on PrEP is 0.0006 for women and MSW and 0.0060 for MSM

* Selected key assumptions are highlighted in this column. See Tables 3 and 4 for more details on the model parameters and see the Appendix for a complete listing of all model parameters and references and a more detailed explanation of the model calculations.

[†] As illustrated in Table 1, the STIC Figure 2.0 user enters the number of people treated for chlamydia, gonorrhea, and syphilis, stratified by up to four categories: (1) the number of confirmed cases treated, (2) the number of “epi-treated” patients, (3) the number of patients given expedited partner therapy (EPT) to distribute, and (4) the number of people treated presumptively. In calculating the benefits of treatment, the STIC Figure 2.0 tool applies estimates of the percentage of people treated who are actually infected (e.g., STIC Figure 2.0 assumes that 100% of those with confirmed infections are infected, but < 100% of those epi-treated are actually infected). See the manuscript text and Appendix for details.

STIC Figure 2.0 is the name of the spreadsheet tool that allows users to estimate the impact of their STI and HIV prevention activities.

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STIC indicates sexually transmitted infection costs; PID, pelvic inflammatory disease; MSW, men who have sex only with women; MSM, men who have sex with men; PrEP, pre-exposure prophylaxis.

Table 3: Main Epidemiologic Parameters in the STIC Figure 2.0 Tool: Parameter Description, Base Case Value, Lower and Upper Bound Values, and Source

Parameter Description	Base case value	Lower bound value	Upper bound value	Source
Parameters regarding population served				
Proportion of women with P&S syphilis who are pregnant	0.15	0.06	0.18	See Appendix
Proportion of chlamydial infections in men that occur in MSM	0.11	0.04	0.18	See Appendix
Proportion of gonococcal infections in men that occur in MSM	0.60	0.40	0.72	6
Proportion of syphilitic infections in men that occur in MSM	0.60	0.45	0.70	6
Proportion of HIV infections in men that occur in MSM	0.87	0.81	0.92	7
Proportion of men using HIV PrEP who are MSM	0.98	0.92	1.00	8
Parameters regarding impact of STI treatment on health outcomes				
Absolute reduction in probability of PID given treatment of chlamydia or gonorrhea in women	0.06	0.01	0.12	9
Absolute reduction in probability of epididymitis given treatment of chlamydia or gonorrhea in men	0.02	0.01	0.04	9
Absolute reduction in probability of long-term syphilis sequelae given treatment of P&S syphilis	0.0010	0.0004	0.0016	10
Absolute reduction in probability of congenital syphilis given treatment of pregnant woman with P&S syphilis	0.50	0.25	0.75	4
Number of secondary infections averted in population per STI treated	0.50	0.05	0.95	4
Parameters regarding STI infection status				
Probability that woman has chlamydia, given the woman has gonorrhea	0.35	0.26	0.40	11–13
Probability that man has chlamydia, given the man has gonorrhea	0.24	0.15	0.35	11,13,14
Probability that sex partner of chlamydia or gonorrhea patient has chlamydia or gonorrhea	0.31	0.21	0.41	15
Probability that sex partner of syphilis patient has syphilis	0.30	0.10	0.80	16
Parameters regarding STI-attributable HIV infections				
Probability of STI-attributable HIV infection per chlamydial or gonococcal infection in women and MSM	0.00022	0.00002	0.00042	17
Probability of STI-attributable HIV infection per chlamydial or gonococcal infection in MSM	0.004	0.003	0.007	18
Probability of STI-attributable HIV infection due to syphilis	0.0046	0.0005	0.0088	17
Parameters regarding impact of STI and HIV prevention services				
Number of HIV infections averted per person linked to care	0.011	0.008	0.019	See Appendix
Number of HIV infections averted per person-year on PrEP: women and MSM	0.0006	0.0004	0.0041	See Appendix
Number of HIV infections averted per person-year on PrEP: MSM	0.006	0.004	0.040	See Appendix

Parameter Description	Base case value	Lower bound value	Upper bound value	Source
Number of persons initiating PrEP per PrEP referral	0.05	0.02	0.21	See Appendix
Probability that EPT, when provided to index patient with chlamydia or gonorrhea, is delivered to and taken by a sex partner of the index patient	0.44	0.34	0.56	19,20

When a single reference is listed for a parameter, the reference is most applicable to the parameter’s base case value; other references (not listed here) might have informed the lower and upper bound estimates. See Appendix for a more complete description and documentation of assumptions.

Parameter values have been rounded to either 2 decimal places or to the minimum number of decimal places needed to distinguish the lower bound value from zero and from the base case value, whichever is greater. See Appendix for the unrounded values used in the STIC Figure 2.0 tool.

STIC Figure 2.0 is the name of the spreadsheet tool that allows users to estimate the impact of their STI and HIV prevention activities.

STIC indicates sexually transmitted infection costs; STI, sexually transmitted infection; P&S, primary and secondary; PID, pelvic inflammatory disease; MSW, men who have sex only with women; MSM, men who have sex with men; PrEP, pre-exposure prophylaxis; EPT, expedited partner therapy.

Table 4: Lifetime Direct Medical Cost and Productivity Cost^{*} per Outcome in the STIC Figure 2.0 Tool, in 2023 US Dollars

Outcome	Direct medical cost per outcome			Productivity cost per outcome			Source
	Base case value	Lower bound value	Upper bound value	Base case value	Lower bound value	Upper bound value	
Pelvic inflammatory disease (PID) [†]	2,703	2,107	4,051	2,173	819	4,499	9 21
Epididymitis [†]	413	256	571	710	268	1,470	9 21
Syphilis sequelae ^{†¶}	26,826	6,170	85,843	206,270	123,762	342,408	10 21
Congenital syphilis ^{†¶}	14,573	8,335	24,514	91,321	45,661	136,982	24 4
Chlamydia in women ^{‡,§}	289	140	532	205	69	498	9 21
Chlamydia in men ^{‡,§}	51	35	68	28	14	50	9 21
Gonorrhea in women ^{‡,§}	280	106	571	212	59	542	9 21
Gonorrhea in men ^{‡,§}	86	40	160	37	17	72	9 21
Syphilis ^{‡¶}	1,311	803	2,076	411	176	1,004	10 21
HIV ^{‡¶}	463,013	359,595	539,865	87,458	17,387	148,158	22 23

^{*} Productivity costs reflect reductions in market productivity (paid work) and nonmarket productivity (unpaid yet economically valuable activities such as providing childcare) due to morbidity and mortality, e.g., losses arising from a reduced ability or inability to perform productive tasks due to morbidity or mortality, losses due to missing time from work to seek medical care, etc. However, the estimate we applied for the productivity cost of HIV reflects mortality costs only.

[†] The costs for these outcomes are expressed in terms of the average discounted lifetime cost per case (future costs are discounted to present value at an annual rate of 3%). These costs were used to value the benefits in those treated for chlamydia, gonorrhea, and syphilis (and in infants of those treated for syphilis). For PID, epididymitis, and congenital syphilis, the cost estimates are discounted to the time of diagnosis, which is assumed to happen within the first year of infection or shortly thereafter. For syphilis sequelae, the cost estimate is discounted to the time of infection.

[‡] The costs for these outcomes are expressed in terms of the average discounted lifetime cost per infection (future costs are discounted to the time of infection at an annual rate of 3%). These costs were used to value the STIs that were averted in the population through treatment of STIs; the STI-attributable HIV infections that were averted through treatment of STIs; and the HIV infections that were averted through HIV prevention services.

[§] We assumed that treatment of people with STIs would avert STIs in the population. As described in the Appendix in more detail, for treatment of chlamydia in women and in men who have sex only with women (MSW), we valued the averted chlamydial infections in the population as the average cost per chlamydial infection in women and men, under the assumption that treatment of women would have

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downstream benefits for men and women and that treatment of MSW would have downstream benefits for women and men. For the treatment of chlamydia in men who have sex with men (MSM), we valued the averted chlamydial infections in the population as the average cost per chlamydial infection in men, under the assumption that treatment of MSM would have downstream benefits primarily to MSM. We used an analogous approach for gonorrhea, but no such approach was needed for syphilis because the syphilis cost estimates we applied were not sex specific. See Appendix for details.

These cost estimates were not stratified by sex.

STIC Figure 2.0 is the name of the spreadsheet tool that allows users to estimate the impact of their STI and HIV prevention activities.

STIC indicates sexually transmitted infection costs; STI, sexually transmitted infection.

Table 5: Results of STIC Figure 2.0 calculations of adverse outcomes averted and costs saved by STI and HIV prevention activities: a hypothetical example*

Item estimated	Adverse STI outcomes averted in those treated for STIs*		Infections averted in the population*		Total (all outcomes)
	Congenital syphilis cases averted in infants of treated mothers [†]	Cases of sequelae averted in patients treated [‡]	HIV infections averted	STI infections averted [§]	
Number of outcomes averted: base case	1	72	2	1,177	1,253
Number of outcomes averted: lower bound	1	44	1	763	809
Number of outcomes averted: upper bound	1	89	3	1,447	1,540
Direct medical costs saved: base case	\$17,540	\$162,000	\$1,008,450	\$241,800	\$1,429,790
Direct medical costs saved: lower bound	\$10,430	\$97,110	\$507,780	\$139,270	\$754,590
Direct medical costs saved: upper bound	\$21,850	\$201,440	\$1,381,400	\$301,580	\$1,906,270
Productivity costs saved: base case	\$109,930	\$147,430	\$190,480	\$150,020	\$597,860
Productivity costs saved: lower bound	\$66,380	\$77,840	\$83,560	\$75,490	\$303,270
Productivity costs saved: upper bound	\$136,680	\$184,710	\$267,810	\$188,140	\$777,340
Total costs saved: base case [¶]	\$127,470	\$309,430	\$1,198,930	\$391,810	\$2,027,650
Total costs saved: lower bound	\$76,800	\$174,950	\$591,350	\$214,760	\$1,057,860
Total costs saved: upper bound	\$158,530	\$386,150	\$1,649,210	\$489,720	\$2,683,610

* This table shows the STIC Figure 2.0 calculations of the health and economic benefits of the hypothetical program activities described in Table 1. The numbers of outcomes averted are rounded to the nearest whole number, and the costs saved are rounded to the nearest multiple of \$10. Totals might not match sum of individual components due to rounding.

[†] This column reflects the number of congenital syphilis cases averted in infants of women treated for primary and secondary syphilis. Treatment of women and men with syphilis is assumed to avert future infections as reflected in the column "Infections averted in the population." Although these averted infections would likely result in additional averted cases of congenital syphilis, these additional congenital syphilis cases averted through interruption of syphilis transmission in the population are not included in the STIC Figure 2.0 calculations.

[‡] This column includes pelvic inflammatory disease (PID) averted in women through treatment of chlamydia and gonorrhea, epididymitis averted in men through treatment of chlamydia and gonorrhea, and long-term syphilis sequelae averted in women and men through treatment of primary and secondary syphilis. Treatment of these STIs is assumed to avert future infections in the population as reflected in the column "Infections averted in the population." These averted infections are assumed to result in additional averted cases of PID, epididymitis, and long-term syphilis sequelae, but these additional cases averted are not reflected in the column "Cases of sequelae averted in patients treated" and are not explicitly reported as part of the STIC Figure 2.0 output. However, the values applied in STIC Figure 2.0 for the average lifetime cost per infection for chlamydia, gonorrhea, and syphilis include the possibility that costs are incurred for PID, epididymitis, and long-term syphilis sequelae.

[§] Includes chlamydia, gonorrhea, and syphilis.

[¶] Total costs saved is the sum of direct medical costs saved and productivity costs saved.

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