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

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The STIC Figure 2.0 tool and User Guide are included in the supplemental digital content.

STIC Figure 2.0 Appendix

Overview

The base case calculations in STIC Figure 2.0 are described in the tables of this Appendix. In the first section of this Appendix, we provide a brief description of these tables and how they explain the calculations of the base case results (i.e., the point estimates). In the second section, we explain how the ranges were calculated around the point estimates.

Except where noted, all costs are presented in 2023 US dollars. To adjust for inflation to 2023 dollars, we used the Consumer Price Index (all items) for productivity cost estimates and the Consumer Price Index (medical care) for medical cost estimates. These indices were obtained from https://www.bls.gov/cpi/.

Section 1: Calculation of point estimates (base case results)

User Inputs

Users can enter up to 28 inputs about their sexually transmitted infection (STI) and HIV program activities, as listed in Appendix Table A1. There are 30 inputs listed in Appendix Table A1, but two of these inputs are not currently available in STIC Figure 2.0 (Number of women with syphilis given expedited partner therapy [EPT] to distribute to partners, and number of men with syphilis given EPT to distribute to partners) given that EPT is currently not recommended for syphilis patients (Workowski 2021). However, these two inputs can be unhidden in STIC Figure 2.0 in the future if guidelines change and EPT is recommended for syphilis patients.

Users do not have to enter values for all the inputs listed in the table. The user can enter 0 for any input that is not applicable for the user's program or if no data are available to generate an estimated value. If a value is provided for at least one of the inputs, STIC Figure 2.0 will calculate results.

Services provided to men who have sex only with women (MSW) and men who have sex with men (MSM)

The user enters information in STIC Figure 2.0 about the number of men treated for STIs and the number of men provided with HIV services as described in Appendix Table A1. STIC Figure 2.0 then calculates how these activities were allocated among men who have sex with men (MSM) and men who

have sex only with women (MSW), according to the equations listed in Appendix Table A2. STIC Figure 2.0 includes default values for the parameters used in these calculations (P_A1–P_A5), but users can enter their own values for these parameters if they prefer.

Calculations of the number of people with STIs who are treated, and the number of people provided with HIV services

Appendix Table A3 describes the equations used to calculate the number of people with STIs who are treated, and the number of people provided with HIV services, for women, MSW, and MSM. For persons provided with EPT to deliver to their partners, we assumed that women would deliver EPT to MSW, MSW would deliver EPT to women, and MSM would deliver EPT to MSM. For example, the number of women treated for chlamydia (Cw) depends in part on MSW4, the number of MSW provided with EPT to deliver to their partners (MSW4). Similarly, the number of MSW treated for chlamydia (Cmsw) depends in part on W4, the number of women provided with EPT to deliver to their partners.

Calculations of the number of adverse outcomes averted by program activities

Appendix Table A4 describes the equations used to calculate the number of adverse outcomes averted by STI and HIV program activities. Appendix Table A8 provides a more detailed explanation of these equations. On the "Output" tab of STIC Figure 2.0, these outcomes are grouped into the following four categories:

Outcome Category 1. Congenital syphilis averted through treatment of women with syphilis

This outcome is described as Outcome_W13 in Appendix Table A4.

Outcome Category 2. Sequelae averted in patients treated

This outcome includes: Outcome_W1, Outcome_W2, Outcome_W3, Outcome MSW1, Outcome_MSW2, Outcome_MSW3, Outcome_MSM1, Outcome_MSM2, and Outcome_MSM3 in Appendix Table A4.

Outcome Category 3. HIV infections averted in the population

This outcome includes: Outcome_W7, Outcome_W8, Outcome_W9, Outcome_W10, Outcome_W11, Outcome_W12, Outcome_MSW7, Outcome_MSW8, Outcome_MSW9, Outcome_MSW10, Outcome_MSW11, Outcome_MSW12, Outcome_MSM7, Outcome_ MSM8, Outcome_ MSM9, Outcome_MSM10, Outcome_MSM11, and Outcome_MSM12 in Appendix Table A4.

Outcome Category 4. STI infections averted in the population

This outcome includes Outcome_W4, Outcome_W5, Outcome_W6, Outcome_MSW4, Outcome_MSW5, Outcome_MSW6, Outcome_MSM4, Outcome_MSM5, Outcome_MSM6 in Appendix Table A4.

For more information about the model calculations of these outcomes, see Appendix Table A8 which provides a more detailed explanation of the equations described in Appendix Table A4.

Costs saved by STI and HIV program activities

Estimates of the costs saved by STI and HIV program activities were calculated by multiplying the number of adverse outcomes averted (from Appendix Table A4) by the estimated average lifetime cost per outcome, as described in Appendix Table A5 for the direct medical costs saved. Calculations of the productivity costs saved (not shown in a table) were calculated as in Appendix Table A5 except that the productivity cost estimates were applied instead of direct medical cost estimates. For example, the direct medical costs saved from averted PID in women treated for chlamydia were calculated as Outcome_W1*Cost_1 as described in Appendix Table A5, where Cost_1 is the direct medical cost per case of PID. The productivity costs of PID averted in women treated for chlamydia were calculated as Outcome_W1*Cost_11, where Cost_11 is the productivity cost per case of PID as listed in Appendix Table A6.

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. For example, treatment for HIV can prevent sexual transmission of HIV. When STIC Figure 2.0 estimates the costs saved by linking to care for people with HIV, STIC Figure 2.0 estimates the costs saved by preventing new HIV infections. However, the costs of providing HIV care to the person linked to HIV care is not included in this calculation. For further illustration, suppose an HIV infection in Person B is averted because Person A was linked to HIV care. In this example, the benefits calculated by STIC Figure 2.0 include the HIV infection averted in Person B as well as the lifetime medical costs of HIV saved in Person B that otherwise would have been incurred if Person B had acquired HIV. However, in this example, the program costs incurred to link Person A to care and the HIV treatment costs incurred for Person A are not included in the STIC Figure 2.0 calculations, which include only the benefits of program activities, not the costs.

Model parameters

The model parameters are described briefly in Appendix Table A6 for quick reference and are described in more detail in Appendix Table A7. Model parameters P_A1–P_A6 can be modified by the users, whereas model parameters P_B1–P_B22 are set in the STIC Figure 2.0 tool. If the user changes one or more of the parameters P_A1–P_A6, the range for the modified parameter(s) is calculated to ensure that the new range is at least as great (in both absolute and relative terms) as the original range. For example, for the percentage of females with syphilis who are pregnant, STIC Figure 2.0 uses a default value of 14.6% with a range of 5.6% to 18.1%. The default lower bound value is 9.0 percentage points lower than the default base case value and is 38.3% of the default base case value. If the user changes the base case value to 12%, then STIC Figure 2.0 applies a lower bound calculated as the minimum of (1) 12.0% - 9.0% =3.0% and (2) 12.0% x 38.3% = 4.6%, which yields a lower bound of 3.0%. If these calculations yielded a result < 0, then 0% was applied. A similar approach was used to calculate the new upper bound, and if these calculations yielded a result > 100%, then 100% was applied.

Illustrative application of model

In the manuscript, we performed an illustrative application of STIC Figure 2.0 in which we calculated the predicted impact of STI and HIV prevention activities for a hypothetical STI program in the United States. The hypothetical program activity described in Table 1 of the manuscript reflects an STI program that provides treatment for 5% of reported chlamydia, gonorrhea, and syphilis cases that occur each year in an average state. To calculate 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 multiplied by 5% and rounded the results up to the nearest multiple of 5. Case report data was obtained from CDC's AtlasPlus, available at https://www.cdc.gov/nchhstp/about/atlasplus.html. Values for the number of people epi-treated for STIs, the number receiving EPT, and the number presumptively treated for other reasons were assumed and reflect data indicating that epi-treatment and EPT account for a relatively small fraction of treated cases (Rowlinson et al. 2021, Cramer et al. 2013).

For HIV prevention activities in this hypothetical example (Table 1, manuscript), we followed the same approach and assumed that the program would account for 5% of the HIV prevention activities in the average state. To calculate the number of people with newly diagnosed HIV linked to care for this example, we divided the number of people diagnosed with HIV in 2022 (obtained from AtlasPlus) by 50

(to represent the average state), multiplied by 5% and rounded the results to the nearest multiple of 5. The number of people re-linked to care in this example was assumed.

To calculate the number of people referred for HIV pre-exposure prophylaxis (PrEP) for this example, we used 2022 AtlasPlus estimates of the number of persons aged ≥16 years classified as having been prescribed HIV PrEP and the estimated number of persons aged ≥16 years who had indications for HIV PrEP. Specifically, we calculated the number of men with need of HIV PrEP as the difference between the number of men with indications for HIV PrEP and the number of men having been prescribed PrEP. We assumed about 45% of men with need of HIV PrEP would be referred to HIV PrEP in a given year, consistent with the 2-year referral probability of 72% reported by Frank and colleagues (2022). We assumed that the hypothetical program in this example would account for 5% of 1/50th of the men referred for HIV PrEP nationally. For the number of women referred for HIV PrEP in this example, the values were assumed and reflect data indicating that uptake of HIV PrEP is lower among women than men nationally.

Section 2: Calculation of ranges

One approach to calculate ranges for the STIC Figure 2.0 estimates would be to perform Monte Carlo simulations in which the results are calculated 10,000 times, each time drawing a random value for each parameter value used in the calculations in accordance with a distribution assumed for each parameter value. However, this simulation approach would produce results that vary each time the 10,000 simulations are repeated, whereas a typical user of STIC Figure 2.0 might prefer that the same set of inputs consistently yield the same results. So, we instead followed a simplified approach as used by Martin (2024) in which we calculated a deterministic approximation of what the interquartile range (IQR) of the Monte Carlo simulations might be over thousands of simulations.

Three step approach to calculating ranges

Here, we describe the approach in three steps and then provide an example of how the ranges were calculated for the number of PID cases averted by treatment of women with chlamydia.

Step One: Calculating ranges for the number of adverse outcomes averted

Appendix Table A3 shows the equations we used to calculate the number of people with STIs who are treated and the number of people provided with HIV services. We calculated minimum and maximum

possible values for each row of Table A3 by setting all parameters used in the “calculation” column to their lower and upper bounds, respectively.

Appendix Table A4 shows the equations we used to calculate the numbers of adverse outcomes averted. For each of these outcomes, we calculated the minimum and maximum possible values for the number of adverse outcomes averted by setting all parameters used in the "calculation” column to their lower and upper bounds, respectively. In doing so, terms in parentheses were varied to minimize or maximize the value of the parenthetical term. For example, to obtain the minimum possible value of Outcome_W1, the upper bound value of P_B9 was applied so that the parenthetical term (1-P_B9) would be minimized.

As noted, to calculate the minimum and maximum possible values for the number of outcomes averted, all parameters used in the calculations were set to their lower or upper bound value as listed in Appendix Table A6. Further, because the calculations described in Appendix Table A4 include inputs from Appendix Table A3 such as the terms Cw, Gw, Sw, we varied these inputs as well by varying the parameter(s) used in these previous steps. For example, Outcome_W1 (the number of PID cases averted in women treated for chlamydia) was calculated as Cw*P_B8*(1-P_B9)*(1-P_B4) as noted in Appendix Table A4. So, when determining the minimum and maximum possible values for Outcome_W1, we varied not only the parameters P_B8, P_B9, and P_B4, but also the value Cw. Because Cw was calculated as Cw = W1 + (P_B1*P_B2*MSW4) + (P_B2*W7) + (P_B3*W10) as described in Appendix Table A3, to find the minimum and maximum values for Cw we varied not only the parameters P_B1, P_B2, and P_B3, but also the value MSW4. Because MSW4 was calculated as MSW4 = M4*(1-P_A1) as described in Appendix Table A2, to determine the minimum and maximum values for MSW4, we varied the parameter P_A1.

For each outcome, once we determined the minimum and maximum possible values for the number of adverse outcomes averted, we assumed the number of outcomes averted followed a lognormal distribution with the base case value as the mean, and the standard deviation approximated as the difference between the maximum and minimum value divided by (2*1.96). We assumed a lognormal distribution because (1) the outcome is bounded by zero and (2) the use of a lognormal distribution simplifies the confidence interval calculation as described in Step Three below.

Step Two: Calculating ranges for the direct medical costs saved per case averted

For each outcome, we assumed the direct medical cost per case followed a lognormal distribution with the base case value as the mean, and the standard deviation approximated as the difference between the upper bound value and lower bound value divided by (2*1.96).

Step Three: Calculating ranges for the total medical costs saved

For each outcome, the total medical cost saved was calculated as the product of the number of outcomes averted and the direct medical cost per case. Following Martin (2024), because both these inputs were "assumed to follow independent lognormal distributions, their product was assumed to follow a lognormal distribution as well." So, given that the lognormal distribution parameters are $\mu 1$ and $\sigma 1$ for the number of adverse outcomes averted and $\mu 2$ and $\sigma 2$ for the lifetime cost per outcome, we calculated the lognormal distribution parameters for the product of these two distributions as $\mu = \mu 1 + \mu 2$ and $\sigma^2 = \sigma 1^2 + \sigma 2^2$. After calculating the lognormal distribution parameters for the total medical costs saved, we calculated the IQR as the expected 25th and 75th percentiles of the lognormal distribution with the given parameters.

Example of calculation of ranges for Outcome_W1 (number of PID cases averted in women treated for chlamydia).

This example assumes that (1) the user inputs for W1, W7, M4, and W10 are as follows: W1=100, W7=90, M4=80, and W10 = 70, (2) all other inputs are 0, and (3) the parameter values (e.g., P_B1, P_B2, etc.) are as described in Appendix Table A6. In this example and other examples below, the precision of the calculations we describe varies (i.e., the number of digits after the decimal place varies from 0 to 7 depending on the context). Our intent was to provide enough precision so that interested readers could more easily reproduce our calculations.

Example, Step One of calculation of ranges

Because Outcome_W1 was calculated as Cw*P_B8*(1-P_B9)*(1-P_B4), we first needed to calculate the lower and upper bound values for Cw in order to calculate the minimum and maximum possible values for Outcome_W1. Because Cw was calculated as Cw =W1 + (P_B1*P_B2*MSW4) + (P_B2*W7) + (P_B3*W10) as described in Appendix Table A3, we first needed to calculate the lower and upper bound values for MSW4 before calculating the minimum and maximum possible values for Cw.

The value MSW4 was calculated as MSW4=M4*(1-P_A1) as described in Appendix Table A2. Because the percentage of men with chlamydia who are MSM is 10.7% (range: 3.9% to 17.5%) as described in Appendix Table A6, the parameter MSW4 in this example has a base case value of 71.44 (calculated as 80*(1-10.7%)), with a lower bound value of 66 (calculated as 80*(1-17.5%)) and an upper bound value of 76.88 (calculated as 80*(1-3.9%)).

So, in this example, the base case value of Cw would be 100 + (0.440*0.310*71.44) + (0.310*90) + (0.354*70) = 162.424, where the values 100, 90, and 70 are user inputs as described above, the value 71.44 is the base case value of MSW4, and the values 0.440, 0.310, and 0.354 are base case parameter values as in Appendix Table A6. The minimum possible value of Cw would be 100 + (0.340*0.210*66) + (0.210*90) + (0.260*70) = 141.8124. The maximum possible value of Cw would be 100 + (0.558*0.410*76.88) + (0.410*90) + (0.400*70) = 182.4886.

So, with the base case value of Cw being 162.424, the base case value of Outcome W1 would be: 162.424*(0.06)*(1-0.2)*(1-0.042) = 7.4689. With the minimum possible value of Cw being 141.8124, the minimum possible value of Outcome_W1 would be: 141.8124*(0.01)*(1-0.32)*(1-0.062) = 0.9045. Similarly, with the maximum possible value of Cw being 182.4886, the maximum possible value of Outcome_W1 would be: 182.4886*(0.12)*(1-0.14)*(1-0.024) = 18.3808. From the minimum and maximum value, we approximated the standard deviation of Outcome_W1 as (18.3808 – 0.9045)/(2*1.96) = 4.4582.

For a variable with a mean of 7.4689 (the base case value) and a standard deviation of 4.4582, the lognormal distribution parameters would be μ =1.85837 and σ = 0.55205. These distribution parameters were calculated as $\mu = Ln(M) - 0.5*Ln(1 + (SE^2 / M^2))$ and $\sigma^2 = Ln(1 + (SE^2 / M^2))$, were M is the base case value and SE is the standard deviation, as was done in Martin (2024). The 25th percentile of this distribution is 4.4195 and the 75th percentile is 9.3066. So, the STIC Figure 2.0 calculations for Outcome_W1 yield a base case estimate of 7.4689 with a range of 4.4195 to 9.3066. We calculated these ranges using the "lognorm inverse" function in Excel (e.g., the value of 4.4195 for the 25th percentile was calculated in Excel using the expression "=LOGNORM.INV(0.25, 1.85837, 0.55205)."

Example, Step Two of calculation of ranges

The estimated cost per case of PID is $2,703 with a range of $2,107 to $4,051. We therefore assumed the cost per case followed a lognormal distribution with parameters μ = 7.88556 and σ = 0.18195, calculated using the same methods described in the example for Step One above.

The STIC Figure 2.0 calculations for the PID costs saved in women treated for chlamydia yield a base case estimate of $20,189, calculated as the base case number of PID cases averted (7.4689) multiplied by the base case cost per case of PID ($2,703).

Example, Step Three of calculation of ranges

The lognormal distribution parameters for the product of the number of cases averted (from Step One) and the cost per case averted (from Step Two) was calculated as $\mu = \mu1 + \mu2$ and $\sigma^2 = \sigma1^2 + \sigma2^2$, where $\mu1$ and $\sigma1$ are the lognormal distribution parameters for the number of PID cases averted and $\mu2$ and $\sigma2$ are the lognormal distribution parameters for the cost per case of PID. So, u = 1.85837 + 7.88556 =9.74394 and σ^2 = (0.55205*0.55205) + (0.18195*0.18195) = 0.33786 (and thus σ = 0.581236). Given these distribution parameters, the 25th percentile of the distribution is $11,520 and the 75th percentile of the distribution is $25,235. So, the STIC Figure 2.0 calculations for the PID costs saved in women treated for chlamydia yield a base case estimate of $20,189, with a range of $11,520 to $25,235.

Ranges of combined outcomes

Results across the outcomes listed in Appendix Table A4 were summed to generate subtotals and overall totals. For these subtotals and totals, the confidence intervals were summed as well. For example, the outcome "sequelae averted in patients treated" was calculated as the sum of 9 outcomes: Outcome_W1, Outcome_W2, Outcome_W3, Outcome_MSW1, Outcome_MSW2, Outcome_MSW3, Outcome_MSM1, Outcome_MSM2, and Outcome_MSM3. The lower bound for "sequelae averted in patients treated" was calculated as the sum of the lower bound values for these 9 outcomes. The upper bound for "sequelae averted in patients treated" was calculated as the sum of the upper bound values for these 9 outcomes. A similar approach was used in Martin (2024) and is supported by the high degree of correlation across the outcomes. That is, many of the outcomes depend on some of the same parameters as other outcomes and thus would be expected to be highly correlated with one another in Monte Carlo simulations. For example, the probability of PID due to chlamydia and gonorrhea affects Outcome_W1 and Outcome_W2; the probability of epididymitis due to chlamydia and gonorrhea affects Outcome_MSW1, Outcome_MSW2, Outcome_MSM1, and Outcome_MSM2; and the probability of syphilis sequelae affects Outcome_W3, Outcome_MSW3, and Outcome_MSM3. However, this approach likely is conservative in that it makes the estimated ranges wider than they would be otherwise, because there is not 100% correlation across the outcomes that are positively correlated. Further, a few of the parameters are inversely correlated, making it even more unlikely that the most extreme outcomes would occur simultaneously for all groups (women, MSW, and MSM). The inversely

correlated parameters are those that classify men as MSW or MSM. For example, when the percentage of chlamydia cases in men that occur in MSW is set to the lower bound, then the percentage of chlamydia cases in men that occur in MSM would be at its upper bound. However, in our simplified approach in which we sum the confidence intervals for women, MSW, and MSM, we did not account for these inverse correlations, thereby yielding wider ranges than would be estimated if these inverse correlations were accounted for.

Example of calculating ranges for a combination of outcomes

Here, we illustrate the calculation of the outcome "sequelae averted in patients treated", which as noted above was calculated as the sum of 9 outcomes: Outcome_W1, Outcome_W2, Outcome_W3, Outcome_MSW1, Outcome_MSW2, Outcome_MSW3, Outcome_MSM1, Outcome_MSM2, and Outcome_MSM3.

For simplicity, we use the same example used previously in which (1) the user inputs for W1, W7, M4, and W10 are as follows: W1=100, W7=90, M4=80, and W10 = 70, (2) all other inputs are 0, and (3) the parameter values (e.g., P_B1, P_B2, etc.) are as described in Appendix Table A6. In this example, Outcome_W2, Outcome_W3, Outcome_MSW1, Outcome_MSW2, Outcome_MSW3, Outcome_MSM2, and Outcome_MSW3 will all be 0. The only nonzero outcomes are Outcome_W1 and Outcome_MSM1. Outcome MSM1 is nonzero because a fraction of the 80 men for input M4 (number of men provided with EPT to deliver to their partners) will be MSM and are assumed to deliver EPT to MSM partners.

As noted in the example above, the STIC Figure 2.0 calculations for Outcome_W1 yield a base case estimate of 7.4689 with a range of 4.4195 to 9.3066. Similarly, the STIC Figure 2.0 calculations for the costs saved in averted PID in women treated for chlamydia yield a base case estimate of $20,189, with a range of $11,520 to $25,235.

In this example, the STIC Figure 2.0 calculations for Outcome_MSM1 yield a base case estimate of 0.0185, with a lower bound of 0.0050 and an upper bound of 0.0213. Because the outcome "sequelae averted in patients treated" is the sum of Outcome_W1 and Outcome_MSM1 in this example, the base case value for "sequelae averted in patients treated" is the sum of the base case values for Outcome_W1 and Outcome_MSM1, or 7.4689 + 0.0185 = 7.4874. The lower bound for "sequelae averted in patients treated" is the sum of the lower bounds of Outcome_W1 and Outcome_MSM1, or 4.4195 + 0.0050 = 4.4244. Similarly, the upper bound for "sequelae averted in patients treated" is the sum of the upper bounds of Outcome_W1 and Outcome_MSM1, or 9.3066 + 0.0213 = 9.3279.

Additional details of example of calculating ranges for combinations of outcomes

Here, the calculations for Outcome_MSM1 are explained in more detail to provide another example to interested readers.

As noted in Appendix Table A4, Outcome_MSM1 = Cmsm*P_B10*(1-P_B9)*(1-P_B6). As noted in Appendix Table A3, the value Cmsm =MSM1 + (P_B1*P_B2*MSM4) + (P_B2*MSM7) + (P_B5*MSM10). As noted in Appendix Table A2, the value MSM4 =M4*P_A1. Thus, the value of MSM4 is 80*0.107 = 8.56 in the base case, 80*0.039 = 3.12 in the lower bound, and 80*0.175 = 14.00 in the upper bound. Because the values for MSM1, MSM7, and MSM10 are 0 in this example, the value for Cmsm simplifies to Cmsm = P_B1*P_B2*MSM4. Accordingly, the value of Cmsm is 0.440*0.310*8.56 = 1.16758 in the base case, 0.340*0.210*3.12 = 0.222768 in the lower bound, and 0.558*0.41*14 = 3.20292 in the upper bound.

In this example, the STIC Figure 2.0 calculations for Outcome_MSM1 yield a base case estimate of 0.018476, calculated as 1.167584*0.02*(1-0.2)*(1-0.011). The minimum possible value of Outcome _MSM1 in this example is 0.00148, calculated as 0.222768*0.01*(1-0.32)*(1-0.023). The maximum possible value of Outcome _MSM1 in this example is 0.10963, calculated as 3.20292*0.04*(1-0.14)*(1-0.005). With these base case, minimum, and maximum values, the lognormal distribution parameters were calculated as μ =-4.5775 and σ = 1.082786. The 25th and 75th percentiles of this distribution would be 0.004953 and 0.021340.

Additional notes on calculating ranges

In some instances when dealing with parameters with extremely low values (such as the probability of an STI-attributable HIV infection in women or MSW), our simplified approach to estimating ranges can lead to implausible results, such as the upper bound being lower than the base case estimate. In instances where the upper bound calculated by STIC Figure 2.0 is lower than the base case value when assuming a lognormal distribution, STIC Figure 2.0 instead uses a normal distribution rather than the lognormal distribution to obtain the upper bound, and if this approach produced errors, STIC Figure 2.0 assumes the upper bound value is simply the average of the base case value and the maximum possible value. Similarly, in instances where the estimated lower bound value is higher than the base case value, STIC Figure 2.0 uses a normal distribution rather than a lognormal distribution to obtain the lower bound, and if this approach produces errors, STIC Figure 2.0 assumes the lower bound is the average of the base case result and the minimum possible value.

Example of application of normal distribution when lognormal distribution yields implausible results

Here we describe an example in which HIV PrEP referral is provided for 10 men, and no other STI/HIV services are provided. In this example, all the program inputs would be 0 on the "User input" tab, with one exception. The row "Persons provided with a PrEP referral" would have a value of 10 for the male column.

The number of HIV infections averted in MSM is calculated as the product of the number of men provided PrEP referral (10); the percent of male PrEP users who are MSM (97.7%; range: 91.9% to 100%); the number of people initiating PrEP per PrEP referral (0.049; range 0.024 to 0.207); the number of person-years on HIV PrEP per person initiating PrEP (0.74; range: 0.60 to 0.82); and the number of HIV infections averted per person year on HIV PrEP for MSM (0.00586; range: 0.00395 to 0.04). Thus, the number of HIV infections averted is 0.002076 in the base case, 0.000523 when applying all the lower bound values, and 0.067896 when applying all the upper bound values.

From these results (base case 0.002076, minimum 0.000523, maximum 0.067896) we calculated lognormal distribution parameters $\mu = -8.29830$ and $\sigma = 2.05960$; these distribution parameters reflect a lognormal distribution with mean 0.002076 and standard deviation of 0.0172, where the standard deviation was approximated as $(0.067896 - 0.000523)/(2*1.96) = 0.0172$.

To estimate the range for the number of HIV infections averted through PrEP referral in MSM, our usual approach would be to take the 25^{th} and 75^{th} percentiles of the lognormal distribution. However, in this scenario the 75^{th} percentile of this distribution is 0.0010, which is lower than the base case value of 0.002076. Thus, in this situation, because the lognormal distribution yielded unrealistic results (upper value of range was lower than base case result), STIC Figure 2.0 instead calculates the 25^{th} and 75^{th} percentiles of a normal distribution with mean 0.002076 and standard deviation of 0.0172, which are -0.00952 and 0.01367, respectively. When the lower bound is negative, STIC Figure 2.0 assigns a value of 0, which in this example yields a range of 0 to 0.01367 for the number of HIV infections averted.

In instances where the normal distribution is used for the number of outcomes averted, we also used the normal distribution for the cost per outcome. In this example, the range for the HIV costs saved by providing PrEP referral to MSM is calculated by multiplying the 25^{th} percentile for the number of HIV infections averted (0) by the 25^{th} percentile of the cost per case of HIV ($431,995), and by multiplying the

75th percentile of outcomes averted (0.01367) by the 75th percentile of the cost per case of HIV ($494,031). The 25th and 75th percentile values for the cost per case of HIV ($431,995 to $494,031) reflect the 25th and 75th percentile of a normal distribution with mean $463,013 and standard deviation of $45,987. The standard deviation of $45,987 was calculated in this example as ($539,865 – $359,595)/(2*1.96). So, the range for the HIV costs saved is $0 – $6,753, where the 25th percentile of $0 is the product of 0 and $431,995, and the 75th percentile of $6,753 is the product of 0.01367 and $494,031.

Appendix Table A1

Model data inputs: Users of the STIC Figure 2.0 tool must enter data for a value for at least one of these inputs

Symbol	Description
W1	Number of women treated for chlamydia: laboratory-confirmed diagnosis
W2	Number of women treated for gonorrhea: laboratory-confirmed diagnosis
W3	Number of women treated for P&S syphilis: laboratory-confirmed diagnosis
W4	Number of women with chlamydia given EPT to distribute to partners
W5	Number of women with gonorrhea given EPT to distribute to partners
W6	Number of women with syphilis given EPT to distribute to partners*
W7	Number of women epi-treated for chlamydia
W8	Number of women epi-treated for gonorrhea
W9	Number of women epi-treated for syphilis
W10	Number of women treated presumptively for chlamydia, excluding epi-treatment
W11	Number of women treated presumptively for gonorrhea, excluding epi-treatment
W12	Number of women with HIV linked to HIV care
W13	Number of women with HIV re-linked to HIV care
W14	Number of women referred to HIV PrEP
W15	Number of women directly provided with HIV PrEP
M1	Number of men treated for chlamydia: laboratory-confirmed diagnosis
M2	Number of men treated for gonorrhea: laboratory-confirmed diagnosis
M3	Number of men treated for P&S syphilis: laboratory-confirmed diagnosis
M4	Number of men with chlamydia given EPT to distribute to partners
M5	Number of men with gonorrhea given EPT to distribute to partners
M6	Number of men with syphilis given EPT to distribute to partners*
M7	Number of men epi-treated for chlamydia
M8	Number of men epi-treated for gonorrhea
M9	Number of men epi-treated for syphilis
M10	Number of men treated presumptively for chlamydia, excluding epi-treatment
M11	Number of men treated presumptively for gonorrhea, excluding epi-treatment
M12	Number of men with HIV linked to HIV care
M13	Number of men with HIV re-linked to HIV care
M14	Number of men referred to HIV PrEP
M15	Number of men directly provided with HIV PrEP

*These two inputs are currently hidden from user view in the STIC Figure 2.0 model given that EPT is currently not recommended for syphilis patients. However, if recommendations change in the future and EPT is recommended for syphilis patients, these inputs can be unhidden for use in future versions of the STIC Figure 2.0 tool.

EPT: Expedited partner therapy

PrEP = pre-exposure prophylaxis

Epi-treatment refers to presumptive treatment of sex partners (before confirming that they are infected) of persons with confirmed infections.

The number treated presumptively for chlamydia and gonorrhea, excluding epi-treatment, refers to any presumptive treatment other than epi-treatment (e.g., presumptive treatment for chlamydia due to a gonorrhea diagnosis).

Appendix Table A2

Description of model calculations of the number of men who have sex with women only (MSW) and men who have sex with men (MSM) who are treated for sexually transmitted infections and provided with HIV services

Symbol	Description	Calculation
MSW1	Number of MSW treated for chlamydia, laboratory-confirmed diagnosis	=M1*(1-P_A1)
MSW2	Number of MSW treated for gonorrhea, laboratory-confirmed diagnosis	=M2*(1-P_A2)
MSW3	Number of MSW treated for P&S syphilis, laboratory-confirmed diagnosis	=M3*(1-P_A3)
MSW4	Number of MSW with chlamydia given EPT to distribute to partners	=M4*(1-P_A1)
MSW5	Number of MSW with gonorrhea given EPT to distribute to partners	=M5*(1-P_A2)
MSW6	Number of MSW with syphilis given EPT to distribute to partners	=M6*(1-P_A3)
MSW7	Number of MSW epi-treated for chlamydia	=M7*(1-P_A1)
MSW8	Number of MSW epi-treated for gonorrhea	=M8*(1-P_A2)
MSW9	Number of MSW epi-treated for syphilis	=M9*(1-P_A3)
MSW10	Number of MSW treated presumptively for chlamydia, excluding epi-treatment	=M10*(1-P_A2)
MSW11	Number of MSW treated presumptively for gonorrhea, excluding epi-treatment	=M11*(1-P_A1)
MSW12	Number of MSW with HIV linked to HIV care	=M12*(1-P_A4)
MSW13	Number of MSW with HIV re-linked to HIV care	=M13*(1-P_A4)
MSW14	Number of MSW referred to HIV PrEP	=M14*(1-P_A5)
MSW15	Number of MSW directly provided with HIV PrEP	=M15*(1-P_A5)
MSM1	Number of MSM treated for chlamydia, laboratory-confirmed diagnosis	=M1*P_A1
MSM2	Number of MSM treated for gonorrhea, laboratory-confirmed diagnosis	=M2*P_A2
MSM3	Number of MSM treated for P&S syphilis, laboratory-confirmed diagnosis	=M3*P_A3
MSM4	Number of MSM with chlamydia given EPT to distribute to partners	=M4*P_A1
MSM5	Number of MSM with gonorrhea given EPT to distribute to partners	=M5*P_A2
MSM6	Number of MSM with syphilis given EPT to distribute to partners	=M6*P_A3
MSM7	Number of MSM epi-treated for chlamydia	=M7*P_A1
MSM8	Number of MSM epi-treated for gonorrhea	=M8*P_A2
MSM9	Number of MSM epi-treated for syphilis	=M9*P_A3
MSM10	Number of MSM treated presumptively for chlamydia, excluding epi-treatment	=M10*P_A2
MSM11	Number of MSM treated presumptively for gonorrhea, excluding epi-treatment	=M11*P_A1
MSM12	Number of MSM with HIV linked to HIV care	=M12*P_A4
MSM13	Number of MSM with HIV re-linked to HIV care	=M13*P_A4
MSM14	Number of MSM referred to HIV PrEP	=M14*P_A5

Symbol	Description	Calculation
MSM15	Number of MSM directly provided with HIV PrEP	=M15*P_A5

The values M1 through M15 are user inputs as described in Appendix Table A1.

EPT= expedited partner therapy

P&S = primary & secondary

PrEP = pre-exposure prophylaxis

MSW = men who have sex with women only

MSM = men who have sex with men

Epi-treatment refers to presumptive treatment of sex partners (before confirming that they are infected) of persons with confirmed infections.

Appendix Table A3

Description of the model calculations of the number of people with sexually transmitted infections who are treated, and the number of people provided with HIV services, for women, men who have sex with women only (MSW) and men who have sex with men (MSM)

Symbol	Description	Calculation
	Women	
Cw	Number of women with chlamydia treated	=W1 + (P_B1*P_B2*MSW4) + (P_B2*W7) + (P_B3*W10)
Gw	Number of women with gonorrhea treated	=W2 + (P_B1*P_B2*MSW5) + (P_B2*W8) + (P_B4*W11)
Sw	Number of women with syphilis treated	=W3 + (P_B1*P_B7*MSW6) + (P_B7*W9)
Ĉw	Number of women with chlamydia treated, excluding epi-treatment and EPT	=W1 + (P_B3*W10)
Ĝw	Number of women with gonorrhea treated, excluding epi-treatment and EPT	=W2 + (P_B4*W11)
Ŝw	Number of women with syphilis treated, excluding epi-treatment	=W3
Hw	Number of women with HIV linked or re-linked to care	=W12 + W13
	Men who have sex with women only (MSW)	
Cmsw	Number of MSW with chlamydia treated	=MSW1 + (P_B1*P_B2*W4) + (P_B2*MSW7) + (P_B5*MSW10)
Gmsw	Number of MSW with gonorrhea treated	=MSW2 + (P_B1*P_B2*W5) + (P_B2*MSW8) + (P_B6*MSW11)
Smsw	Number of MSW with syphilis treated	=MSW3 + (P_B1*P_B7*MSW6) + (P_B7*MSW9)
Ĉmsw	Number of MSW with chlamydia treated, excluding epi-treatment and EPT	=MSW1 + (P_B5*MSW10)
Ĝmsw	Number of MSW with gonorrhea treated, excluding epi-treatment and EPT	=MSW2 + (P_B6*MSW11)
Ŝmsw	Number of MSW with syphilis treated, excluding epi-treatment	=MSW3
Hmsw	Number of MSW with HIV linked or re-linked to care	=MSW12 + MSW13
	Men who have sex with men (MSM)	
Cmsm	Number of MSM with chlamydia treated	=MSM1 + (P_B1*P_B2*MSM4) + (P_B2*MSM7) + (P_B5*MSM10)
Gmsm	Number of MSM with gonorrhea treated	=MSM2 + (P_B1*P_B2*MSM5) + (P_B2*MSM8) + (P_B6*MSM11)
Smsm	Number of MSM with syphilis treated	=MSM3 + (P_B1*P_B7*MSM6) + (P_B7*MSM9)
Ĉmsm	Number of MSM with chlamydia treated, excluding epi-treatment and EPT	=MSM1 + (P_B5*MSM10)
Ĝmsm	Number of MSM with gonorrhea treated, excluding epi-treatment and EPT	=MSM2 + (P_B6*MSM11)

Symbol	Description	Calculation
Ŝmsm	Number of MSM with syphilis treated, excluding epi-treatment	=MSM3
Hmsm	Number of MSM with HIV linked or re-linked to care	=MSM12 + MSM13

EPT= expedited partner therapy

Epi-treatment refers to presumptive treatment of sex partners (before confirming that they are infected) of persons with confirmed infections.

The values W1–W13, MSW1–13, and MSW1–13 are defined in Appendix Tables A1 and A2.

Appendix Table A4

Description of model calculations of the number of adverse outcomes averted by STI and HIV program activities

Outcome symbol	Description	Calculation
	Outcomes averted by services provided to women	
Outcome_W1	PID cases averted in women treated for chlamydia	=Cw*P_B8*(1-P_B9)*(1-P_B4)
Outcome_W2	PID cases averted in women treated for gonorrhea	=Gw*P_B8*(1-P_B9)*(1-P_B3)
Outcome_W3	Cases of syphilis sequelae averted in women treated for P&S syphilis	=Sw*P_B11
Outcome_W4	Chlamydial infections averted in the population	=Ĉw*P_B13
Outcome_W5	Gonococcal infections averted in the population	=Ĝw*P_B13
Outcome_W6	Syphilitic infections averted in the population	=Ŝw*P_B13
Outcome_W7	Chlamydia-attributable HIV infections averted	=Ĉw*P_B14*(P_B15 + P_B13)
Outcome_W8	Gonorrhea-attributable HIV infections averted	=Ĝw*P_B14*(P_B15 + P_B13)
Outcome_W9	Syphilis-attributable HIV infections averted	=Ŝw*P_B17*(P_B15 + P_B13)
Outcome_W10	HIV infections averted by linkage to care	=Hw*P_B18
Outcome_W11	HIV infections averted by HIV PrEP referrals	=W14*P_B19*P_B20*P_B21
Outcome_W12	HIV infections averted by HIV PrEP provision	=W15* P_B20*P_B21
Outcome_W13	Congenital syphilis cases averted in infants of women treated for P&S syphilis	=Sw*P_A6*P_B12
	Outcomes averted by services provided to MSW	
Outcome_MSW1	Epididymitis cases averted in MSW treated for chlamydia	=Cmsw*P_B10*(1-P_B9)*(1-P_B6)
Outcome_MSW2	Epididymitis cases averted in MSW treated for gonorrhea	=Gmsw*P_B10*(1-P_B9)*(1-P_B5)
Outcome_MSW3	Cases of syphilis sequelae averted in MSW treated for P&S syphilis	=Smsw*P_B11
Outcome_MSW4	Chlamydial infections averted in the population	=Ĉmsw*P_B13
Outcome_MSW5	Gonococcal infections averted in the population	=Ĝmsw*P_B13
Outcome_MSW6	Syphilitic infections averted in the population	=Ŝmsw*P_B13
Outcome_MSW7	Chlamydia-attributable HIV infections averted	=Ĉmsw* P_B14*(P_B15 + P_B13)
Outcome_MSW8	Gonorrhea-attributable HIV infections averted	=Ĝmsw* P_B14*(P_B15 + P_B13)
Outcome_MSW9	Syphilis-attributable HIV infections averted	=Ŝmsw* P_B17*(P_B15 + P_B13)
Outcome_MSW10	HIV infections averted by linkage to care	=Hmsw*P_B18
Outcome_MSW11	HIV infections averted by HIV PrEP referrals	=MSW14*P_B19*P_B20*P_B21
Outcome_MSW12	HIV infections averted by HIV PrEP provision	=MSW15* P_B20*P_B21
	Outcomes averted by services provided to MSM	
Outcome_MSM1	Epididymitis cases averted in MSM treated for chlamydia	=Cmsm*P_B10*(1-P_B9)*(1-P_B6)
Outcome_MSM2	Epididymitis cases averted in MSM treated for gonorrhea	=Gmsm*P_B10*(1-P_B9)*(1-P_B5)

Outcome symbol	Description	Calculation
Outcome_MSM3	Cases of syphilis sequelae averted in MSM treated for P&S syphilis	=Smsm*P_B11
Outcome_MSM4	Chlamydial infections averted in the population	=Ĉmsm*P_B13
Outcome_MSM5	Gonococcal infections averted in the population	=Ĝmsm*P_B13
Outcome_MSM6	Syphilitic infections averted in the population	=Ŝmsm*P_B13
Outcome_MSM7	Chlamydia-attributable HIV infections averted	=Ĉmsm* P_B16*(P_B15 + P_B13)
Outcome_MSM8	Gonorrhea-attributable HIV infections averted	=Ĝmsm* P_B16*(P_B15 + P_B13)
Outcome_MSM9	Syphilis-attributable HIV infections averted	=Ŝmsm* P_B17*(P_B15 + P_B13)
Outcome_MSM10	HIV infections averted by linkage to care	=Hmsm*P_B18
Outcome_MSM11	HIV infections averted by HIV PrEP referrals	=MSM14*P_B19*P_B20*P_B22
Outcome_MSM12	HIV infections averted by HIV PrEP provision	=MSM15* P_B20*P_B22

For a more detailed description of these calculations, see Appendix Table A8. The parameter used in the calculation column are defined in Appendix Tables A1, A2, A3, and A6. Additional details of the model parameters are provided in Appendix Table A7.

STI = sexually transmitted infection

PID = pelvic inflammatory disease

PrEP = pre-exposure prophylaxis

P&S = primary & secondary

MSW = men who have sex with women only

MSM = men who have sex with men

Appendix Table A5

Description of model calculations of the direct medical costs saved by STI and HIV program activities

Description	Calculation
Costs saved by services provided to women	
PID costs saved in women treated for chlamydia	=Outcome_W1*Cost_1
PID costs saved in women treated for gonorrhea	=Outcome_W2*Cost_1
Costs of syphilis sequelae averted in women treated for P&S syphilis	=Outcome_W3*Cost_3
Chlamydia treatment and sequelae costs saved in the population	=Outcome_W4*Cost_5
Gonorrhea treatment and sequelae costs saved in the population	=Outcome_W5*Cost_7
Syphilis treatment and sequelae costs saved in the population	=Outcome_W6*Cost_9
Costs of chlamydia-attributable HIV infections averted	=Outcome_W7*Cost_10
Costs of gonorrhea-attributable HIV infections averted	=Outcome_W8*Cost_10
Costs of syphilis-attributable HIV infections averted	=Outcome_W9*Cost_10
Costs of HIV infections averted by linkage to care	=Outcome_W10*Cost_10
Costs of HIV infections averted by HIV PrEP referrals	=Outcome_W11*Cost_10
Costs of HIV infections averted by HIV PrEP provision	=Outcome_W12*Cost_10
Congenital syphilis costs saved in infants of women treated for P&S syphilis	=Outcome_W13*Cost_4
Costs saved by services provided to MSW	
Epididymitis costs saved in MSW treated for chlamydia	=Outcome_MSW1*Cost_2
Epididymitis costs saved in MSW treated for gonorrhea	=Outcome_MSW2*Cost_2
Costs of syphilis sequelae averted in MSW treated for P&S syphilis	=Outcome_MSW3*Cost_3
Chlamydia treatment and sequelae costs saved in the population	=Outcome_MSW4*Cost_5
Gonorrhea treatment and sequelae costs saved in the population	=Outcome_MSW5*Cost_7
Syphilis treatment and sequelae costs saved in the population	=Outcome_MSW6*Cost_9
Costs of chlamydia-attributable HIV infections averted	=Outcome_MSW7*Cost_10
Costs of gonorrhea-attributable HIV infections averted	=Outcome_MSW8*Cost_10
Costs of syphilis-attributable HIV infections averted	=Outcome_MSW9*Cost_10
Costs of HIV infections averted by linkage to care	=Outcome_MSW10*Cost_10
Costs of HIV infections averted by HIV PrEP referrals	=Outcome_MSW11*Cost_10
Costs of HIV infections averted by HIV PrEP provision	=Outcome_MSW12*Cost_10
Costs saved by services provided to MSM	
Epididymitis costs saved in MSM treated for chlamydia	=Outcome_MSM1*Cost_2
Epididymitis costs saved in MSM treated for gonorrhea	=Outcome_MSM2*Cost_2

Description	Calculation
Costs of syphilis sequelae averted in MSM treated for P&S syphilis	=Outcome_MSM3*Cost_3
Chlamydia treatment and sequelae costs saved in the population	=Outcome_MSM4*Cost_6
Gonorrhea treatment and sequelae costs saved in the population	=Outcome_MSM5*Cost_8
Syphilis treatment and sequelae costs saved in the population	=Outcome_MSM6*Cost_9
Costs of chlamydia-attributable HIV infections averted	=Outcome_MSM7*Cost_10
Costs of gonorrhea-attributable HIV infections averted	=Outcome_MSM8*Cost_10
Costs of syphilis-attributable HIV infections averted	=Outcome_MSM9*Cost_10
Costs of HIV infections averted by linkage to care	=Outcome_MSM10*Cost_10
Costs of HIV infections averted by HIV PrEP referrals	=Outcome_MSM11*Cost_10
Costs of HIV infections averted by HIV PrEP provision	=Outcome_MSM12*Cost_10

STI = sexually transmitted infection
PID = pelvic inflammatory disease
P&S = primary & secondary
PrEP = pre-exposure prophylaxis
MSW = men who have sex with women only
MSM = men who have sex with men
The parameters used in the calculation column are defined in Appendix Tables A3 and A4. Additional details of the model parameters are provided in Appendix Table A7.

Appendix Table A6

Parameter names, brief descriptions of parameters, and parameter values

Parameter name	Description of parameter	Base case value	Lower bound value	Upper bound value
P_A1	Proportion of chlamydial infections in men that occur in MSM	0.107	0.039	0.175
P_A2	Proportion of gonococcal infections in men that occur in MSM	0.597	0.403	0.719
P_A3	Proportion of syphilitic infections in men that occur in MSM	0.600	0.451	0.699
P_A4	Proportion of men linked to HIV care who are MSM	0.869	0.809	0.921
P_A5	Proportion of men on HIV PrEP who are MSM	0.977	0.919	1.000
P_A6	Among women with P&S syphilis, proportion who are pregnant	0.146	0.056	0.181
P_B1	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	0.440	0.340	0.558
P_B2	Probability that the partner of index patient with chlamydia or gonorrhea is infected	0.310	0.210	0.410
P_B3	Probability that a woman has chlamydia, given that the woman has gonorrhea	0.354	0.260	0.400
P_B4	Probability that a woman has gonorrhea, given that the woman has chlamydia	0.042	0.024	0.062
P_B5	Probability that a man has chlamydia, given that the man has gonorrhea	0.236	0.150	0.350
P_B6	Probability that a man has gonorrhea, given that the man has chlamydia	0.011	0.005	0.023
P_B7	Probability that the partner of index patient with syphilis is infected	0.298	0.100	0.800
P_B8	Absolute reduction in probability of PID given treatment of chlamydia or gonorrhea in women	0.060	0.010	0.120
P_B9	Probability of reinfection among those with chlamydia or gonorrhea	0.200	0.140	0.320
P_B10	Absolute reduction in probability of epididymitis given treatment of chlamydia or gonorrhea in men	0.020	0.010	0.040
P_B11	Absolute reduction in probability of sequelae given treatment of P&S syphilis	0.0010	0.0004	0.0016
P_B12	Absolute reduction in probability of congenital syphilis given timely and adequate treatment of pregnant woman with P&S syphilis	0.500	0.250	0.750
P_B13	Average number of additional infections averted in the population per STI treated	0.500	0.050	0.950
P_B14	Probability of an STI-attributable HIV infection, per chlamydial or gonococcal infection in women and MSW	0.00022	0.000022	0.000418
P_B15	Relative benefit of treatment of an STI (vs. prevention of an STI) in terms of averting STI-attributable HIV infections	0.25	0.025	0.475

Parameter name	Description of parameter	Base case value	Lower bound value	Upper bound value
P_B16	Probability of an STI-attributable HIV infection, per chlamydial or gonococcal infection in MSM	0.00439	0.002641	0.006574
P_B17	Probability of an STI-attributable HIV infection, per syphilitic infection	0.00462	0.000462	0.008778
P_B18	Number of HIV infections averted per person with HIV linked or re-linked to care	0.011	0.008	0.019
P_B19	Number of persons initiating PrEP per PrEP referral	0.049	0.024	0.207
P_B20	Number of person-years on HIV PrEP contributed per person initiating HIV PrEP	0.740	0.600	0.820
P_B21	Number of HIV infections averted per person-year on HIV PrEP (women and MSW)	0.00060	0.00040	0.00407
P_B22	Number of HIV infections averted per person-year on HIV PrEP (MSM)	0.00586	0.00395	0.0400
Cost_1	Average direct medical cost per case of PID	$2,703	$2,107	$4,051
Cost_2	Average direct medical cost per case of epididymitis	$413	$256	$571
Cost_3	Average direct medical cost per case of long-term syphilis sequelae	$26,826	$6,170	$85,843
Cost_4	Average direct medical cost per case of congenital syphilis	$14,573	$8,335	$24,514
Cost_5	Average lifetime direct medical cost per chlamydial infection (women and MSW)	$189	$96	$337
Cost_6	Average lifetime direct medical cost per chlamydial infection (MSM)	$51	$35	$68
Cost_7	Average lifetime direct medical cost per gonococcal infection (women and MSW)	$199	$78	$399
Cost_8	Average lifetime direct medical cost per gonococcal infection (MSM)	$86	$40	$160
Cost_9	Average lifetime direct medical cost per syphilitic infection	$1,311	$803	$2,076
Cost_10	Average lifetime direct medical cost per HIV infection	$463,013	$359,595	$539,865
Cost_11	Average productivity cost per case of PID	$2,173	$819	$4,499
Cost_12	Average productivity cost per case of epididymitis	$710	$268	$1,470
Cost_13	Average productivity cost per case of long-term syphilis sequelae	$206,270	$123,762	$342,408
Cost_14	Average productivity cost per case of congenital syphilis	$91,321	$45,661	$136,982
Cost_15	Average lifetime productivity cost per chlamydial infection (women and MSW)	$131	$46	$310
Cost_16	Average lifetime productivity cost per chlamydial infection (MSM)	$28	$14	$50
Cost_17	Average lifetime productivity cost per gonococcal infection (women and MSW)	$139	$41	$345
Cost_18	Average lifetime productivity cost per gonococcal infection (MSM)	$37	$17	$72
Cost_19	Average lifetime productivity cost per syphilitic infection	$411	$176	$1,004
Cost_20	Average lifetime productivity cost per HIV infection	$87,458	$17,387	$148,158

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

Appendix Table A7

Detailed description of model parameters, parameter values and sources.

Parameter name	Base case value	Lower bound value	Upper bound value	Description of parameter and sources for base case value and range
P_A1	0.107	0.039	0.175	**Proportion of chlamydial infections in men that occur in MSM**. Lower bound is the estimated percentage of men who are MSM (Grey 2016); if MSM and MSW had the same rate of chlamydia, then the share of chlamydial infections in males that are MSM would be proportionate to the MSM share of the population. Given that MSM are generally at higher risk for STIs than MSW, this value (0.039) is the lower bound value. The upper bound was calculated using the percentage of chlamydia cases in male STI clinic patients that occurred in MSM in New York City (17.3%, Pathela 2015) and in Kansas City (21.3%, Bamberger 2019), which yielded a weighted total percentage of 17.5% across these two settings. MSM are typically disproportionately represented among STI clinic populations and in large urban areas, so this value was interpreted as the upper bound probability. Given the lack of data to inform a base case estimate, we applied the midpoint of the lower bound (0.039) and the upper bound (0.175), which yielded a base case value of 0.107. The value we applied for the percent of chlamydia cases in men in STI clinics that occur in MSM (0.175) is likely conservative in that it is lower than observed in many other STI clinic settings, based on unpublished STD Surveillance Network (SSuN) data (data obtained from Dr. Eloisa Llata, personal communication, August 29, 2024).
P_A2	0.597	0.403	0.719	**Proportion of gonococcal infections in men that occur in MSM**. Based on gonorrhea cases in MSM and men who have sex with women only in STD Surveillance Network (SSuN) data as reported in the 2022 STI surveillance report (CDC 2024a). The base case is the number of cases in MSM divided by the sum of cases in MSM and cases in men who have sex with women only, across all SSuN sites. The lower bound proportion is the unweighted average proportion across the 3 SSun sites with the lowest proportion of cases in men that occur in MSM; the upper bound is the unweighted average

Parameter name	Base case value	Lower bound value	Upper bound value	Description of parameter and sources for base case value and range
				proportion across the 3 SSuN sites with the highest percentage of cases in men that occur in MSM.
P_A3	0.600	0.451	0.699	**Proportion of syphilitic infections in men that occur in MSM.** Based on 2022 STI surveillance report (CDC 2024a). The base case is the proportion of P&S cases in MSM among men with sex of sex partners data available, calculated as MSMcase/(MSMcase + MSWcase), where MSMcase is the number of P&S syphilis cases that occur in MSM, and MSWcase is the number of P&S syphilis cases that occur in in men who have sex with women only (MSW). The lower bound value was calculated by including in the denominator the number of cases in men with unknown sex of sex partners. The upper bound value was calculated by including in both the numerator and denominator the number of cases in men with unknown sex of sex partners.
P_A4	0.869	0.809	0.921	**Proportion of men linked to HIV care who are MSM**. These parameter values were based on the 2021 HIV surveillance report of estimated HIV incidence (CDC 2024b). The base case value (0.869) is the proportion of estimated incident HIV infections among men that occurred in the transmission categories "male-to-male sexual contact" and "male-to-male sexual contact and injection drug use". The lower bound value (0.809) was calculated by setting the number of incident HIV infections in the transmission categories "male-to-male sexual contact" and "male-to-male sexual contact and injection drug use" to their lower bound value of the reported 95% confidence interval, while also setting the number of HIV infections in the transmission categories "injection drug use: male" and "heterosexual contact: male" to their upper bound value of the reported 95% confidence interval. The upper bound value (0.921) was calculated by setting the number of incident HIV infections in the transmission categories "male-to-male sexual contact" and "male-to-male sexual contact and injection drug use" to their upper bound value of the reported 95% confidence interval, while also setting the number of HIV infections in the transmission categories "injection drug use: male" and "heterosexual contact: male" to their lower bound value of the reported 95% confidence interval.
P_A5	0.977	0.919	1	**Proportion of men on HIV PrEP who are MSM**. The base case value was calculated as the number of recent PrEP users in the 2017 MSM cycle of the National HIV Behavior Surveillance System (NHBSS) divided by the sum of recent PrEP users in the 2016

Parameter name	Base case value	Lower bound value	Upper bound value	Description of parameter and sources for base case value and range
				Heterosexual persons cycle of NHBSS, in the 2017 MSM cycle of NHBSS, and the 2018 People who inject drugs cycle of NHBSS, using data reported by Jones, Smith, and colleagues (2021). This estimate likely underestimates the percentage of male PrEP recipients who are MSM because it includes female PrEP users in the denominator. However, for the purposes of STIC Figure 2.0, a lower base case value is more conservative, given that the average benefits of HIV PrEP per person-year on HIV PrEP are greater for MSM than for MSW. For the lower bound value, we obtained data from AtlasPlus on HIV PrEP use in 2022 by sex (32,854 female PrEP users and 405,189 male PrEP users) and calculated what the percentage of males on HIV PrEP who are MSM would be if the number of MSW PrEP users was equal to the number of female PrEP users. For the upper bound, we applied the maximum possible value of 100%.
P_A6	0.146	0.056	0.181	**Among women with P&S syphilis, proportion who are pregnant**. The base case is the number of syphilis cases (all stages) among women reported as pregnant (9,823) in 2022, from the 2022 STI surveillance report (CDC 2024a), divided by approximate syphilis incidence in women in 2022 of 67,500. The value assumed for incidence (67,500) was based on estimated annual syphilis incidence in women of 25,000 infections in 2018 (Spicknall 2021), multiplied by 2.7 to adjust for the relative increase in the number of reported syphilis cases (all stages) in women in 2022 vs. 2018, using data from CDC's AtlasPlus. The lower bound is the general fertility rate among females aged 15-44 years (0.056, Martin 2023). The upper bound (0.181) is the proportion of syphilis cases occurring in pregnant women in 2022 as reported in the 2022 STI surveillance report (CDC 2024a), among women with pregnancy status reported. We applied this as an upper bound rather than the base case because the high percentage of syphilis cases occurring in pregnant women likely arises to some degree because pregnant women are more likely to be screened for syphilis than women who are not pregnant.

Parameter name	Base case value	Lower bound value	Upper bound value	Description of parameter and sources for base case value and range
				Note: Although we define this parameter as the proportion of women with P&S syphilis who are pregnant, this value actually represents the proportion of women with P&S syphilis (1) who are pregnant at the time of treatment for P&S syphilis or (2) who, in the absence of treatment for P&S syphilis, would have become pregnant in the future while still infected. We therefore include data from pregnant women with all stages of syphilis in calculating this parameter value.
P_B1	0.440	0.340	0.558	**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**. Slutsker (2020) reports that the percentage of EPT vouchers redeemed at the pharmacy was 41% overall, and 34% when excluding a high-volume student health center. In another study (Kissinger 2005), 55.8% of men given patient-delivered partner therapy reported having been told by their partners that the antibiotic treatment had been taken. We applied 44% as the base case value (the average of 34%, 41%, and 55.8%), and applied 34% as the lower bound and 55.8% as the upper bound.
P_B2	0.310	0.210	0.410	**Probability that the partner of index patient with chlamydia or gonorrhea is infected.** Base case value and ranges were obtained from Rowlinson's 2020 study of epi-treatment for contacts to *Neisseria gonorrhoeae* and *Chlamydia trachomatis* infection. The base case value (31%) reflects the percentage of all partners who tested positive for gonorrhea and/or chlamydia and includes MSM, MSW, and women. The lower bound value (21%) reflects the percentage of MSW testing positive and the upper bound value (41%) reflects the percentage of women testing positive.
P_B3	0.354	0.260	0.400	**Probability that a woman has chlamydia, given that the woman has gonorrhea.** The probability of chlamydia given gonorrhea was applied in two distinct ways in STIC Figure 2.0. First, if there is presumptive treatment of chlamydia (other than epi-treatment), then this probability was applied to estimate the number of women presumptively treated for chlamydia that did indeed have chlamydia. That is, we assumed that these instances of presumptive treatment for chlamydia would be based on a gonorrhea diagnosis. Second, we adjusted the estimated number of PID cases averted through treatment of gonorrhea in women by multiplying by (1-0.354) to prevent the possibility of double counting of PID cases averted in women coinfected with gonorrhea and

Parameter name	Base case value	Lower bound value	Upper bound value	Description of parameter and sources for base case value and range
				chlamydia. STIC Figure 2.0 accounts for the number of cases of STIs treated, not the number of women treated for STIs. Thus, when a woman is coinfected with chlamydia and gonorrhea and treated for both, STIC Figure 2.0 interprets this as a case of chlamydia treated and a case of gonorrhea treated and allows for the possibility that both cases might have progressed to PID if not treated. However, treating gonorrhea and chlamydia in a woman coinfected with gonorrhea and chlamydia would not prevent two cases of PID (one attributable to gonorrhea and one attributable to chlamydia) in the same woman. Hence, the adjustment for coinfection is applied to prevent potential double-counting of potential benefits. The base case value of 35.4% was calculated as the weighted average (weighted by sample size) of three studies: Stamm (1984), Ginocchio (2012), Van der Pol (2017). Specifically, we used the formula: coinfection = (246*26% + 7579*35.7% + 45*40%)/ (246+7579+45), where 246, 7579, and 45 are the respective sample sizes from these three studies and 26%, 35.7%, and 40% are the respective chlamydia coinfection rates among women with gonorrhea. We first attempted to calculate ranges using a binomial approximation of the confidence interval for a proportion, but this yielded a very narrow and implausible range of approximately 34.4% to 36.5%; a range that excluded the point estimates from two of the three studies. Instead, we used the range across the three studies (26% - 40%) as the lower and upper bound values, respectively.
P_B4	0.042	0.024	0.062	**Probability that a woman has gonorrhea, given that the woman has chlamydia**. As above for the probability of chlamydia given gonorrhea, the probability of gonorrhea given chlamydia was applied in two distinct ways in STIC Figure 2.0. First, if there is presumptive treatment of gonorrhea, then this probability was applied to estimate the number of women presumptively treated for gonorrhea that did indeed have gonorrhea. That is, we assumed that gonorrhea prevalence among those treated presumptively would be higher than gonorrhea prevalence among the general population, and we used gonorrhea prevalence among those with chlamydia as an approximation of gonorrhea prevalence among those presumptively treated. Second, we adjusted the estimated number of PID cases averted through treatment of chlamydia in women by multiplying by (1-0.042) to prevent the possibility of double counting of PID cases averted in women coinfected with gonorrhea and chlamydia. The

Parameter name	Base case value	Lower bound value	Upper bound value	Description of parameter and sources for base case value and range
				base case value (0.042) was calculated based on the estimated number of prevalent infections in women in 2018 for gonorrhea (155,000) and chlamydia (1,306,000) from Kreisel (2021). Under our base case assumption that 35.4% of women with gonorrhea also have chlamydia, then 54,870 women are coinfected, and the probability of gonorrhea given chlamydia would be 0.041, calculated as 54,870/1,306,000. For the lower bound probability of gonorrhea given chlamydia, we applied Kreisel's lower bound value of gonorrhea prevalence (131,000) and upper bound value of chlamydia prevalence (1,418,000), and our lower bound probability of chlamydia in women with gonorrhea (0.260). For the upper bound probability of gonorrhea given chlamydia, we applied Kreisel's upper bound value of gonorrhea prevalence (184,000) and lower bound value of chlamydia prevalence (1,193,000), and our upper bound probability of chlamydia in women with gonorrhea (0.400).
P_B5	0.236	0.150	0.350	**Probability that a man has chlamydia, given that the man has gonorrhea**. Analogous to the above parameter P_B3 for women, the probability of chlamydia given gonorrhea in men was applied in two distinct applications in STIC Figure 2.0. First, if users report presumptive treatment of chlamydia, then this probability was applied to estimate the number of men presumptively treated for chlamydia that did indeed have chlamydia. Second, we adjusted the estimated number of epididymitis cases averted through treatment of gonorrhea in men by multiplying by (1-0.236) to prevent the possibility of double-counting of epididymitis cases averted in men coinfected with gonorrhea and chlamydia. The idea is that treating gonorrhea and chlamydia in a man coinfected with gonorrhea and chlamydia could not prevent two cases of epididymitis (one attributable to gonorrhea and one attributable to chlamydia) in the same man. The base case value of 23.6% was calculated as the weighted average (weighted by sample size) of three studies: Stamm (1984), Rob (2020), and Van der Pol (2017). Specifically, we used the formula: coinfection = (293*15%+ 138*35.0%+ 108*32.4%)/ (293+138+108), where 293, 138, and 108 are the respective sample sizes from these three studies and 15%, 35.0%, and 32.4% are the respective chlamydia coinfection rates among men with gonorrhea. In doing so, we note that we interpreted the Rob study results as coinfection rates in men although 5 of the 191 participants were women. As above for women, we first attempted to calculate ranges using a binomial approximation of the

Parameter name	Base case value	Lower bound value	Upper bound value	Description of parameter and sources for base case value and range
				confidence interval for a proportion, but this yielded a very narrow and implausible range of approximately 20.0% to 27.2%; a range that excluded all three of the point estimates of the studies. Instead, we used the range across the three studies (15% - 35%) as the lower and upper bound values, respectively.
P_B6	0.011	0.005	0.023	**Probability that a man has gonorrhea, given that the man has chlamydia**. Analogous to the description for women above for P_B4, the base case value and ranges were calculated based on the estimated number of prevalent infections in men in 2018 for gonorrhea (50,000; range: 40,000 to 63,000) and chlamydia (1,050,000; range: 944,000 to 1,157,000) from Kreisel (2021), and the probability of chlamydia in men with gonorrhea described above. See the description for P_B4 above for details on the calculation approach and for a more detailed explanation of the application of this parameter value.
P_B7	0.298	0.100	0.800	**Probability that the partner of index patient with syphilis is infected**. The base case value was obtained from Cope (2022). The lower and upper bounds reflect the range of available estimates of the per-partner risk of syphilis transmission (Chesson 1999).
P_B8	0.060	0.010	0.120	**Absolute reduction in probability of PID given treatment of chlamydia or gonorrhea in women**. Each instance of treatment of chlamydia or gonorrhea in women is assumed to avert 0.06 cases of PID (range: 0.01 to 0.12). These values were obtained from Kumar (2021).
P_B9	0.200	0.140	0.320	**Probability of reinfection among those with chlamydia or gonorrhea**. To avoid double-counting of benefits of treatment of women who acquire chlamydia twice in the same year or gonorrhea twice in the same year, we multiplied the number of PID cases averted by 0.80, where 0.80 is 1 minus the probability of reinfection. The idea is that a woman would be highly unlikely to have two cases of PID in the same year as a result of the two infections. The base case value was based on a systematic review of the literature (Hosenfeld 2009) in which modeled chlamydia reinfection rates peaked at 20% at 10 months post treatment. The value 14% was based on the median proportion of females reinfected with chlamydia, and the value 32% was based on the maximum proportion of females reinfected with chlamydia across the included studies.
P_B10	0.020	0.010	0.040	**Absolute reduction in probability of epididymitis given treatment of chlamydia or gonorrhea in men**. Each instance of treatment of chlamydia or gonorrhea in men was

Parameter name	Base case value	Lower bound value	Upper bound value	Description of parameter and sources for base case value and range
				assumed to avert 0.02 cases of epididymitis (range: 0.01 to 0.04). These values were obtained from Kumar (2021).
P_B11	0.001	0.0004	0.0016	**Absolute reduction in probability of sequelae given timely and adequate treatment of P&S syphilis**. We assumed a combined probability of 0.0010 of the following outcomes of untreated syphilis: cardiovascular syphilis, tabes dorsalis, meningovascular syphilis, and general paresis (range: 0.0004 to 0.0016). The base case value (0.0010) reflects the combined lifetime probability of these outcomes per infection, as described in Table 3 of Chesson & Peterman (2021). The range of values (0.004 to 0.016) reflects the approximate relative range in values used for the probabilities of cardiovascular syphilis, tabes dorsalis, meningovascular syphilis, and general paresis in the Chesson & Peterman (2021) study.
P_B12	0.500	0.250	0.750	**Absolute reduction in probability of congenital syphilis given treatment of pregnant woman with P&S syphilis**. The base case value and range were obtained from Chesson and colleagues (2008), the supporting manuscript of the original STIC Figure 1.0 tool.
P_B13	0.500	0.050	0.950	**Average number of additional infections averted in the population per STI treated**. The base case value and range were obtained from Chesson and colleagues (2008), the supporting manuscript of the original STIC Figure 1.0 tool. Treating STIs can prevent transmission to the patient's partners. We assumed that on average, each instance of treatment of chlamydia, gonorrhea, or syphilis prevents 0.5 infections in the population. This assumption was applied in the original STIC Figure 1.0 tool under the rationale that (1) reported numbers of STI cases are fairly similar from one year to the next, such that the effective reproductive rate is approximately 1, meaning that each new infection on average leads to 1.0 secondary infections in the population and (2) that on average half of these secondary infections would have already occurred prior to STI treatment, such that the average net effect is 0.5 infections averted per person treated. Although these assumptions are subject to considerable uncertainty and are a simplistic characterization of complex STI transmission dynamics, we kept the same values for this parameter as used in the original STIC Figure 1.0 tool because the resulting approximations are roughly consistent with the results of published mathematical models showing notable reductions in incidence and prevalence of STIs due to screening and treatment programs (Althaus 2012; Rönn 2020).

Parameter name	Base case value	Lower bound value	Upper bound value	Description of parameter and sources for base case value and range
P_B14	0.00022	0.000022	0.000418	**Probability of an STI-attributable HIV infection, per chlamydial or gonococcal infection in women and MSW**. Chlamydia and gonorrhea in those with HIV can increase the probability of HIV transmission, and chlamydia and gonorrhea in those without HIV can increase susceptibility to HIV. We assumed that each chlamydial infection and each gonococcal infection in women and MSW, on average, resulted in 0.00022 (range: 0.000022 to 0.000418) STI-attributable HIV infections. The base case value and range were obtained from Chesson, Song, et al. (2021).
P_B15	0.250	0.025	0.475	**Relative benefit of treatment of an STI (vs. prevention of an STI) in terms of averting STI-attributable HIV infections**. To calculate the number of STI-attributable HIV infections averted in people treated for STIs, the probability of an STI-attributable HIV infection (per STI infection) was multiplied by this adjustment factor of 0.25, thereby assuming that treating an STI is only 25% as beneficial as preventing an STI altogether in terms of preventing STI-attributable HIV infections. For example, in the base case, each chlamydial infection in women is assumed to result in 0.0002275 chlamydia-attributable HIV infections, on average. Thus, we assumed that preventing a chlamydial infection in women would avert 0.0002275 chlamydial-attributable HIV infections. However, treating a woman who has chlamydia would not be expected to avert 0.0002275 chlamydial-attributable HIV infections, because of the possibility that chlamydia-attributable HIV infections would have already occurred prior to treatment. We therefore assumed that treatment of chlamydia in women averts 0.25*0.0002275 chlamydial-attributable HIV infections. The base case value and range of this relative value were obtained from Chesson and colleagues (2008), the supporting manuscript of the original STIC Figure 1.0 tool.
P_B16	0.00439	0.002641	0.006574	**Probability of an STI-attributable HIV infection, per chlamydial or gonococcal infection in MSM**. As noted above for parameter P_B14, chlamydia and gonorrhea in those with HIV can increase the probability of HIV transmission, and chlamydia and gonorrhea in those without HIV can increase susceptibility to HIV. We assumed that each chlamydial infection and each gonococcal infection in MSM, on average, resulted in 0.0044 (range: 0.002641 to 0.006574) STI-attributable HIV infections. The base case value was obtained from Jones (2023), a mathematical modeling study of the probability of an STI-attributable HIV infection among MSM, per gonococcal or chlamydial infection. The

Parameter name	Base case value	Lower bound value	Upper bound value	Description of parameter and sources for base case value and range
				Jones study provided an interquartile range (IQR) of model simulation results of 0.00371 to 0.00507. The 95% confidence interval shown here was approximated by (1) assuming that the distribution of the Jones model simulation results followed a Beta distribution with mean 0.00439 and variance approximated based on the IQR reported by Jones (2023), (2) estimating the 2.5th and 97.5th percentiles implied by this Beta distribution, and (3) assuming that these approximate 2.5th and 97.5th percentiles of simulation results represent a reasonable approximation of a 95% confidence interval for this parameter.
P_B17	0.00462	0.000462	0.008778	**Probability of an STI-attributable HIV infection, per syphilitic infection**. Syphilis in those with HIV can increase the probability of HIV transmission, and syphilis in those without HIV can increase susceptibility to HIV. We assumed that each syphilitic infection in women, MSW, and MSM, on average, resulted in 0.00462 (range: 0.000462 to 0.008788) STI-attributable HIV infections. The base case value and range were obtained from Chesson, Song, et al. (2021).
P_B18	0.011	0.008	0.019	**Number of HIV infections averted per person with HIV linked or re-linked to care**. We assumed that 37.0% of persons with HIV linked to care would become virally suppressed, based on pooled results from Shade (2021) and Maulsby (2018), two studies that examined interventions to enhance HIV care continuum outcomes (e.g., HIV linkage to care). The value 37.0% reflects the probability that a person not virally suppressed at enrollment would be virally suppressed at follow-up. We assumed that each person suppressed at follow-up would contribute 0.5 person-years of viral suppression (Maulsby 2018). We assumed that each person-year of viral suppression would avert 0.061 new HIV infections (Shrestha 2020, Li 2019). The base case value of 0.011 was calculated as 0.370*0.5*0.061. For the lower bound value, we assumed a 14.4% probability of achieving suppression (the lowest value across all sites in the Shade and Maulsby studies) and assumed 0.047 HIV infections averted per person-year of suppression (Maulsby 2018). For the upper bound value, we assumed a probability of 83.6% of achieving suppression (the highest value across all sites in the Shade and Maulsby studies), assumed that each person suppressed would contribute a full year of viral suppression (Maulsby 2018 sensitivity analysis), and assumed 0.066 HIV infections averted per person year of suppression (Li 2019). The 0.066 input value applied for the

Parameter name	Base case value	Lower bound value	Upper bound value	Description of parameter and sources for base case value and range
				upper bound calculation reflects the estimated HIV transmission rate from those not in care, whereas the base case value of 0.061 that we applied reflects the estimated HIV transmission rate from those "receiving HIV care but not virally suppressed" from Li (2019), which was applied by Shrestha (2020).
P_B19	0.049	0.024	0.207	**Number of persons initiating PrEP per PrEP referral**. Kelley (2015) provides an illustration of the PrEP continuum of care for MSM. In their full cohort, 50% of MSM were aware/willing to have PrEP, 86.1% of those aware/willing had access to healthcare, 69.1% of those with access to healthcare received the PrEP medications, and 51.0% of those receiving meds were adherent. Based on this continuum, 15.1% of MSM are adherent to HIV PrEP. For the base case assessment of the impact of a PrEP referral, we assumed that all MSM referred were at least aware/willing to get HIV PrEP. For the referral scenario, we assumed access to care is 100% as a result of the referral. Under these assumptions, 35.2% of willing/aware MSM with a referral for HIV PrEP will become adherent to HIV PrEP, vs. 30.3% of willing/aware MSM without referral for HIV PrEP. The marginal benefit is 4.9%. For the lower bound estimate (2.4%), we dropped the assumption that all MSM referred are aware/willing to get HIV PrEP. For the upper bound estimate (20.7%), we assumed that the HIV PrEP referral not only increases access to care to 100% but also increases the probability of receiving medications to 100%.
P_B20	0.740	0.600	0.820	**Number of person-years on HIV PrEP contributed per person initiating HIV PrEP**. For each person initiating HIV PrEP, we assumed an average of 0.74 years of HIV PrEP time within the first year of initiation based on extrapolations of findings from a literature review (Zhang 2022). The base case value of 0.74 reflects a discontinuation probability of 0.378 (the point estimate for North America in the Zhang review) and assumes this probability is per 9 months; i.e., the probability of discontinuing HIV PrEP by 9 months is 0.378. We calculated a corresponding daily rate of discontinuation under these assumptions and calculated that each person initiating HIV PrEP would accrue an average of 270.192 days of HIV PrEP usage over the next 365 days when accounting for the possibility of discontinuation (the value 0.74 is 270.192/365). For the lower bound value, we applied a higher dropout rate (the upper bound value of 0.430 for the North American studies in the Zhang review) and assumed this reflected a 6-month probability

Parameter name	Base case value	Lower bound value	Upper bound value	Description of parameter and sources for base case value and range
				instead of 9 months. For the upper bound value, we applied a lower dropout rate (the lower bound value of 0.329 for the North American studies in the Zhang review) and assumed this reflected a 12-month probability instead of 9 months. The STIC Figure 2.0 tool quantifies the benefits of program activities within a given year, so, as noted above, these calculations reflect the estimated the number of person-years on HIV PrEP that occur within the first year of initiation of HIV PrEP. To simplify the analysis, we assumed that all HIV PrEP referrals occurred at the very start of the year (January 1). This simplification would not be expected to bias the results if program activities are fairly constant from one year to the next. For example, in assessing the impact of program activities in 2024, overestimation of program benefits by inclusion of benefits that spill over into 2025 will be offset by exclusion of program benefits from 2023 that spill over into 2024. Thus, our simplification represents an approximation of program benefits in a given year.
P_B21	0.0006	0.0004	0.00407	**Number of HIV infections averted per person-year on HIV PrEP (women and MSW)**. The base case value was extrapolated from Khurana (2018). In that modeling study, 9,045,474 heterosexual men and women were eligible for HIV PrEP, and 2,694 new HIV infections were averted over 5 years at 10% HIV PrEP coverage, assuming no PrEP recipients dropped out. Thus, there were 9,045,474 x 10% x 5 HIV PrEP years, or 4,522,737 HIV PrEP years. The number of HIV infections averted per person-year on HIV PrEP was calculated as 2,694/4,522,737 = 0.0006. The lower and upper bound values for this parameter (0.00040 and 0.00407) were obtained by assuming that the range for this parameter for heterosexuals was the same in relative terms as the range we calculated for this analogous parameter for MSM (i.e., the lower bound value was about 67.5% of the base case value and the upper bound value was about 6.8 times the base case value; see P_B22).
P_B22	0.00586	0.00395	0.040	**Number of HIV infections averted per person-year on HIV PrEP (MSM)**. The base case value was extrapolated from Khurana (2018) as described above for heterosexual men and women. Using the number of MSM eligible for HIV PrEP (2,206,379), PrEP coverage (40%), and the number of HIV infections averted over 5 years (25,848), the number of HIV infections averted per person-year on HIV PrEP was calculated to be 0.00586. The

Parameter name	Base case value	Lower bound value	Upper bound value	Description of parameter and sources for base case value and range
				lower and upper bound values were based on Jenness (2016). The lower bound value was calculated assuming one HIV infection averted per 253 PrEP years (the most extreme value reported in the confidence intervals in the Jenness study, see their Table 2 scenario 1a) and the upper bound value was calculated assuming one HIV infection averted per 25 person-years on HIV PrEP (the base case result of the Jenness study).
Cost_1	$2,703	$2,107	$4,051	**Average direct medical cost per case of PID**. The base case value and range were obtained from Kumar (2021), updated to 2023 dollars. These values represent the average discounted lifetime direct medical cost per case of PID.
Cost_2	$413	$256	$571	**Average direct medical cost per case of epididymitis**. The base case value and range were obtained from Kumar (2021), updated to 2023 dollars. These values represent the average discounted lifetime direct medical cost per case of epididymitis.
Cost_3	$26,826	$6,170	$85,843	**Average direct medical cost of long-term syphilis sequelae**. This value represents the estimated average discounted lifetime direct medical cost per syphilitic infection of the following sequelae: cardiovascular syphilis, tabes dorsalis, meningovascular syphilis, and general paresis. The base case value and range were extrapolated from results of the Chesson and Peterman (2021) model, updated to 2023 dollars. The base case value can be replicated based on data in Chesson and Peterman (2021) Table 3, in which the sequelae outcomes listed above (cardiovascular syphilis, tabes dorsalis, meningovascular syphilis, and general paresis) are associated with a combined lifetime probability of 0.1% per infection and a combined cost (in 2019 dollars) of $24.35 ($8.59+$2.21+$6.40+$7.15) per infection. These two values (0.1% and $24.35) suggest that syphilis sequelae, if it occurs, on average costs $24,350 per case ($24,350 = $24.35/0.1%) in 2019 dollars ($26,826 in 2023 dollars), when discounted to the time of infection. The range was calculated by assuming the lower bound was 0.23 times the base case value and the upper bound was 3.2 times the base case value; these relative values of 0.23 and 3.2 reflect the average relative values used in the Chesson and Peterman (2021) study for the individual cost-per-case estimates for cardiovascular syphilis, tabes dorsalis, meningovascular syphilis, and general paresis. The syphilis cost estimates from Chesson and Peterman (2021) were not sex-specific, and thus the same values we derived from the Chesson and Peterman (2021) study for this parameter (Cost_3) were applied for women, MSW and MSM.

Parameter name	Base case value	Lower bound value	Upper bound value	Description of parameter and sources for base case value and range
Cost_4	$14,573	$8,335	$24,514	**Average direct medical cost per case of congenital syphilis**. The base case value and range were obtained from Owusu-Edusei (2013), updated to 2023 dollars, and reflect the hospitalization costs of newborns with congenital syphilis. This cost estimate is conservative in that it excludes potential long-term costs of congenital syphilis.
Cost_5	$189	$96	$337	**Average lifetime direct medical cost per chlamydial infection in women and MSW**. This parameter (Cost_5) was used to approximate the direct medical costs saved by prevention of chlamydia in the population through treatment of women and MSW with chlamydia. We assumed that chlamydial infections averted in the population by treatment of women and MSW would accrue in women and MSW, so for simplicity we applied an average lifetime cost per infection for women and MSW to these averted infections. The base case value and range were obtained from Kumar (2021), updated to 2023 dollars. The base case value represents the weighted average discounted lifetime direct medical cost per chlamydial infection for women and men, in which the cost for women (from Kumar 2021) was given 58% weight and the cost for men (also from Kumar 2021) was given 42% weight, based on the approximate share of total chlamydia and gonorrhea incidence that occurs among women, using incidence estimates of Kreisel (2021).
Cost_6	$51	$35	$68	**Average lifetime direct medical cost per chlamydial infection in MSM**. This parameter (Cost_6) was used to approximate the direct medical costs saved by prevention of chlamydia in the population through treatment of MSM with chlamydia. We assumed that chlamydial infections averted in the population by treatment of MSM would accrue primarily among MSM, and thus we applied the average discounted lifetime cost per chlamydial infection in men obtained from Kumar (2021) and updated to 2023 dollars.
Cost_7	$199	$78	$399	**Average lifetime direct medical cost per gonococcal infection in women and MSW**. This parameter (Cost_7) was used to approximate the direct medical costs saved by prevention of gonorrhea in the population through treatment of women and MSW with gonorrhea. Like our approach for chlamydia as described above for the parameter Cost_5, we assumed that gonococcal infections averted in the population by treatment of women and MSW would accrue in women and MSW, so for simplicity we applied an average lifetime cost per infection for women and MSW to these averted infections. The base case value and range were obtained from Kumar (2021), updated to 2023

Parameter name	Base case value	Lower bound value	Upper bound value	Description of parameter and sources for base case value and range
				dollars. The base case value represents the weighted average discounted lifetime direct medical cost per gonococcal infection for women and men, in which the cost for women (from Kumar 2021) was given 58% weight and the cost for men (also from Kumar 2021) was given 42% weight, based on the approximate share of total chlamydia and gonorrhea incidence that occurs among women, using incidence estimates of Kreisel (2021).
Cost_8	$86	$40	$160	**Average lifetime direct medical cost per gonococcal infection in MSM**. This parameter (Cost_8) was used to approximate the direct medical costs saved by prevention of gonorrhea in the population through treatment of MSM with chlamydia. As with our assumptions for chlamydia described above for the parameter Cost_6, we assumed that gonococcal infections averted in the population by treatment of MSM would accrue primarily among MSM, and thus we applied the average discounted lifetime cost per gonococcal infection in men obtained from Kumar (2021) and updated to 2023 dollars.
Cost_9	$1,311	$803	$2,076	**Average lifetime direct medical cost per syphilitic infection**. The base case value and range for the average discounted lifetime cost per syphilitic infection were obtained from Chesson and Peterman (2021), updated to 2023 dollars. These syphilis cost estimates from Chesson and Peterman (2021) were not sex-specific, and thus the same values were applied for women, MSW, and MSM.
Cost_10	$463,013	$359,595	$539,865	**Average lifetime direct medical cost per HIV infection**. This parameter represents the average discounted lifetime cost per HIV infection. The base case value and ranges were obtained from Bingham (2021), updated to 2023 dollars. These HIV cost estimates from Bingham (2021) were not sex-specific, and thus the same values were applied for women, MSW and MSM.
Cost_11	$2,173	$819	$4,499	**Average productivity cost per case of PID**. The base case value and range were obtained from Chesson (2024). These values represent the average discounted lifetime productivity cost per case of PID. Note: The Chesson (2024) study results were published in 2023 dollars and thus did not require further adjustment.
Cost_12	$710	$268	$1,470	**Average productivity cost per case of epididymitis**. The base case value and range were obtained from Chesson (2024). These values represent the average discounted lifetime productivity cost per case of epididymitis.

Parameter name	Base case value	Lower bound value	Upper bound value	Description of parameter and sources for base case value and range
Cost_13	$206,270	$123,762	$342,408	**Average productivity cost of long-term syphilis sequelae**. This value represents the estimated average discounted lifetime productivity cost per syphilitic infection of the following sequelae: cardiovascular syphilis, tabes dorsalis, meningovascular syphilis, and general paresis. The base case value and range were extrapolated from results of the Chesson (2024) model, using an analogous approach to that described above for the direct medical cost of syphilis sequelae (Cost_3). The base case value of $206,270 can be replicated based on data in Chesson (2024) Table 3, in which the sequelae outcomes listed above (cardiovascular syphilis, tabes dorsalis, meningovascular syphilis, and general paresis) are associated with a combined lifetime probability of 0.1% per infection and a combined cost (in 2023 dollars) of $206.27 ($101.06 + $22.50 + $37.96 + $44.75) per infection. These two values (0.1% and $206.27) suggest that syphilis sequelae, if it occurs, on average costs $206,270 per case, when discounted to the time of infection ($206,270 = $206.27/0.1%). The range was calculated by assuming the lower bound was 0.60 times the base case value and the upper bound was 1.66 times the base case value; these relative values of 0.60 and 1.66 reflect the average relative values used in the Chesson (2024) study for the individual cost-per-case estimates cardiovascular syphilis, tabes dorsalis, meningovascular syphilis, and general paresis. The syphilis productivity cost estimates from Chesson (2024) were not sex-specific, and thus the same values we derived from the Chesson (2024) study for this parameter (Cost_13) were applied for women, MSW and MSM.
Cost_14	$91,321	$45,661	$136,982	**Average productivity cost per case of congenital syphilis**. The base case value and range were obtained from Chesson and colleagues (2008), the supporting manuscript of the original STIC Figure 1.0 tool.
Cost_15	$131	$46	$310	**Average lifetime productivity cost per chlamydial infection in women and men**. Like the corresponding direct medical cost parameter (Cost_5), this parameter (Cost_15) was used to approximate the productivity costs saved by prevention of chlamydia in the population through treatment of women and MSW with chlamydia. We assumed that chlamydial infections averted in the population by treatment of women and MSW would accrue in women and MSW, so for simplicity we applied an average lifetime productivity cost per infection for women and MSW to these averted infections. The base case value and range were obtained from Chesson (2024). The

Parameter name	Base case value	Lower bound value	Upper bound value	Description of parameter and sources for base case value and range
				base case value represents the weighted average discounted lifetime productivity cost per chlamydial infection for women and men, in which the cost for women (from Chesson 2024) was given 58% weight and the cost for men (also from Chesson 2024) was given 42% weight, based on the approximate share of total chlamydia and gonorrhea incidence that occurs among women, using incidence estimates of Kreisel (2021).
Cost_16	$28	$14	$50	**Average lifetime productivity cost per chlamydial infection in men**. Like the corresponding direct medical cost parameter (Cost_6), this parameter (Cost_16) was used to approximate the productivity costs saved by prevention of chlamydia in the population through treatment of MSM with chlamydia. We assumed that chlamydial infections averted in the population by treatment of MSM would accrue primarily among MSM, and thus we applied the average productivity cost per chlamydial infection in men obtained from Chesson (2024).
Cost_17	$139	$41	$345	**Average lifetime productivity cost per gonococcal infection in women and men**. Like the corresponding direct medical cost parameter (Cost_7), this parameter (Cost_17) was used to approximate the productivity costs saved by prevention of gonorrhea in the population through treatment of women and MSW with gonorrhea. We assumed that gonococcal infections averted in the population by treatment of women and MSW would accrue in women and MSW, so for simplicity we applied an average lifetime productivity cost per gonococcal infection for women and MSW to these averted infections. The base case value and range were obtained from Chesson (2024 under review), updated to 2023 dollars. The base case value represents the weighted average discounted lifetime productivity cost per gonococcal infection for women and men, in which the cost for women (from Chesson 2024) was given 58% weight and the cost for men (also from Chesson 2024) was given 42% weight, based on the approximate share of total chlamydia and gonorrhea incidence that occurs among women, using incidence estimates of Kreisel (2021).
Cost_18	$37	$17	$72	**Average lifetime productivity cost per gonococcal infection in men**. Like the corresponding direct medical cost parameter (Cost_8), this parameter (Cost_18) was used to approximate the productivity costs saved by prevention of gonorrhea in the population through treatment of MSM with gonorrhea. We assumed that gonococcal

Parameter name	Base case value	Lower bound value	Upper bound value	Description of parameter and sources for base case value and range
				infections averted in the population by treatment of MSM would accrue primarily among MSM, and thus we applied the average productivity cost per gonococcal infection in men obtained from Chesson (2024).
Cost_19	$411	$176	$1,004	**Average lifetime productivity cost per syphilitic infection**. The base case value and range for the average discounted lifetime cost per syphilitic infection were obtained from Chesson (2024). These syphilis cost estimates from Chesson (2024) were not sex-specific, and thus the same values were applied for women, MSW and MSM.
Cost_20	$87,458	$17,387	$148,158	**Average lifetime productivity cost per HIV infection**. The base case value and range were obtained from Islam (2024). The Islam study assessed only the productivity costs associated with HIV mortality, and thus excluded productivity losses associated with HIV morbidity. The lower bound value and upper bound value were obtained from the extreme values reported in two-way sensitivity analyses.

PID = pelvic inflammatory disease
P&S = primary & secondary
PrEP = pre-exposure prophylaxis
MSW = men who have sex with women only
MSM = men who have sex with men
STI = sexually transmitted infection
EPT= expedited partner therapy

Appendix Table A8

Additional explanation of model calculations of the number of adverse outcomes averted by STI and HIV program activities provided to women

Outcome symbol	Description and additional explanation
Outcome_W1	**PID cases averted in women treated for chlamydia**. The term Cw (see Appendix Table A3) represents the number of women with chlamydia who were treated. The parameter P_B8 represents the estimated absolute reduction in the probability of PID given treatment of a woman with chlamydia. Thus, the expected number of averted PID cases is Cw*P_B8, before we adjusted for the possibility of reinfection and coinfection. We adjusted for the probability of reinfection by multiplying by (1-P_B9), where P_B9 is the approximate probability of reinfection within one year. This adjustment is conservative in that it assumes there any benefits of treating a woman for chlamydia are lost if she reacquires chlamydia within a year. We adjusted for the probability of gonorrhea coinfection by multiplying by (1-P_B4), where P_B4 is the probability that a woman with chlamydia also has gonorrhea. This approach to adjust for coinfection is conservative because (1) it assumes that treatment for chlamydia in the absence of treatment for gonorrhea does not reduce the risk of PID in women with both chlamydia and gonorrhea and (2) a similar adjustment is also applied for gonorrhea (see Outcome_W2 below) such that the benefits of treating coinfected women for both infections can be underestimated.
Outcome_W2	**PID cases averted in women treated for gonorrhea**. The term Gw (see Appendix Table A3) represents the number of women with gonorrhea who were treated. The parameter P_B8 represents the estimated absolute reduction in the probability of PID given treatment of a woman with gonorrhea, as we assumed that the risks of PID were the same for untreated gonorrhea as for untreated chlamydia. This assumption was used by Kumar (2021), who noted that this assumption is likely conservative given evidence that the risks of PID might be greater for untreated gonorrhea than for untreated chlamydia. The expected number of averted PID cases is Gw*P_B8, before we adjusted for the possibility of reinfection and coinfection; these adjustments for reinfection and coinfection are analogous to the adjustments described above for Outcome_W1.
Outcome_W3	**Cases of syphilis sequelae averted in women treated for P&S syphilis.** The term Sw (see Appendix Table A3) represents the number of women with P&S syphilis who were treated. The parameter P_B11 represents the absolute reduction in the probability of long-term sequelae of syphilis given treatment of a woman with P&S syphilis, where "long-term sequelae" refers to the following four outcomes: cardiovascular syphilis, tabes dorsalis, meningovascular syphilis, and general paresis. We did not adjust for the probability of reinfection of syphilis because the probability of long-term sequelae we applied is low (0.1%), and thus the potential impact of reinfection on the estimated benefits of syphilis treatment is likely minor.
Outcome_W4	**Chlamydial infections averted in the population**. We assumed that treatment of women with chlamydia could avert subsequent chlamydial infections in the women's sex partners, their partners' partners, and so on. We conservatively

Outcome symbol	Description and additional explanation
	assumed that there would be no "infections averted in the population" for (1) women with chlamydia who were epi-treated due to contact with an infected partner and (2) women with chlamydia who were treated via EPT delivered via MSW partners, because in both of these instances the immediate partners of the women were already being treated for chlamydia. Thus, in estimating the number of chlamydial infections averted in the population through treatment of women with chlamydia, we applied the term Ĉw, which represents the number of women with chlamydia treated, excluding (1) women with chlamydia who were epi-treated due to contact with an infected partner and women with chlamydia who were treated via EPT (see Table 1). The parameter P_B13 represents the average number of infections averted in the population per person treated for an STI, and thus Outcome_W4 was estimated as the product of Ĉw and P_B13.
Outcome_W5	**Gonococcal infections averted in the population**. See the description above for Outcome_W4, which describes the estimation of the number of chlamydial infections averted in the population. Outcome_W5 was estimated in an analogous manner.
Outcome_W6	**Syphilitic infections averted in the population**. See the description above for Outcome_W4, which describes the estimation of the number of chlamydial infections averted in the population. Outcome_W6 was estimated in an analogous manner.
Outcome_W7	**Chlamydia-attributable HIV infections averted**. Similar to our assumptions for Outcome_W4 above, we conservatively assumed that there would be no chlamydia-attributable HIV infections averted for (1) women with chlamydia who were epi-treated due to contact with an infected partner and (2) women with chlamydia who were treated via EPT delivered via MSW partners, because in both of these instances the immediate partners of the women were already being treated for chlamydia and thus the chlamydia-attributable HIV infections averted would be reflected in the treatment of these sex partners. If a woman were epi-treated for chlamydia based on sexual contact with a man known to have chlamydia, then the potential for chlamydia-attributable HIV infections averted in the woman (if she does not have HIV) or in the woman's partner (if she does have HIV) would be reflected at least in part by Outcome_MSW7 (Table 4), because treatment of the woman's partner known to have chlamydia would be included in the Ĉmsw term (Table 3). Thus, in estimating the number of chlamydia-attributable HIV infections averted through treatment of women with chlamydia, we applied the term Ĉw, which represents the number of women with chlamydia treated, excluding (1) women with chlamydia who were epi-treated due to contact with an infected partner and women with chlamydia who were treated via EPT (see Table 1). We assumed that treatment of chlamydia in women could prevent chlamydia-attributable HIV infections in two ways. First, treatment of chlamydia could reduce a woman's susceptibility to HIV if the woman does not have HIV and could reduce the probability of HIV transmission to a sex partner if the woman has HIV. The number of chlamydia-attributable HIV infections averted by reducing the susceptibility or infectiousness of the treated woman can be expressed as

Outcome symbol	Description and additional explanation
	Ĉw*P_B14*P_B15, as described below. Second, treatment of chlamydia in women could prevent additional chlamydial infections in the population, as described in Outcome_W4 above, and these additional chlamydial infections could lead to chlamydia-attributable HIV infections. The number of chlamydia-attributable HIV infections averted by preventing chlamydial infections in the population was estimated as Ĉw*P_B13* P_B14, as described below. *Explanation of the term Ĉw*P_B14*P_B15* The term Ĉw represents the number of women treated for chlamydia, excluding those who were epi-treated due to contact with an infected partner or who were treated via EPT. The parameter P_B14 represents the probability of a chlamydia-attributable HIV infection, per chlamydial infection in women (Table A6). Thus, the parameter P_14 can be interpreted as the number of HIV infections averted per chlamydial infection in women averted. However, treating chlamydia is not as beneficial as averting the chlamydial infection altogether, and thus the number of HIV infections averted per woman treated for chlamydia is lower than the number of HIV infections averted per chlamydial infection in women averted. To account for the fact that treating an STI is less beneficial than preventing an STI altogether, we multiplied by the parameter P_B15, which is the relative benefit of treatment of an STI (vs. prevention of an STI) in terms of averting STI-attributable HIV infections (see P_B15 in Appendix Table A7). *Explanation of the term Ĉw*P_B13* P_B14* As described above for Outcome_W4, the number of chlamydial infections averted in the population was estimated as Ĉw*P_B13. The number of chlamydia-attributable HIV infections averted by preventing chlamydial infections in the population was estimated as Ĉw*P_B13* P_B14, where P_B14 represents the probability of a chlamydia-attributable HIV infection, per chlamydial infection in women. *Combining these two terms* The sum of these two components of the estimated number of chlamydia-attributable HIV infections averted (Ĉw*P_B14*P_B15 and Ĉw*P_B13* P_B14) can be simplified to Ĉw*P_B14*(P_B15+P_B13).
Outcome_W8	**Gonorrhea-attributable HIV infections averted**. See the description above for Outcome_W7, which describes the estimation of the number of chlamydia-attributable HIV infections averted. Outcome_W8 was estimated in an analogous manner.
Outcome_W9	**Syphilis-attributable HIV infections averted**. See the description above for Outcome_W7, which describes the estimation of the number of chlamydia-attributable HIV infections averted. Outcome_W9 was estimated in an analogous manner.
Outcome_W10	**HIV infections averted by linkage to care**. The number of HIV infections averted by linkage to care was calculated as the number of women with HIV linked or re-linked to care (Hw) multiplied by the estimated number of HIV infections averted per person with HIV linked or re-linked to care (P_B18) as described in Appendix Table A7.

Outcome symbol	Description and additional explanation
Outcome_W11	**HIV infections averted by HIV PrEP referrals**. The number of HIV infections averted by referring women to HIV PreP was calculated as the number of person-years on HIV PrEP gained by referring women to HIV PrEP multiplied by the number of HIV infections averted per person year on HIV PrEP for women. The number of person-years on HIV PrEP gained by referring women to HIV PrEP was calculated as W14*P_B19*P_B20, where W14 is the number of women referred to HIV PrEP, P_B19 is the number of persons initiating PrEP per PrEP referral, and P_20 is the number of person-years on HIV PrEP contributed per person initiating PrEP. The term W14*P_B19*P_B20*P_B21 is the product of the number of person-years on HIV PrEP gained by referring women to HIV PrEP (W14*P_B19*P_B20) and the number of HIV infections averted per person-year on HIV PrEP (P_B21). See Appendix Table A7 for descriptions of P_B19, P_B20, and P_B21; note that the number of person-years contributed per person initiating HIV PrEP (P_B20) was limited to the first year within PrEP initiation, because STIC Figure 2.0 estimates the benefits of program activities over a one-year period.
Outcome_W12	**HIV infections averted by HIV PrEP provision**. The number of HIV infections averted by PrEP provision was estimated in a similar manner as the number of HIV infections averted by PrEP referrals described above for Outcome_W11, except that for Outcome_W12 we applied the term W15 (the number of women directly provided with HIV PrEP) instead of W14 (the number of women referred to HIV PrEP) and we did not include the parameter P_B19 (the number of women initiating HIV PrEP per HIV PrEP referral). The term W15* P_B20*P_B21 reflects the number of women directly provided with HIV PrEP multiplied by the number of person-years on HIV PrEP contributed per person initiating PrEP multiplied by the number of HIV infections averted per person-year on HIV PrEP. For simplicity, we assumed that all persons provided with HIV PrEP in a given year were on HIV PrEP as of the beginning of the year (i.e., January 1). Although the parameter P_B20 is defined as the number of person-years on HIV PrEP contributed per person initiating PrEP, the parameter value for P_B20 was calculated assuming a constant HIV PrEP discontinuation rate. Thus, the parameter P_B20 can also be interpreted as the number of person-years on HIV PrEP that occur within a given year for those on HIV PrEP as of January 1 of the given year, regardless of whether the person using HIV PrEP on January 1 is a new HIV PrEP user initiating HIV PrEP or is an existing HIV PrEP user from the previous year.
Outcome_W13	**Congenital syphilis cases averted in infants of women treated for P&S syphilis**. This outcome refers to reported congenital syphilis cases, which includes congenital syphilis-related stillbirth. The number of congenital syphilis cases averted was estimated as the number of women with P&S syphilis who were treated (Sw) multiplied by the percentage of women with syphilis who are pregnant (P_A6) and multiplied by the probability of congenital syphilis when the mother has syphilis and is not treated (P_B12).

PID = pelvic inflammatory disease; P&S = primary & secondary; PrEP = pre-exposure prophylaxis; MSW = men who have sex with women only; MSM = men who have sex with men; STI = sexually transmitted infection; EPT= expedited partner therapy
The parameters used in the descriptions of the calculations are defined in Appendix Tables A1, A2, A3, A4, A5, A6, and A7.

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