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The Estimated Impact of Implementing a Funding Allocation Formula on the Number of Gonorrhea Cases in the United States, 2014 to 2018

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Abstract

Background: The Centers for Disease Control and Prevention (CDC) allocates funds annually to state and local programs in the United States to monitor and prevent sexually transmitted diseases (STDs). In 2014, a funding formula was implemented to allocate prevention funds to jurisdictions according to their STD burden and population size. We estimated the effect of implementing the funding formula in terms of gonorrhea cases averted from 2014 to 2018, a period during which inflation-adjusted CDC STD prevention funding declined.

Methods: Our model assumed that STD prevention funds have a measurable effect on subsequent reported gonorrhea case rates, and the magnitude of this effect was as estimated in an empirical analysis of decades of state-level gonorrhea rates. In applying this equation-based model, we assumed all factors affecting jurisdictions' gonorrhea rates were constant over time except for their STD prevention funding allocations. We used data on CDC STD prevention funding allocated to each jurisdiction over time. We estimated gonorrhea rates under the "funding formula" scenario compared with a hypothetical "status quo" funding scenario, which reflected traditional methods to allocate prevention funds.

Results: In the model, gonorrhea cases increased from 2014 to 2018 by approximately 6% because of a decline in prevention funding, regardless of how funds were allocated. However, the estimated increase in gonorrhea cases was 5222 (range, 1181–9195) cases less in the funding formula scenario than in the status quo scenario.

Conclusions: By shifting resources toward jurisdictions with greater disease burden, the funding formula averted a substantial number of gonorrhea cases at no additional cost.

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Each year, the Centers for Disease Control and Prevention (CDC) allocates federal funds to state and local programs in the United States to prevent, treat, and monitor sexually transmitted diseases (STDs). From 2014 to 2018, Improving Sexually Transmitted Disease Programs through Assessment, Assurance, Policy Development, and Prevention Strategies (STD-AAPPS), the flagship program of CDC's Division of STD Prevention at the time, provided funding to 59 jurisdictions, including 50 states, 7 cities, and 2 territories.[1] A key innovative feature of STD-AAPPS was the introduction of a funding allocation formula, in which prevention funds were allocated across jurisdictions according to each jurisdiction's STD burden and the size of its population aged 15 to 44 years.[2]

Before the implementation of the STD-AAPPS funding formula, CDC's STD prevention funding allocations were based primarily on historical allocations,[3] such that each jurisdiction's share of overall funding typically did not change substantially from 1 year to the next. Over time, however, this legacy-based approach resulted in funding allocations that were not fully aligned with burden and need.[3,4] The STD-AAPPS funding formula was implemented to address these imbalances.[3,4] Despite the potential for a more efficient and transparent allocation of resources, the establishment of formulas for federal allocations can create controversy and debate.[5,6] To ease the transition to a formula-based allocation process, some funding formulas include a "hold harmless" provision to limit the magnitude of changes in funding from 1 year to the next.[6,7] Such limits can help stabilize state and local budgets and facilitate planning.[7] Accordingly, the STD-AAPPS funding formula was phased in gradually from 2014 to 2018 and included caps on losses such that no jurisdiction's allocation would be cut by more than 5% per year or $200,000 per year.

Several studies have demonstrated that higher levels of STD prevention funding in a given year are associated with lower reported STD rates in subsequent years.[8–11] Using the evidence from these studies of the magnitude of the impact of STD prevention resources on STD incidence, researchers have developed simple models to estimate the impact and cost-effectiveness of STD prevention programs,[12] to illustrate the potential effects of changes to the budgets of STD prevention programs,[13] and to estimate the relative effectiveness of hypothetical resource allocation strategies for STD prevention.[14] In this article, we used a similar approach to estimate the impact of the resource allocation formula established in 2014 through STD-AAPPS.

The specific contribution of this study was to provide model-based estimates of the number of gonorrhea cases averted from 2014 to 2018 by implementing the STD-AAPPS "funding allocation formula," as compared with a "status quo" scenario that reflected traditional methods to allocate STD-AAPPS prevention funds across jurisdictions. We focused on gonorrhea cases as the outcome measure because the documented link between STD prevention funding in a given year and lower reported STD rates in subsequent years is much more robust for gonorrhea than for chlamydia and syphilis.[8,10,11,13] In addition to estimating the impact of the funding formula as it was actually implemented, we explored what the impact of the funding formula might have been had it been implemented without restrictions (e.g., without a gradual phase-in or without caps on losses from 1 year to the next).

This analysis is particularly important in the era of increasing STD rates and decreasing funding for STD prevention activities. Reported rates of gonorrhea, chlamydia, and syphilis in the United States have increased dramatically in recent years.[15,16] Furthermore, implementation of the funding formula coincided with an overall reduction in the federal funding for STD prevention activities provided through STD-AAPPS (STD-AAPPS funding),[16] making the efficient allocation of available STD prevention funds a more prominent public health issue. Estimates of the effect of changes in allocation of STD-AAPPS prevention funds on national-level gonorrhea incidence can inform future efforts to promote the efficient allocation of limited resources across US jurisdictions for STD prevention activities.

METHODS

Overview of Modeling Approach

Our approach was to use a mathematical model to estimate what the reported number of gonorrhea cases nationwide might have been from 2014 to 2018 in a hypothetical setting, in which all factors affecting gonorrhea rates were constant over time except for funding for STD prevention activities provided through STD-AAPPS. Although actual reported gonorrhea rates from 2014 to 2018 were already known at the time our study was conducted, our modeling approach allowed us to compare the estimated number of gonorrhea cases under a “funding formula” scenario with that of a status quo scenario, in which traditional methods to allocate prevention funding from 2011 to 2013 continued into 2014 to 2018. In our model, the total amount of prevention funds in any given year was the same under the funding formula and the status quo scenarios. The key difference between the scenarios was in how the prevention funds were allocated across jurisdictions (Table 1).

The Model

Our model assumed that STD-AAPPS prevention funds have a measurable effect on subsequent reported gonorrhea case rates, and that the magnitude of this effect was as estimated in an analysis by Williams et al.[8] of more than 35 years of state-level gonorrhea rates. Specifically, we modeled gonorrhea rates by using the following equation:

$$\ln(\text{Rate}_{i,t}) = \alpha_i - 0.096 * \ln(\text{Funding}_{i,t}) - 0.115 * \ln(\text{Funding}_{i,t-1}) - 0.114 * \ln(\text{Funding}_{i,t-2}). \quad (1)$$

In this equation, $\text{Rate}_{i,t}$ was the number of reported gonorrhea cases per 100,000 population in jurisdiction i in year t. $\text{Funding}_{i,t}$ represented STD-AAPPS prevention funding (dollars per capita) allocated to jurisdiction i in year t. There were 53 jurisdictions in our model: 50 US states, District of Columbia, Puerto Rico, and US Virgin Islands. Following Williams et al.,[8] we included prevention funding in the current year and the 2 previous years because prevention activities such as STD screening and treatment in a given year might reduce the spread of gonorrhea in the population and thus contribute to lower numbers of reported cases in subsequent years. A set of coefficients −0.096, − 0.115, and −0.114 represented estimates of the marginal impact of the federal STD-AAPPS prevention funds on rates of reported gonorrhea cases in each of those years.[8] The jurisdiction-specific term α_i accounted

for all factors that influence gonorrhea rates in jurisdiction *i* other than its STD-AAPPS prevention funding, and all of those factors were assumed not to change in our model from 2011 to 2018. In our model, α_i was calculated such that the modeled gonorrhea rate for each jurisdiction would match the reported gonorrhea rate in 2013, the year preceding implementation of the funding formula. A detailed example of the model calculations is provided in Supplemental Appendix (http://links.lww.com/OLQ/A639).

Under the approach outlined in Equation 1, the modeled gonorrhea rate would remain constant in a given jurisdiction if the jurisdiction's STD-AAPPS prevention funding allocation remained unchanged over time. For example, because the value assigned to term α_i in jurisdiction *i* did not change from year to year, modeled gonorrhea rate in this jurisdiction was affected only by changes in its STD-AAPPS funding. Furthermore, a one-time temporary change in prevention funding would affect a jurisdiction's estimated gonorrhea rate for 3 years, after which the gonorrhea rate would have gradually returned to the initial level. Of note, the STD-AAPPS funding allocations for the *entire period* of 2014–2018 were based on population size and reported STD case numbers and rates from the period preceding implementation of the funding formula. Thus, we did not have to account for "feedback" in our model, in which gonorrhea rates influenced prevention funding in subsequent years.

Data Sources

Reported gonorrhea rates from 2011 to 2013 were used to inform model estimates for 2014 through 2018, as described in Equation 1. Reported gonorrhea rates were obtained from CDC's AtlasPlus.[17] Modeled gonorrhea rates from 2014 to 2018 for each jurisdiction were converted to the number of gonorrhea cases by using jurisdiction-level population estimates from the US Census Bureau.[18]

STD-AAPPS funding for STD prevention allocated by jurisdiction from 2011 to 2018 was obtained from unpublished and published[19] DSTDP records. STD-AAPPS funds allocated directly to cities were included in the model as funding to the respective states. STD-AAPPS prevention funds were adjusted to 2016 US dollars by using the consumer price index for all urban consumers,[20] where the base year of 2016 was selected to be consistent with the empirical analysis[8] on which our model was based.

Following Williams et al.,[8] we included only STD-AAPPS, thereby excluding certain other types of funding, such as for the Gonococcal Isolate Surveillance Project and special evaluation projects. For simplicity, we assumed that each jurisdiction spent its entire funding allocation in the year in which it was allocated; that is, we did not account for the possibility that funds might be "carried over" from 1 year to the next.

Accounting for Uncertainty in the Model Predictions

In our analyses, we calculated point estimates of the model predictions by applying the funding coefficients listed in Equation 1: −0.096, −0.115, and −0.114. To calculate ranges around these point estimates, we applied 2 alternate sets of values for these coefficients (−0.022, −0.026, −0.026; and −0.170, −0.204, −0.202) based on the 95%

confidence intervals for the cumulative effect of prevention funding from Williams et al[8] (see Supplemental Appendix for details, http://links.lww.com/OLQ/A639).

Estimating the Total Number of Gonorrhea Cases Averted by Implementing the Funding Formula

We computed the number of gonorrhea cases averted by implementing the funding formula in each jurisdiction, comparing gonorrhea cases estimated under a funding formula scenario with those estimated under status quo funding. Under the status quo funding, STD-AAPPS prevention funding in 2014 to 2018 was allocated across jurisdictions in the same relative proportions as in 2011 to 2013 to reflect continued traditional methods to allocate STD-AAPPS prevention funds across jurisdictions. To compute the total number of gonorrhea cases averted by the funding formula in the United States from 2014 to 2018, we summed the model results for all 53 jurisdictions.

Alternative Implementation Strategies for the Funding Formula

Our actual implementation analysis focused on the funding formula as it was implemented and included the actual funding allocations to each jurisdiction in 2014 to 2018. The funding formula as implemented was phased-in from 2014 to 2018, and capped reductions in prevention funding allocated to each jurisdiction at approximately 5% per year for jurisdictions receiving up to $4 million and at approximately $200,000 per year for jurisdictions receiving $4 million or more. In addition to this actual implementation analysis, we examined 3 hypothetical strategies in which we varied how the funding formula was implemented (Table 2). In all 3 alternate hypothetical implementation strategies, the status quo funding allocation scenario was assumed to be the same as in the actual implementation analysis. Additional details of our methods and results are provided in Supplemental Appendix (http://links.lww.com/OLQ/A639). The Appendix also describes a supplemental analysis of the implementation of the funding formula in the context of stable, rather than declining, STD-AAPPS prevention funding.

RESULTS

Total STD-AAPPS Prevention Funding

During the 2014–2018 period, the CDC allocated $466.4 million (in 2016 US dollars) through STD-AAPPS to jurisdictions nationwide for STD prevention activities. The sum of STD-AAPPS prevention funding allocations across jurisdictions declined over the study period from $96.4 million in 2014 to $89.3 million in 2018 (Table 3); most of this decline was due to the inflation adjustment to 2016 dollars.

Estimated Effect of Implementing the Funding Formula

The model predicted that the decline in STD-AAPPS funding would lead to an increase in the annual number of gonorrhea cases, regardless of how the funds were allocated across jurisdictions. However, the increase in gonorrhea cases would be lower under the funding formula scenario than the status quo scenario. Specifically, under the funding formula scenario, the predicted annual number of gonorrhea cases would have increased from 340,550 (range, 336,950–344,191; Table 3) in 2014 to 360,265 (range, 347,788–373,363)

in 2018, with a total of 1,756,192 (range, 1,714,650–1,799,215) cases estimated over the course of 2014–2018. Conversely, under the status quo scenario, the predicted annual number of gonorrhea cases would have increased from 340,695 (range, 336,982–344,449) in 2014 to 362,251 (range, 348,239–376,842) in 2018, with the total of 1,761,414 (range, 1,715,831–1,808,410) cases estimated during the 2014–2018 period.

The estimated number of gonorrhea cases averted by the funding formula as compared with the status quo funding was 145 (range, 32–258; Table 3) in 2014 and 1986 (range, 451–3480) in 2018. For example, the 145 cases averted in 2014 represent the difference between 340,695 cases in the status quo scenario and 340,550 cases in the funding formula scenario. Over the 5-year period from 2014 to 2018, implementing the funding formula averted an estimated cumulative total of 5222 (range, 1181–9195; Table 3, Fig. 1) gonorrhea cases.

Alternative Implementation Strategies for the Funding Formula

The funding formula was estimated to be more efficient when implemented without restrictions, as shown by the alternative implementation strategies (Table 4). An estimated 8438 (range, 1948–14,515) gonorrhea cases would have been averted over the course of 2014–2018 if the funding formula had been implemented without caps on reductions in the annual STD-AAPPS funding across jurisdictions (alternate implementation strategy 1). An estimated 9585 (range, 2261–16,107) gonorrhea cases would have been averted if the funding formula had been implemented immediately instead of through a gradual phase-in (alternate implementation strategy 2). Finally, an estimated 13,181 (range, 3249–20,906) gonorrhea cases would have been averted if the funding formula had been implemented without caps on losses and without a gradual phase-in (alternate implementation strategy 3).

DISCUSSION

This study analyzed a novel approach to allocating CDC STD prevention funds, established in 2014 through the STD-AAPPS funding allocation formula, and estimated that a notable number of gonorrhea cases was likely averted at no additional cost by shifting available resources for STD prevention to jurisdictions with greater disease burden. We compared the funding formula scenario with a status quo funding scenario that reflected traditional methods to allocate STD-AAPPS prevention funds. In doing so, we analyzed the funding formula as it was actually implemented, as well as under a variety of alternate implementation strategies. In our analysis of the funding formula as it was actually implemented, we estimated 5222 gonorrhea cases averted by the funding formula from 2014 to 2018 as compared with the status quo. Because of practical and logistical considerations, the funding formula was implemented gradually with caps on reductions in funding across jurisdictions. Had these restrictions not been necessary, the funding formula could have averted an estimated 13,181 gonorrhea cases from 2014 to 2018 as compared with the status quo. In all analyses, the 5-year estimated effects of the funding formula were minor in relative terms (<2% reduction in cases). However, the number of gonorrhea cases averted by the funding formula from 2014 to 2018 increased exponentially, indicating that more pronounced effects are possible over time.

The relevant question to ask when evaluating the effect of the funding formula is not "Did gonorrhea incidence decrease after implementation of the funding formula?" but instead "Was gonorrhea incidence after the implementation of the funding formula lower than it would have been had the funding formula not been implemented?" Our model predicted that from 2014 to 2018, the number of gonorrhea cases would increase owing to a decline in STD-AAPPS prevention funding, with or without the implementation of the funding formula. The increase in gonorrhea cases predicted in this study was qualitatively consistent with the real world, in which the reported number of gonorrhea cases was on the rise over the course of the study period. However, the degree of increase in the real world (a 67% increase from 2014 to 2018[17]) was much more pronounced than the model estimated, which could indicate that STD-AAPPS prevention funding is even more important than our model assumed, or could reflect the influence of real-world factors not considered in our hypothetical setting. Regardless, the key result of this analysis is that if the funding formula had not been implemented, there would have been an estimated 5222 (range, 1181–9195) additional gonorrhea cases from 2014 to 2018 in the United States.

To our knowledge, this is one of few studies that analyzed different approaches to allocating STD prevention funds across US jurisdictions and—among those studies—the first to estimate the impact of a real-world implementation of a resource allocation formula. Furthermore, we quantified the potential efficiency costs of "hold-harmless" provisions that limit changes in funding from 1 year to the next. However, additional studies are needed to help understand the intermediate factors that link increases in STD prevention funding to decreases in STDs, such as partner services and the promotion of screening and treatment. Similarly, future studies could examine whether redistribution of STD-AAPPS prevention funding had an effect on these intermediate outcomes or on other relevant program performance measures. Such studies could also help to refine the estimated association between prevention funding and disease outcomes.

Although the model we used was practical and data-based, it had important limitations. First, the model did not account for potential differences in the quality and effectiveness of STD prevention services across jurisdictions. Specifically, for each jurisdiction, we applied the same estimates of the marginal impact of federal STD-AAPPS prevention funds on rates of reported gonorrhea cases. Second, we did not account for the possibility that a given jurisdiction might not have used its entire STD-AAPPS allocation in a given year. Similarly, we did not account for the possibility that a jurisdiction's allocation in a given year might have been "offset" by the carryover of unobligated funds from the previous year. This simplification would have biased our results, but the direction of this bias is difficult to predict. Third, the model predicted only the impact of changes in CDC funding for STD prevention activities and thus did not consider changes in any other factors affecting trends in gonorrhea rates, such as funding for STD prevention from sources other than CDC, funding for programs other than STD prevention that can affect gonorrhea rates (e.g., HIV prevention and teen pregnancy prevention), population-level behavioral changes (e.g., condom use and sexual mixing patterns), or socioeconomic factors (e.g., poverty or unstable housing).[21] However, to the extent that these factors would have a similar effect on trends in reported gonorrhea cases regardless of whether or not the funding formula had been implemented, the omission of these factors would not be expected to bias our estimates

of the effect of implementing the funding formula, unless changes in these factors were correlated with gonorrhea case burden or STD funding allocations. Fourth, the model did not explicitly incorporate gonorrhea transmission dynamics, as these dynamics were assumed to be reflected in the previous study on which the model was based.[8] Fifth, our model was better suited for assessing relatively small (e.g., <5%) changes in funding than relatively large changes (e.g., >20% in select US jurisdictions) and for assessing changes over a short time frame. Furthermore, our modeling study was based on the previously published empirical analysis and thus inherited certain limitations of the original analysis. For instance, we modeled the impact on reported gonorrhea cases, not actual gonorrhea incidence. Despite these limitations, our analysis provided a useful estimation of the impact of implementing a funding formula to allocate STD-AAPPS prevention funds across jurisdictions.

Our study demonstrated that the increase in the number of reported gonorrhea cases from 2014 to 2018 was not unexpected. An approximately 7% decline in STD-AAPPS prevention funding from 2014 to 2018 translated into a nearly 6% increase in the predicted annual number of gonorrhea cases over this time frame, highlighting the importance of additional funding for reducing the burden of STDs. However, implementation of the funding formula in 2014 likely helped to slow the rate of increase in reported gonorrhea rates by shifting available prevention funding to areas with larger populations and a higher STD burden. Consistent with a basic tenet of resource allocation modeling in public health, we demonstrated that prevention funding can have a greater impact when it is focused in areas of the greatest need.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Conflict of Interest and Sources of Funding:

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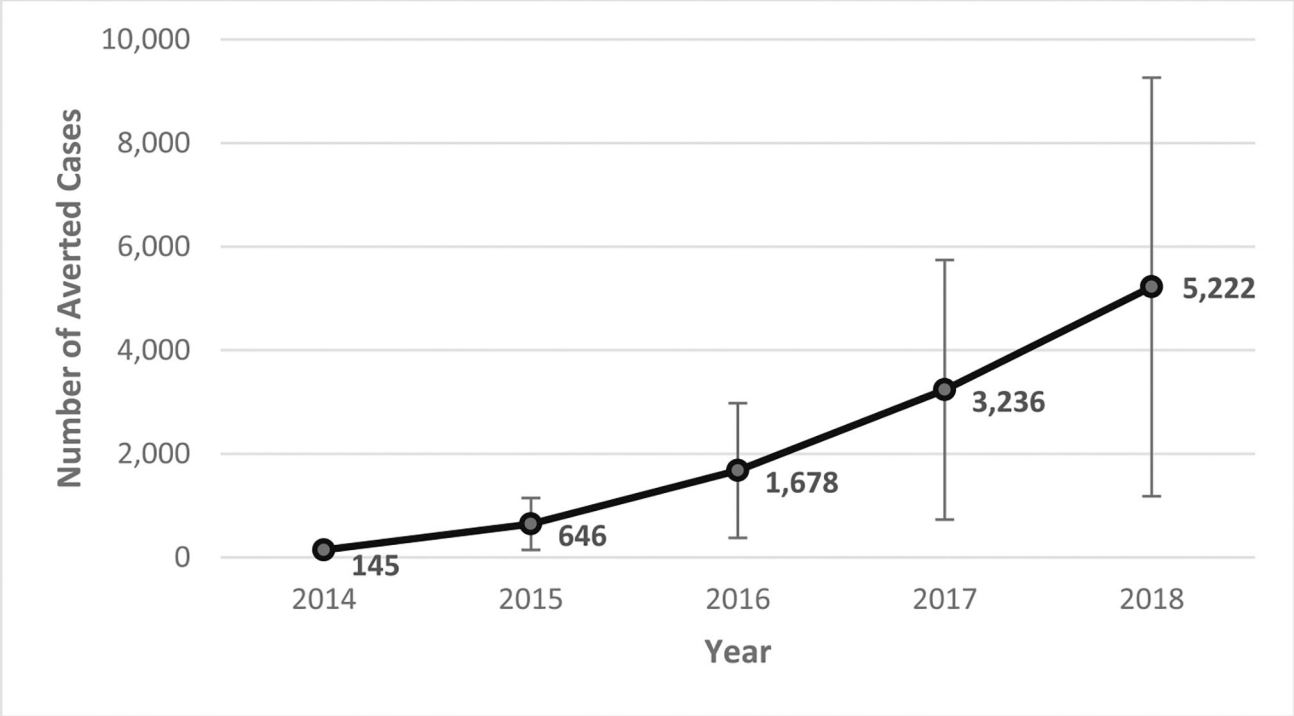

Figure 1.

Cumulative estimated number of gonorrhea cases averted in the United States from 2014 to 2018 by using the funding formula to allocate prevention resources, compared with traditional funding allocations. This figure shows point estimates and ranges of the cumulative number of gonorrhea cases averted in the United States from 2014 to 2018. The number of averted gonorrhea cases was defined as the difference between the annual number of reported gonorrhea cases estimated under the status quo funding scenario and the funding formula scenario. In both scenarios, the point estimates of the number of reported gonorrhea cases in 2014 to 2018 were obtained based on (1) an empirical analysis of state-level sexually transmitted infection prevention funding and gonorrhea rates from 1981 to 2016 and (2) unpublished and published[19] data on CDC prevention funding allocated in 2011 to 2018 to 53 US jurisdictions under the STD-AAPPS program. Under the funding formula scenario, the funding allocations in the model from 2014 to 2018 reflected actual STD-AAPPS prevention funding allocations to each jurisdiction from 2014 to 2018 as determined by the funding formula. Under the hypothetical status quo funding scenario, the funding allocations in the model from 2014 to 2018 were calculated such that each jurisdiction would continue to receive the same proportion of total funding that they received in 2011 to 2013. The ranges for the number of averted gonorrhea cases were estimated by using 2 alternate sets of values for the model parameters that were based on the 95% confidence intervals for the cumulative effect of prevention funding on rates of reported gonorrhea cases from Williams et al.[8]

TABLE 1.

Illustration of the “Funding Formula” Scenario and the “Status Quo” Scenario Examined in the Modeling Study: Total Annual Funding and Method Used to Allocate Funds

	Year				
Allocation Scenario	**2014**	**2015**	**2016**	**2017**	**2018**
Funding formula scenario					
Total annual funding, 2016 US$	96,357,588	95,280,916	94,093,909	91,306,196	89,333,843
Method used to allocate funding across jurisdictions	Funding formula	Funding formula	Funding formula	Funding formula	Funding formula
Status quo scenario					
Total annual funding, 2016 US$	96,357,588	95,280,916	94,093,909	91,306,196	89,333,843
Method used to allocate funding across jurisdictions	Traditional allocations	Traditional allocations	Traditional allocations	Traditional allocations	Traditional allocations

The purpose of this table is to clarify that in our analysis the total amount of funds allocated in any given year was the same under the funding formula and the status quo scenarios, and that the only difference between the scenarios was in how the prevention funds were allocated across jurisdictions. Under the funding formula allocation scenario, total funding in 2014 was $96,357,588 and was assumed to be allocated across jurisdictions according to the funding formula. Under the status quo allocation scenario, total funding in 2014 remained the same as under the funding formula scenario ($96,357,588) and was assumed to be allocated across jurisdictions in the same relative proportion as in 2011 to 2013. Similar assumptions were applied in all subsequent years, although the total funding available declined over time.

TABLE 2.

Description of the Actual and Alternate Strategies for Implementing the Funding Formula Examined in the Modeling Study

Funding Formula Implementation Strategy	Key Approaches to Implementing Funding Formula	
	5-y Phase-in of C the Funding Formula*	aps on Reduction in Prevention Funding†
Actual implementation strategy	Yes	Yes
Alternate implementation strategy 1	Yes	No
Alternate implementation strategy 2	No	Yes
Alternate implementation strategy 3	No	No

*The funding formula as it was actually implemented in 2014 to 2018 included a gradual phase-in over the 5-year period. The 5-year funding formula phase-in assumption was also retained under the alternate implementation strategy 1. Under the remaining alternate strategies, this assumption was relaxed, and the relative proportion of prevention funding allocated to each jurisdiction in 2018 through STD-AAPPS (Improving Sexually Transmitted Disease Programs through Assessment, Assurance, Policy Development, and Prevention Strategies) was applied to the entire period of 2014–2018 to reflect an immediate implementation of the funding formula.

†The funding formula as it was actually implemented in 2014 to 2018 included caps on reduction in funding so that a jurisdiction's funding would not be reduced by more than 5% from 1 year to the next (or by >$200,000 annually for jurisdictions receiving $4 million or more per year). This assumption was retained under alternate implementation scenario 2. Under the remaining alternate strategies, this assumption was relaxed, and the STD prevention funding was allocated across jurisdictions solely according to jurisdiction's STD burden and the size of population aged 15 to 44 years.

TABLE 3.

Annual Funding, Estimated Annual Number of Gonorrhea Cases in the "Funding Formula" and "Status Quo" Funding Scenarios, and Estimated Number of Gonorrhea Cases Averted in the United States by Implementing the Funding Formula, 2014 to 2018

	2014	2015	2016	2017	2018	2014–2018 Total
Federal funding for STD prevention provided through STD-AAPPS						
Annual funding, 2016 US$	$96,357,588	$95,280,916	$94,093,909	$91,306,196	$89,333,843	$466,372,452
Estimated annual number of gonorrhea cases, n (range)*						
Status quo funding scenario	340,695 (336,982–344,449)	347,792 (340,537–355,205)	352,681 (343,530–362,081)	357,994 (346,543–369,832)	362,251 (348,239–376,842)	1,761,414 (1,715,831–1,808,410)
Funding formula scenario	340,550 (336,950–344,191)	347,291 (340,425–354,312)	351,648 (343,297–360,258)	356,436 (346,190–367,092)	360,265 (347,788–373,363)	1,756,192 (1,714,650–1,799,215)
No. averted gonorrhea cases	145 (32–158)	501 (112–893)	1033 (233–1823)	1558 (353–2741)	1986 (451–3480)	5222 (1181–9195)

The number of gonorrhea cases averted in the United States was defined as the difference between the annual number of reported gonorrhea cases estimated under the status quo funding scenario and the funding formula scenario. In both hypothetical scenarios considered, the estimated number of reported gonorrhea cases in 2014 to 2018 was modeled based on (1) an empirical analysis of state-level STD prevention funding and gonorrhea rates from 1981 to 2016 and (2) unpublished and published[19] data on CDC prevention funding allocated in 2011 to 2018 to 53 US jurisdictions under the STD-AAPPS program. Under the funding formula scenario, the funding allocations in the model from 2014 to 2018 reflected actual STD-AAPPS prevention funding allocations to each jurisdiction from 2014 to 2018 as determined by the funding formula. Under the hypothetical status quo funding scenario, the funding allocations in the model from 2014 to 2018 were calculated such that each jurisdiction would continue to receive the same proportion of total funding that they received in 2011 to 2013.

*n is the estimated number of reported cases of gonorrhea. Ranges were estimated by using 2 alternate sets of values for the model parameters that were based on the 95% confidence intervals for the cumulative effect of prevention funding on rates of reported gonorrhea cases from Williams et al.[8]

STD-AAPPS indicates Improving Sexually Transmitted Disease Programs through Assessment, Assurance, Policy Development, and Prevention Strategies.

TABLE 4.

Estimated Number of Gonorrhea Cases Averted in the United States From 2014 to 2018 by Using the Funding Formula to Allocate Prevention Resources Under Different Implementation Strategies of the Funding Formula, 2014 to 2018

Funding Formula Implementation Strategy	Approach to Implementing Funding Formula*	2014, n (Range)†	2015, n (Range)	2016, n (Range)	2017, n (Range)	2018, n (Range)	2014–2018 Total, n (Range)
Actual implementation strategy	Phased-in implementation; caps on reduction in federal funding	145 (32–158)	501 (112–893)	1033 (233–1823)	1558 (353–2741)	1986 (451–3480)	5222 (1181–9195)
Alternate implementation strategy 1	Phased-in implementation; no caps on reduction in federal funding	257 (57–459)	846 (190–1505)	1713 (389–3002)	2492 (575–4287)	3131 (736–5262)	8438 (1948–14,515)
Alternate implementation strategy 2	Immediate implementation; caps on reduction in federal funding	722 (165–1261)	1563 (365–2662)	2362 (566–3901)	2423 (575–4038)	2515 (590–4245)	9585 (2261–16,107)
Alternate implementation strategy 3	Immediate implementation; no caps on reduction in federal funding	1007 (233–1729)	2148 (519–3504)	3204 (809–4920)	3325 (829–5185)	3497 (857–5568)	13,181 (3249–20,906)

For each funding formula implementation strategy, the number of gonorrhea cases averted in the United States was defined as the difference between the annual number of reported gonorrhea cases estimated under the status quo funding scenario and the funding formula scenario. For instance, in 2014 the funding formula as it was actually implemented averted a total of 145 (32–158) cases of gonorrhea, defined as the difference between 340,695 (336,982–344,449) gonorrhea cases estimated under the status quo funding scenario (Table 3) and 340,550 (336,950–344,191) gonorrhea cases estimated under the funding formula scenario (Table 3). In both status quo and funding formula scenarios, the estimated number of reported gonorrhea cases in 2014 to 2018 was modeled based on (1) an empirical analysis of state-level STD prevention funding and gonorrhea rates from 1981 to 2016 and (2) unpublished and published[19] data on CDC prevention funding allocated in 2011 to 2018 to 53 US jurisdictions under the STD-AAPPS (Improving Sexually Transmitted Disease Programs through Assessment, Assurance, Policy Development, and Prevention Strategies) program. Under the hypothetical status quo funding scenario, the funding allocations in the model from 2014 to 2018 were calculated such that each jurisdiction would continue to receive the same proportion of total funding that they received in 2011 to 2013. The actual and alternate strategies for implementing the funding formula are described in Table 2

*Approaches to implementing the funding formula are described in Table 2.

†n is the estimated number of reported gonorrhea cases averted in the United States by implementing each funding formula strategy compared with the status quo scenario. Ranges were estimated by using 2 alternate sets of values for the model parameters that were based on the 95% confidence intervals for the cumulative effect of prevention funding on rates of reported gonorrhea cases from Williams et al.[8]