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Estimated Incidence and Prevalence of Gonorrhea in the United States, 2006–2019

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Abstract

Background: We extend recent work estimating incidence and prevalence of gonococcal infections among men and women aged 15–39 years in the US in 2018 by applying the same modeling framework to estimate gonococcal incidence and prevalence during 2006–2019.

Methods: The model is informed by cases from the Nationally Notifiable Disease Surveillance System, data from the National Survey of Family Growth, and data on other factors known to impact gonococcal incidence and prevalence. We use Monte Carlo simulation to account for uncertainty in input parameters. Results are reported as median annual per-capita incidence and prevalence; uncertainty intervals are characterized by the 25th and 75th simulated percentiles.

Results: 1,603,473 (1,467,801–1,767,779) incident cases of gonorrhea were estimated in 2019. Per-capita incidence increased 32%, from 1101 (1002–1221) to 1456 (1333–1605) infections per 100,000 persons. This trend in per-capita incidence had three phrases: an initial decline during 2006–2009, a plateau through 2013, and a rapid increase of 66% through 2019. Men aged 25–39 experienced the greatest increase in incidence (125%, 541 (467–651) to 1212 infections (1046–1458) per 100,000 men). Women aged 25–39 had the lowest incidence in 2019, with 1040 infections (882–1241) per 100,000 women. Prevalence increased more slowly among those aged 25–39 vs. 15–24. The incidence ratio comparing men to women aged 25–39 increased from 0.76 to 1.18.

Conclusions: The burden of gonorrhea has increased among men and women aged 15–39 years since 2013. An increasing proportion of incident infections are among men. Additional biomedical and behavioral interventions are needed to control gonococcal transmission.

Summary:

The burden of gonorrhea has increased in the United States since 2009. An increasing proportion of incident infections are among men. Additional biomedical and behavioral interventions are needed.

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OMB/CDC Disclaimer: The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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Keywords

Mathematical model; gonorrhea; incidence; prevalence; STIs

1. Introduction

Gonorrhea is the second most commonly reported sexually transmitted infection (STI) in the United States after chlamydia. Rates of reported gonorrhea cases have been increasing across many age, geographic, and racial/ethnic groups, and especially among gay, bisexual, and other men who have sex with men (MSM) [1]. Cases reported to the Centers for Disease Control and Prevention (CDC) reflect both symptomatic and asymptomatic infections identified through screening. Because infections are commonly asymptomatic and screening is not universal, many gonococcal infections go undiagnosed [2]. Consequently, case reports should not be interpreted as incidence, but rather as the minimum burden of the true number of infections acquired per year, since they exclude undiagnosed and/or unreported infections. Other contextual factors like changes in care-seeking behaviors over time also complicate this issue.

Nevertheless, estimates of the incidence and prevalence of gonorrhea over time are crucial to understanding disease trends. Mathematical models have been developed to estimate the incidence and prevalence of gonorrhea by accounting for undiagnosed infection and care-seeking behaviors, with the most recently published estimates for 2018 [3]. Previous estimates were published for 2008, but due to methodological differences, the results are not directly comparable to 2018 [4]. Here we extended the recent mathematical modeling work by applying the models to historical data and assessing changes in incidence and prevalence over time. Our goal is not to identify the specific causes of change in these values over time, but to document the burden of gonorrhea using a parsimonious framework.

2. Methods

We extended an ordinary-differential-equation based model previously used to produce estimates for 2018 in order to estimate the annual incidence and prevalence of gonorrhea from 2006 to 2019 for the total population aged 15–39 years, and additionally stratified by sex/age subgroups, women and men aged 15–24 and 25–39 years [3]. The date range (2006–2019) was selected to align with available behavioral data from the National Survey of Family Growth (NSFG).

Model Structure

The model has closed-form solutions for incidence and prevalence counts, assuming equilibrium conditions within each year, and accounts for the natural history of gonococcal infection, case-reporting, and care-seeking behaviors among the sex/age subgroups. Our estimates of incidence and prevalence reflect the number of new infections and existing infections estimated separately for each year. We provide a brief overview of the model components below, and a more detailed description can be found in the supplement.

To model the natural history of gonorrhea, we used a simple elaboration of the general SIS model. We assumed three possible states of infection: uninfected (U), asymptomatically infected (A), and symptomatically infected (S). All people must be in one of these three states. We consider four mechanisms: 1) infection, 2) recovery due to natural clearance, 3) recovery due to background screening, and 4) recovery due to symptomatic treatment seeking. Uninfected people acquire infection at rate λ, also known as the force of infection. The force of infection is constant within each year, but varies between years, which is consistent with our assumption of steady state dynamics within each year described below.

A proportion of newly infected people (β) develop asymptomatic infection, and a complementary proportion $(1-\beta)$ develop symptomatic infection. Infected people (regardless of symptoms) can recover from infection due to natural clearance. The natural clearance rate ψ, is the inverse duration of time to natural clearance. Those with symptomatic infection can seek medical care. Assuming a perfect test (i.e., 100% sensitivity and specificity), and assuming all who test positive are treated effectively (no treatment failure), the rate of symptomatic treatment seeking (τ) is equivalent to the rate of recovery due to this process.

We assumed recovery due to background screening and subsequent treatment can occur in both the symptomatically and asymptomatically infected. Background screening represents testing that might occur without any syndromic indication. Each subpopulation has a specific screening rate (σ). Within a subpopulation, we assumed the screening rate was homogeneous, and averaged across all who comprise this subpopulation. Though rare, the model allows symptomatically infected people to possibility clear their infection via background screening. We assumed no treatment failure following either symptomatic treatment seeking or background screening. When cases are diagnosed from either symptomatic treatment seeking or background screening, only a proportion (ρ), are reported. The following equations mathematically summarize all descriptions.

Natural History:

$$\frac{dU}{dt} = -\lambda U + \left(\psi + \sigma\right)A + \left(\psi + \sigma + \tau\right)S$$

$$\frac{dA}{dt} = \lambda U\beta - \left(\psi + \sigma\right)A$$

$$\frac{dS}{dt} = \lambda U(1-\beta) - \left(-\psi + \sigma + \tau\right)S$$

Point Prevalence:

$$P = \frac{A+S}{A+S+U}$$

Population Size:

$$N = A + S + U$$

Case Reporting:

$$K = \rho(\sigma(A + S) + \tau S)$$

We use symbolic algebra in Python to solve these systems of equations for their steady state values. By solving for the state variable formulations (i.e., U, A, and S) as well as the force of infection formulation (λ), we derive steady state solutions for the annual number of incident infections (λU) and the point prevalence of infection in each year. The final equations can be found in the supplement.

Data Inputs

Table 1 provides a summary of the input parameters and state variables used in the system of equations derived above. The values and detailed descriptions of all parameters by year, sex, and age can be found in the supplement, but we present a brief overview. The model is informed by case report data from the Nationally Notifiable Disease Surveillance System (NNDSS), the case reporting fraction, the population size, natural history parameters, including the expected duration of an untreated gonococcal infection and the probability of an infection being asymptomatic, as well as health-seeking behaviors, namely, the rate of screening and the time to treatment seeking among symptomatically infected individuals [1,2,13–22,5,23,24,6–12]. We assumed that the expected duration of untreated infections and the proportion of cases that are asymptomatic have not changed over time, while all other parameters are time varying.

While all our data sources remain the same as previous work, we estimated the screening rates over a different period compared to Kreisel et al. (2021) to account for the NSFG collection cycles in this time frame. The previous estimates for 2018 used a four-year survey period from NSFG [3]. Here we used the two-year survey weights from NSFG to obtain annual estimates of σ during 2006–2019 (these two-year cycles are the shortest period for which NSFG provides weights.) Because NSFG collects data starting in June of each year, for those years that lay in two collection periods we used the average value between the two cycles. For example, the most recent cycles of NSFG were 2015–2017 and 2017–2019. For 2018 and 2019, we applied the screening rate from the 2017–2019 collection period. But for 2017, we averaged the estimates from 2015–2017 and 2017–2019 cycles. Supplemental table S7 shows the estimated screening rate over the 2006–2019 period by age group and sex. Because NSFG does not ask respondent motivation for STI testing or how many times in last year a respondent tested, we continue to use the assumption of Kreisel et al. that if a respondent reported STI screening in the last year, they were not experiencing any symptoms, and they only screened once in the past year[3].

Simulation & Analysis

We used Monte Carlo simulation to account for uncertainty in input parameters. We generated 10,000 parameter sets among each sex/age subgroup and converted raw counts to rates per 100,000 persons by dividing by each subgroup's population size and multiplying by 100,000. We calculated estimates among the full age distribution (15–39 years) by summing the incident and prevalent infection count distributions across both age groups and repeating the conversion to per capita rates using the population size of the aggregated group. Results are reported as the median per capita number of incident and prevalent infections; uncertainty intervals are characterized by the 25th and 75th percentiles of the simulated distribution for each outcome.

We calculated the estimated incidence ratio comparing men to women over this period and the change in this ratio since 2006. We also estimated the proportion of gonorrhea cases that got diagnosed from 2006 to 2019, calculated as the number of case reports from NNDSS divided by the estimated number of incident cases by age and sex group. Finally, we conducted sensitivity analyses for the effect of two time-varying that are more influenced by changes in health care utilization and technological trends than others in our model: the rate of background STI screening among each age/sex subgroup and the rate that diagnosed cases were reported to CDC by the states.

3. Results

Figures 1 and 2 show the estimated per capita incidence and prevalence over time overall, and by sex and age group. Tables 2 and 3 show these estimates numerically, including incidence and prevalence ratios comparing 2019 to 2006 among each subgroup. The estimated incidence of gonorrhea among all persons aged 15–39 years increased from 1101 (1002–1221) to 1456 (1333–1605) infections per 100,000 persons from 2006 to 2019, for a total 1,603,473 (1,467,801–1,767,779) incident cases estimated in 2019. This represents a 32% total increase in per-capita gonorrhea incidence since 2006. However, this overall trend masks several components: the estimated incidence of gonorrhea initially declined through 2009, plateaued, and then rapidly increased by 66% from 2014 to 2019.

Women aged 15–24 years consistently had the largest burden of gonorrhea compared to all other sex/age subgroups (in both absolute and per-capita terms), with an estimated 509,092 (433,531–608,408) cases in 2019. These women experienced a decline and rebound like other groups, but whereas all other groups ultimately surpassed their 2006 per-capita incidence, women aged 15–24 years experienced similar incidence compared to 2006 in 2019 (2263 (1925–2701) versus 2441 (2078–2917) per 100,000 women). Since 2006, women aged 25–39 years have experienced a 45% increase in incidence, from 718 (611–861) to 1040 (882–1241) incident infections per 100,000 women, for a total of 346,859 (294,160–414,094) cases in 2019.

All men experienced similar trends in incidence, decreasing from 2006 to 2009, plateauing or slowly increasing through 2013, and rapidly increasing through 2019. The per-capita incidence among men aged 15–24 years increased by 37% since 2006, from 899 (773–1078) to 1248 (1070–1506) cases per 100,000 men, for a total of 273,551 (234,524–330,037) cases

in 2019. Men aged 25–39 years had the lowest incidence of all subgroups in 2006, 508 (435–610) per 100,000 men, but experienced the largest increase (125%) over this period. By 2019 their per-capita incidence was nearly equivalent to men aged 15–24 years at 1212 (1046–1458) cases per 100,000 men, resulting in a total of 412,157 (355,720–495,638) cases. Among men and women aged 15–24 years, increases in incidence are mirrored by similar increases in prevalence. Per-capita prevalence among men and women aged 25–39 years, however, have increased more slowly than incidence. Tables of the absolute counts of estimated incident and prevalent cases can be found in the supplement.

The gonorrhea incidence ratio comparing all men to women increased from 0.53 to 0.80 during 2006–2019, demonstrating that men are making up an increasing proportion of estimated incident gonococcal infections (Figure 3). Among men and women aged 25–39 years, the median value for this ratio surpasses 1 from 2015 onward.

Figures S1 and S2 in supplement show the two analyses of sensitivity of results on our assumptions about the STI screening rates and the case reporting rate to CDC. There has been little change in the screening rate over time for men, so the static screening rate results are comparable to the numbers described above. However, due to recent increases in STI screening among women aged 25–39 years, had we not incorporated the time-varying parameter, we would have estimated that these women experienced roughly 8% fewer incident infections in 2019 than if their screening rate had stayed at 2006 levels (median and 25th and 75th percentiles of difference between simulated distributions: 27,804 (−57,800 – 114,862)). The rate of case reporting to CDC was estimated to be 86% in 2006 and increased to 95% by the time electronic lab reporting was widespread in 2013. These changes have linear effects on the results. For example, if we had assumed 95% reporting across the time series, in 2006, we would have estimated 9% lower incidence across all age/sex subgroups.

Finally, Figure 4 shows the proportion of cases per year that got diagnosed. The proportion of incident cases that were diagnosed increased steadily through 2013, and in 2019 was approximately 43.5% among men and 27.5% among women. Changes to the proportion of incident cases that get diagnosed over time highlight the effect of two time-varying parameters we used for sensitivity analyses discussed above.

Discussion

In this paper, we extended a method using historical data to produce national estimates and uncertainty measures for trends in the incidence and prevalence of gonorrhea among men and women aged 15–39 years from 2006 to 2019. After experiencing a steep decline in the incidence of gonorrhea, all sex/age subgroups had large increases in burden during 2014–2019.

The proportion of incident infections among each sex/age subgroup has also changed. The ratio of incident infections among men to women across all ages increased, but this ratio increased the most among those aged 25–39 years, with men accounting for more incident infections in this subgroup than women in 2019. While this is not a direct measure of the

change in infections among MSM, Heffelfinger et al. used a similar method to estimate increases in syphilis among MSM (2007). Additionally, the shapes of these curves, including the slowing in recent years, are similar to sentinel data from the STD Surveillance Network, where a sample of patients are interviewed and the resulting case reports can be stratified by sex and sex of sex partners [1]. However, because our analysis relies on NNDSS reports and is unable to separate out incident infections by sex of sex partner, some of the changes shown here could also be due to changes in incident infections in heterosexuals and/or other behaviors like age mixing.

A strength of this work is that we accounted for potential changes in care-seeking behaviors and reporting mechanisms over time, which allowed us to better understand temporal trends in infection burden among certain subgroups than we would have from just considering the case reports alone. If we had not accounted for increases in STI screening among women aged 25–39 years, we would have overestimated the incidence and prevalence for these women. Indeed, previous work showed that changes in screening behaviors potentially averted 30% of gonococcal infections from 2000 to 2015 [26]. While this percentage is larger than the effects of screening on incidence than we estimate in our sensitivity analysis, their own model calibration shows that the largest increases in yearly STI screening occurred during from 2000 to 2005, and these rates remained stable for most subgroups from 2005 to 2015. Therefore, most averted cases in their model occurred prior to the start of the period studied in this work, and the relative stability of screening across the other subgroups from 2006–2015 is in line with our model inputs and conclusions.

A limitation of this model is that we assume that the screening rates we estimated from NSFG represent the proportion of people who are screened for an asymptomatic infection each year. However, we are unable to determine two important factors from these data that operate in opposite directions. First, we do not know what portion of this testing was motivated by symptoms. If we overestimated the proportion of asymptomatic cases diagnosed via screening because we attributed all STI testing reported in the NSFG to strictly asymptomatic screening, we might have underestimated the number of prevalent and incident infections. Second, we do not know if individuals who reported testing in the last year did so more than once. If some respondents who reported STI screening tested multiple times in the previous year and were potentially responsible for multiple diagnosed cases, we could have underestimated the number of asymptomatic infections that were diagnosed and subsequently overestimated the number of prevalent and incident infections. To our knowledge, there is no source of data that would provide both the motivation for STI testing and a more detailed picture of the frequency of testing at the national level. Improving the quality of these data would help refine these estimates further.

An additional limitation of this model is that we did not explore diagnostic test improvements over time. We assumed perfect test sensitivity and specificity over the entire period in order to keep the model more mathematically tractable. However, the largest changes to the testing landscape occurred prior to the start of our study period. By 2005, NAAT (nucleic acid amplification tests) held close to 60% of the market share of diagnostic tests for bacterial STIs among private insurers, the 2006 STI Treatment Guidelines highlight NAATs as the most sensitive tests for gonorrhea and chlamydia, and by 2007, the National

Job Training Program exclusively used the highly sensitive and specific dual gonorrhea and chlamydia NAAT test for screenings completed through national contact laboratories [27–29]. It is possible that continued improvements in NAAT test specifications could have contributed to increased detection of cases through 2019, although we believe the effect to be minimal.

While case report data for gonorrhea from 2020 are currently available, other input parameter sources such as the NSFG have not published updated data, so we do not present estimates for 2020. Additionally, the coronavirus disease 2019 (COVID-19) pandemic significantly affected trends in reported cases of STDs in 2020, likely resulting in underreporting of infections. What we can understand about the 2020 case report data remains very unclear and any changes in incidence and prevalence during this period warrant separate consideration.

We also do not estimate the incidence and prevalence of antimicrobial resistant (AMR) gonococcal infections. Previous work estimated the proportion of all cases that display AMR from data collected in the Gonococcal Isolate Surveillance Project, but since these data only capture men with symptomatic urethral infections who visit STI clinics in select cities, these data may not be nationally representative of all AMR gonorrhea cases in the US. A more detailed estimation method should be considered to assess changes in AMR in strains of gonorrhea among each subpopulation over time.

Lastly, the sensitivity analyses of the original model (not reproduced here) highlighted that this method is sensitive to assumptions about the natural history of gonorrhea, particularly the proportion of cases in men and women that are symptomatic and the expected duration of untreated infections, about which there is a lack of robust data [3]. As such, our results should be interpreted with some caution. However, while our estimates may improve with more robust data, in the absence of major evolutionary changes to the pathogen's natural history, we would expect the general trends we highlight in this paper to hold.

These results are useful in understanding the potential burden of gonorrhea in this population, in providing input parameters or validation targets for other modeling efforts, and in highlighting the need for additional strategies to combat the estimated increases in incidence and prevalence. The increases since 2013 are particularly significant given the stability of case reporting to CDC, the availability of highly sensitive and specific tests, and the minimal effect of changes in background screening on incidence during this time. This evidence leads us to conclude that the burden of gonorrhea is likely increasing, and that more effective biomedical and behavioral interventions are needed to address this issue. One possible tool may be the meningitis-B vaccine. Growing evidence suggests that this vaccine can act as a short-term, partially effective vaccine against strains of gonorrhea and could help reduce its incidence, although more research on the longevity of the vaccine and efficient intervention strategies are needed [30–32s].

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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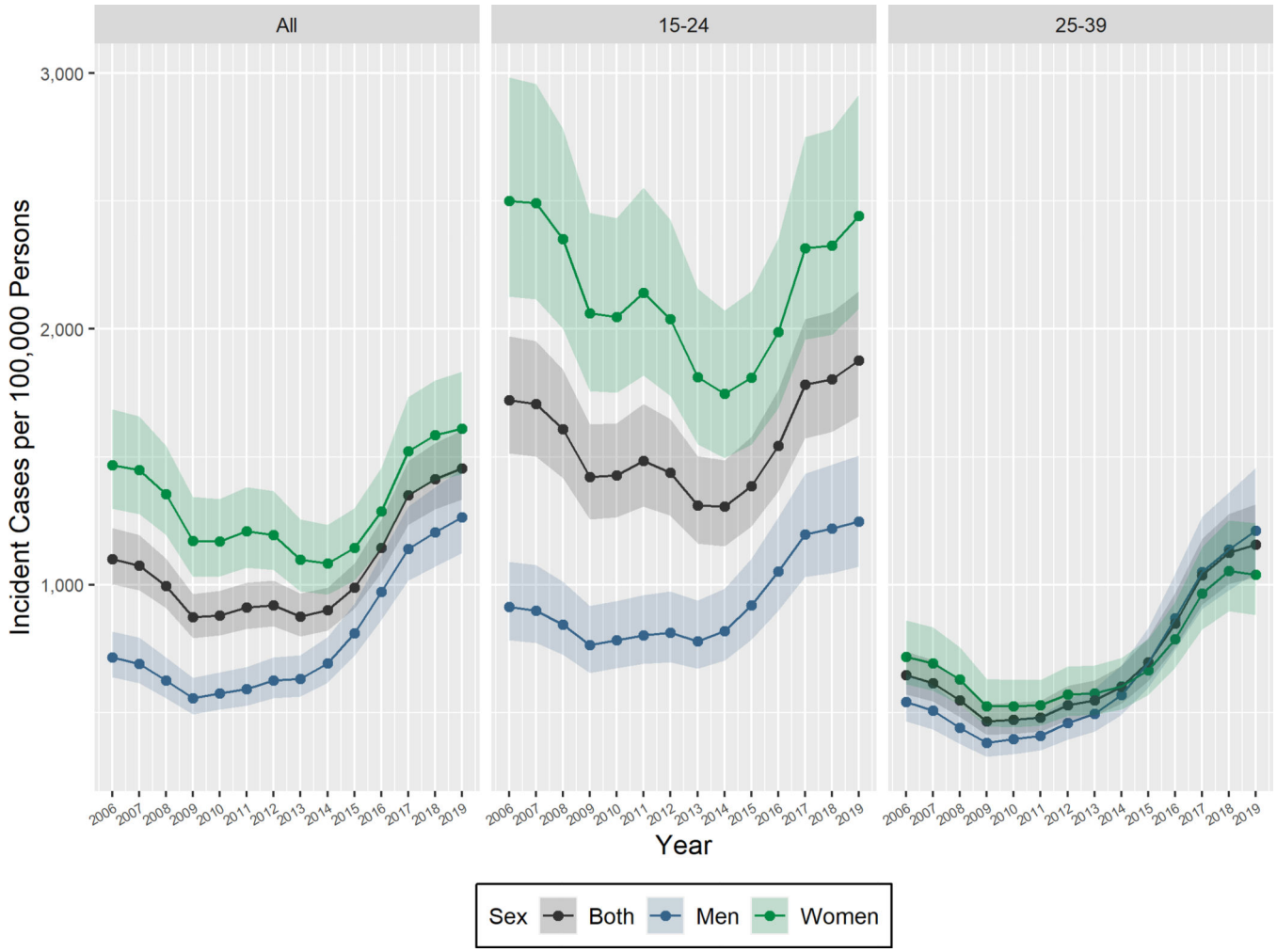

Figure 1:

Estimated Per-Capita Incidence of Gonorrhea in the United States, 2006–2019Estimates shown are the median and the 25th and 75% percentiles of the simulated distrubtion for each year.

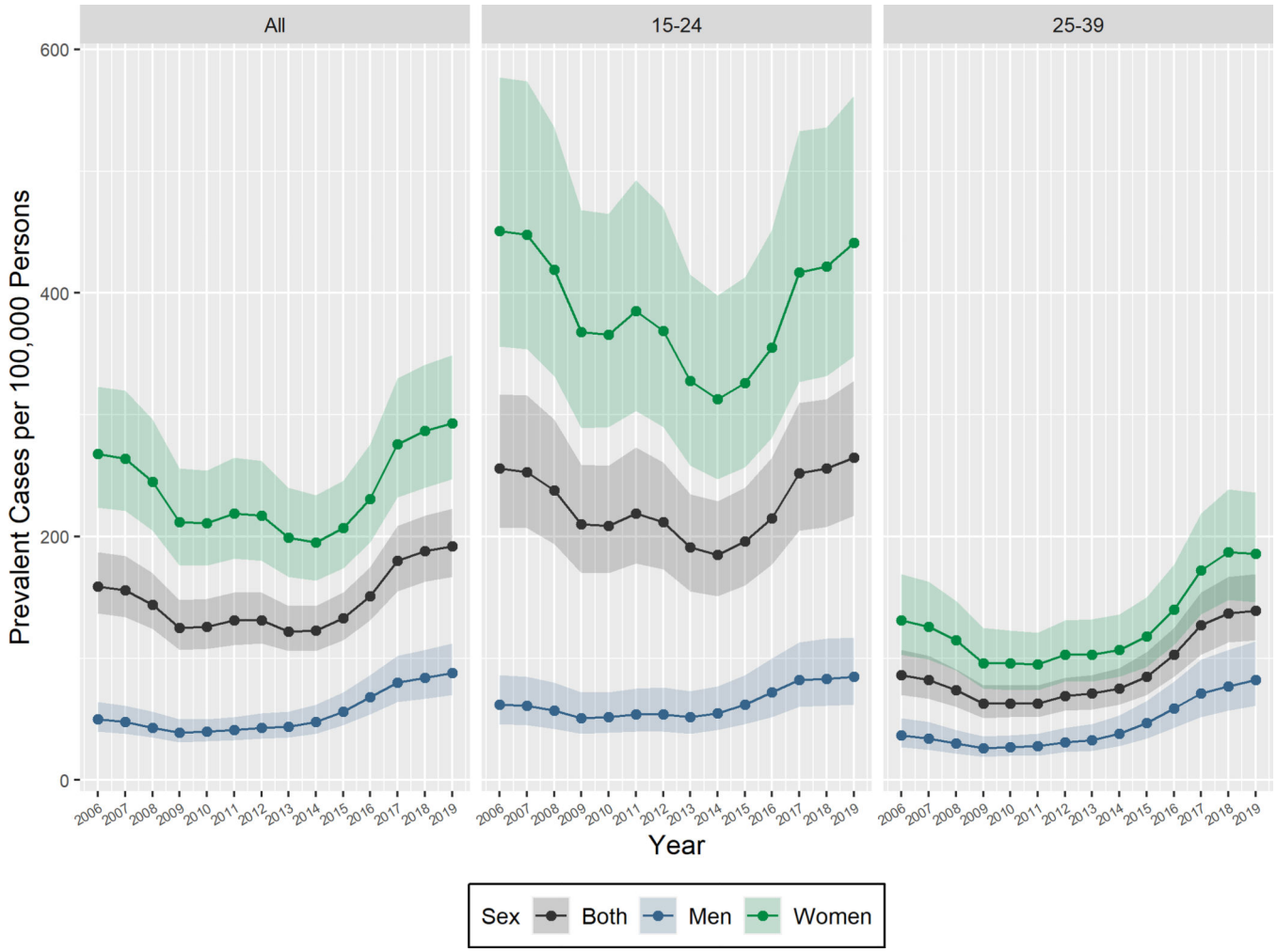

Figure 2:

Estimated Per-Capita Prevalence of Gonorrhea in the United States, 2006–2019Estimates shown are the median and the 25th and 75% percentiles of the simulated distrubtion for each year.

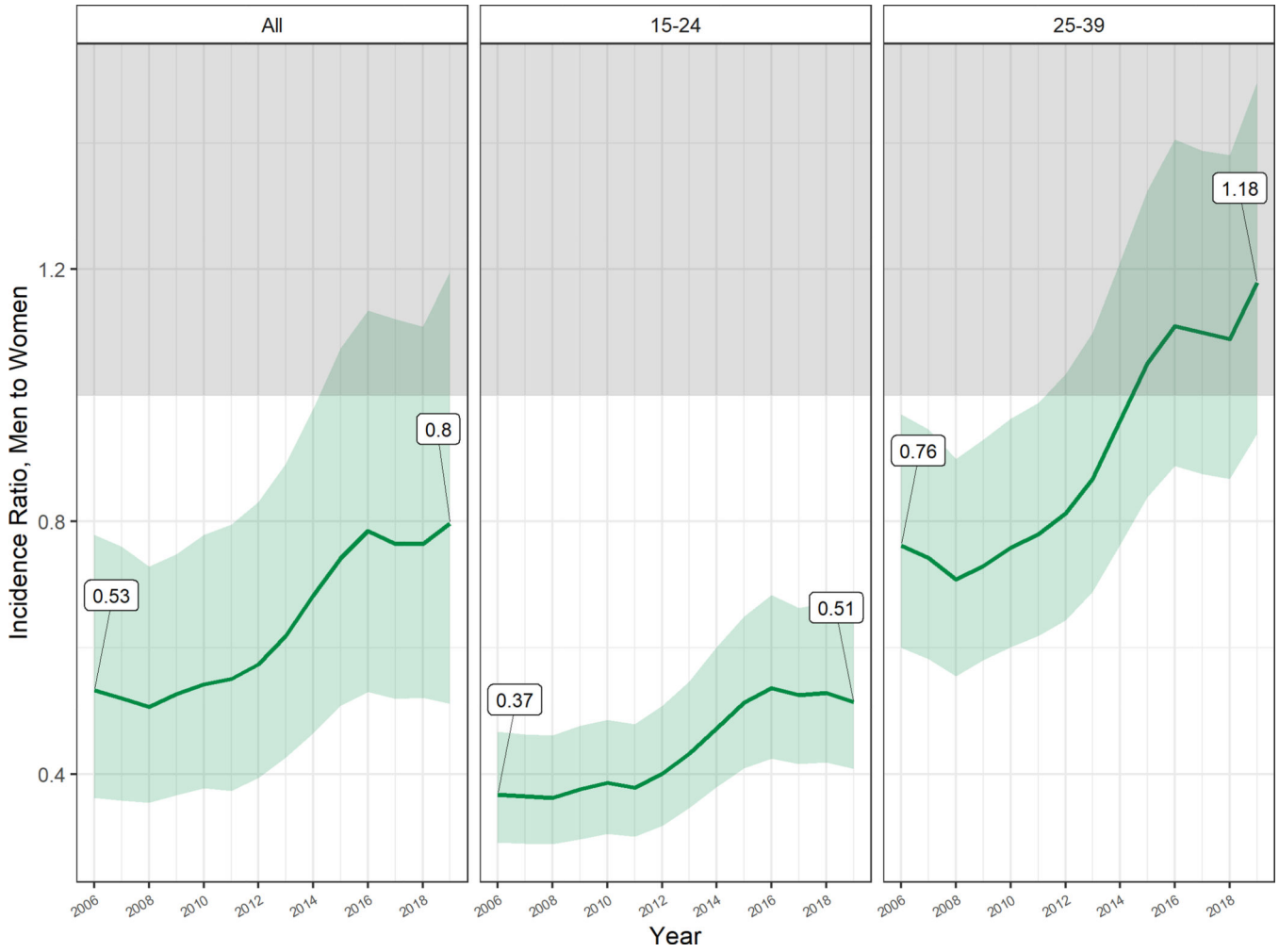

Figure 3:

Incidence Rate Ratio of Gonorrhea, Men to Women, 2006–2019Estimates shown are the median and 25th and 75th percentiles of the ratio of the simulated distributions in each year. Shaded area indicates ratio >=1.

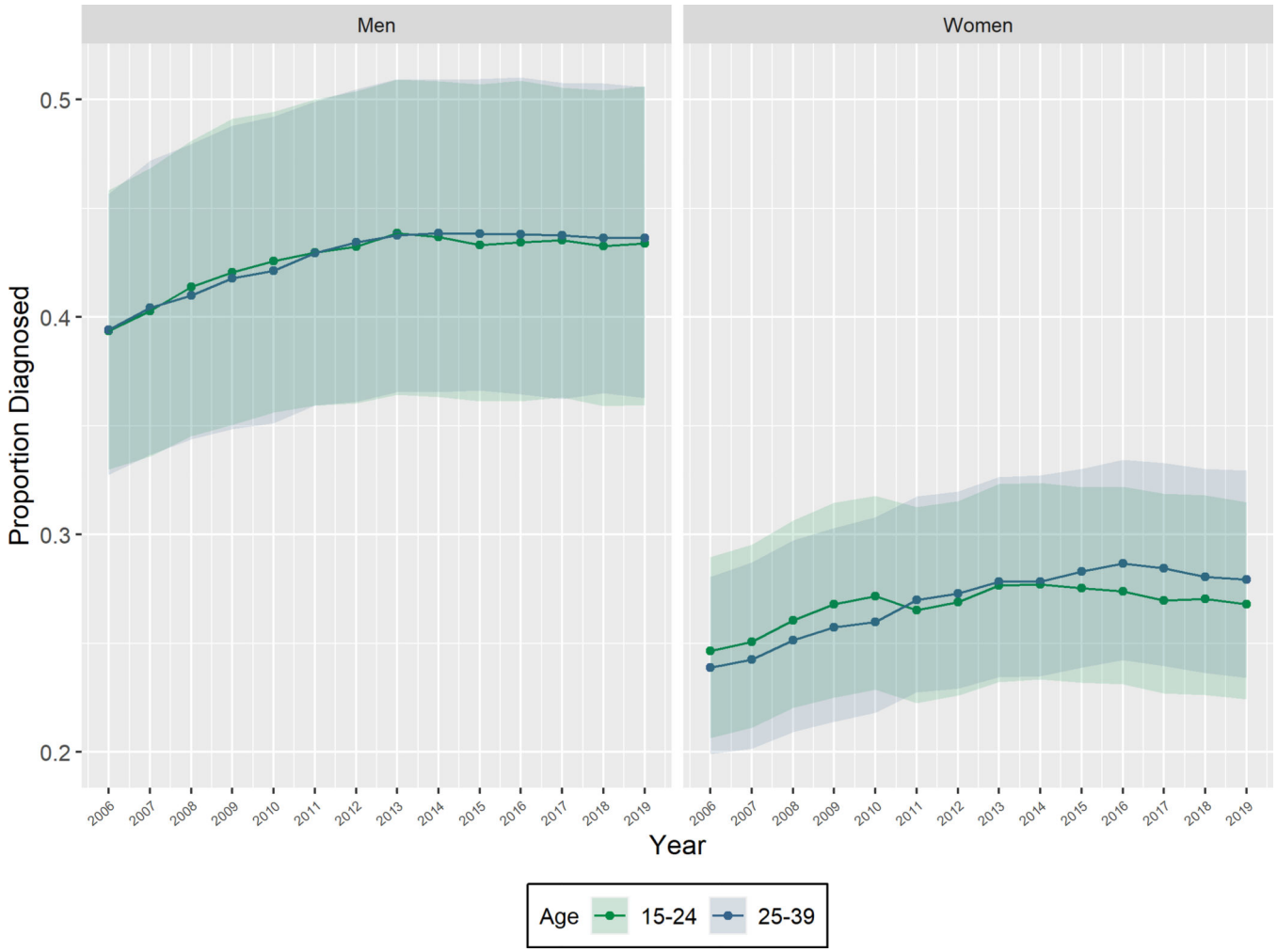

Figure 4:

Proportion of Estimated Incident Cases that got DiagnosedEstimates shown are the number of reported cases in each year divided by the median, 25th and 75th percentiles of the simulated incidence distribution.

Table 1:

Model Parameters & State Variables

Parameter / State		Group	Time-Varying	Source
N	Population size	Sex & Age	Yes	American Community Survey [11,12,21–23,13–20]
K	Case reports	Sex & Age	Yes	STD Surveillance Reports [1,5,6]
ρ	Case reporting fraction	All	Yes	[33]
ψ	Duration of untreated infection	Sex	No	Varies, see appendix
σ	Probability of STI screening per year	Sex & Age	Yes	National Survey of Family Growth [7–10,34s]
β	Probability of asymptomatic infection	Sex	No	[2]
τ	Time to treatment seeking (symptomatic infections)	Sex & Age	Yes	Composite parameter, see appendix.
U	Number of susceptible people			State Parameter
S	Number of people with symptomatic infection			State Parameter
A	Number of people with asymptomatic infection			State Parameter

Table 2:

Median Per Capita Incidence of Gonorrhea per 100,000 persons, 2006–2019

Age	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Ratio*
Men															
15–24	913 (784–1089)	899 (773–1078)	845 (727–1013)	765 (655–918)	783 (674–936)	803 (690–960)	812 (697–974)	779 (671–938)	818 (703–984)	920 (786–1103)	1052 (898–1264)	1197 (1031–1435)	1219 (1046–1469)	1248 (1070–1506)	1.37 (1.09–1.73)
25–39	541 (467–651)	508 (435–610)	442 (378–527)	382 (327–458)	396 (339–475)	409 (352–489)	459 (395–552)	496 (426–594)	570 (491–684)	695 (598–832)	869 (746–1044)	1049 (904–1267)	1139 (979–1361)	1212 (1046–1458)	2.25 (1.78–2.83)
All	717 (638–816)	690 (615–793)	626 (557–717)	557 (493–637)	576 (512–657)	592 (527–678)	625 (556–716)	633 (563–724)	694 (617–795)	811 (722–926)	972 (863–1117)	1140 (1017–1307)	1205 (1070–1382)	1264 (1123–1452)	1.76 (1.48–2.11)
Women															
15–24	2500 (2127–2983)	2493 (2116–2959)	2351 (2000–2782)	2062 (1757–2455)	2048 (1750–2433)	2142 (1818–2553)	2038 (1739–2427)	1812 (1550–2159)	1746 (1494–2073)	1809 (1548–2148)	1988 (1691–2354)	2316 (1959–2750)	2327 (1978–2780)	2441 (2078–2917)	0.98 (0.77–1.23)
25–39	718 (611–861)	693 (585–834)	629 (532–756)	526 (447–633)	526 (444–627)	529 (450–628)	572 (488–681)	576 (491–684)	602 (512–713)	665 (570–788)	788 (676–933)	966 (826–1147)	1054 (896–1251)	1040 (882–1241)	1.45 (1.13–1.84)
All	1467 (1297–1686)	1448 (1276–1658)	1355 (1195–1543)	1171 (1032–1344)	1169 (1033–1335)	1209 (1066–1381)	1194 (1058–1367)	1098 (975–1256)	1083 (962–1235)	1144 (1016–1300)	1287 (1142–1458)	1522 (1349–1735)	1585 (1406–1800)	1611 (1431–1832)	1.09 (0.92–1.31)
Both															
15–24	1722 (1514–1972)	1706 (1501–1953)	1608 (1417–1841)	1422 (1256–1627)	1428 (1263–1632)	1485 (1306–1706)	1438 (1270–1649)	1310 (1161–1504)	1306 (1151–1486)	1385 (1229–1578)	1544 (1364–1761)	1782 (1572–2038)	1804 (1597–2066)	1876 (1659–2147)	1.09 (0.91–1.31)
25–39	646 (572–739)	615 (544–706)	548 (484–626)	466 (413–533)	473 (417–540)	481 (427–547)	529 (470–604)	549 (488–625)	600 (535–683)	697 (623–793)	849 (756–968)	1038 (922–1181)	1126 (1004–1276)	1156 (1029–1315)	1.79 (1.5–2.14)
All	1101 (1002–1221)	1075 (978–1194)	995 (909–1103)	873 (791–963)	880 (802–976)	911 (828–1008)	919 (837–1017)	875 (798–966)	900 (822–990)	989 (908–1084)	1144 (1047–1256)	1350 (1235–1485)	1414 (1295–1554)	1456 (1333–1605)	1.32 (1.16–1.51)

*Ratio compares most 2019 to 2006

Uncertainty intervals represent the 25% and 75% percentiles of the simulated distributions.

Table 3:

Median Per-Capita Prevalence of Gonorrhea per 100,000 persons, 2006–2019

Age	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Ratio*
Men															
15–24	62 (46–86)	61 (45–85)	57 (42–80)	51 (38–72)	52 (39–72)	54 (40–75)	54 (40–76)	52 (38–73)	55 (41–77)	62 (46–86)	72 (52–100)	82 (60–113)	83 (61–116)	85 (62–117)	1.37 (0.88–2.12)
25–39	37 (27–51)	34 (25–48)	30 (22–41)	26 (19–36)	27 (20–37)	28 (20–38)	31 (23–43)	33 (24–46)	38 (28–53)	47 (34–65)	59 (43–81)	71 (52–99)	77 (57–107)	82 (61–114)	2.06 (1.31–3.18)
All	50 (40–64)	48 (38–61)	43 (35–56)	39 (31–50)	40 (32–50)	41 (33–52)	43 (34–55)	44 (35–56)	48 (38–62)	56 (45–72)	68 (54–86)	80 (64–102)	84 (67–107)	88 (70–112)	1.6 (1.16–2.25)
Women															
15–24	451 (356–577)	448 (354–574)	419 (332–536)	368 (289–468)	366 (290–465)	385 (303–493)	369 (290–470)	328 (258–415)	313 (247–398)	326 (257–413)	355 (281–452)	417 (327–533)	422 (332–536)	441 (348–562)	0.97 (0.69–1.36)
25–39	131 (103–169)	126 (99–163)	115 (90–147)	96 (75–125)	96 (74–123)	95 (74–121)	103 (81–131)	103 (81–132)	107 (85–136)	118 (93–150)	140 (111–177)	172 (136–219)	187 (148–239)	186 (146–236)	1.27 (0.9–1.81)
All	268 (224–323)	264 (221–320)	245 (205–296)	212 (176–256)	211 (176–254)	219 (182–265)	217 (180–262)	199 (167–240)	195 (164–234)	207 (174–246)	231 (195–276)	276 (232–330)	287 (240–341)	293 (247–349)	1.01 (0.78–1.32)
Both															
15–24	256 (207–317)	253 (207–316)	238 (194–296)	210 (170–259)	209 (170–258)	219 (178–273)	212 (173–261)	191 (155–235)	185 (151–229)	196 (160–240)	215 (177–265)	252 (205–310)	256 (208–313)	265 (217–328)	1.03 (0.76–1.39)
25–39	86 (70–107)	82 (67–102)	74 (60–91)	63 (51–78)	63 (52–78)	63 (52–78)	69 (57–84)	71 (58–86)	75 (62–92)	85 (70–105)	103 (85–125)	127 (103–154)	137 (113–167)	139 (115–169)	1.46 (1.09–1.94)
All	159 (137–187)	156 (134–184)	144 (124–170)	125 (107–148)	126 (108–149)	131 (111–154)	131 (112–154)	122 (106–143)	123 (106–143)	133 (115–154)	151 (131–175)	180 (155–209)	188 (163–217)	192 (167–223)	1.11 (0.89–1.39)

*Ratio compares 2019 to 2006

Uncertainty intervals represent the 25% and 75% percentiles of the simulated distributions.