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Sexually Transmitted Infections Among US Women and Men: Prevalence and Incidence Estimates, 2018

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Abstract

Background: The most recent estimates of the number of prevalent and incident sexually transmitted infections (STIs) in the United States (US) were for 2008. We provide updated estimates for 2018 using new methods.

Methods: We estimated the total number of prevalent and incident infections in the US for eight STIs: chlamydia, gonorrhea, trichomoniasis, syphilis, genital herpes, human papillomavirus (HPV), sexually transmitted hepatitis B, and sexually transmitted HIV. Updated per capita prevalence and incidence estimates for each STI were multiplied by the 2018 full resident population estimates to calculate the number of prevalent and incident infections. STI-specific estimates were combined to generate estimates of the total number of prevalent and incident STIs overall, and by gender and age group. Primary estimates are represented by medians and uncertainty intervals are represented by the 25th (Q1) and 75th (Q3) percentiles of the empirical frequency distributions of prevalence and incidence for each STI.

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Results: In 2018, there were an estimated 67.6 (Q1=66.6, Q3=68.7) million prevalent and 26.2 (Q1=24.0, Q3=28.7) million incident STIs in the US. Chlamydia, trichomoniasis, genital herpes, and HPV comprised 97.6% of all prevalent and 93.1% of all incident STIs. Persons aged 15–24 years comprised 18.6% (12.6 million) of all prevalent infections; however, they comprised 45.5% (11.9 million) of all incident infections.

Conclusions: The burden of STIs in the US is high. Almost half of incident STIs occurred in persons aged 15–24 years in 2018. Focusing on this population should be considered essential for national STI prevention efforts.

Short Summary

There were an estimated 67.6 million prevalent and 26.2 million incident sexually transmitted infections in the United States in 2018.

Keywords

sexually transmitted infections; prevalence; incidence

Introduction

Although rates of reported cases of all three nationally notifiable sexually transmitted infections (STIs; chlamydia, gonorrhea, and syphilis) increased during 2014–2018, case rates only represent diagnosed and reported infections. As most STIs are asymptomatic, estimates of prevalence and incidence are important for understanding the full burden of infection. (1) STI prevalence and incidence estimates have been reported several times, most recently for 2008; however, previous efforts did not quantify uncertainty. (2–5) Additionally, since that time, there have been changes in the epidemiology of several STIs, potentially impacting their prevalence and incidence. (6–8) Given more recent data and improved estimation methods, we provide updated STI prevalence and incidence estimates for 2018, both overall and by disease. Having a combined estimate is crucial for policy purposes to illustrate the importance of STIs in the United States.

Overview of Methods and Data Sources Used

We estimated the combined number of prevalent and incident infections of eight STIs in the US in 2018: chlamydia, gonorrhea, trichomoniasis, syphilis, genital herpes (due to herpes simplex virus type 2, HSV-2), human papillomavirus (HPV), sexually transmitted hepatitis B virus (HBV), and sexually transmitted HIV. The combined number of STIs was generated using a multi-step process. We first generated prevalence and incidence estimates using appropriate methodology and available data for each STI. Table 1 provides a summary of the data sources used for each STI and more detailed information on the methodology for estimating the prevalence and incidence of each STI is found in the manuscripts that follow in this Special Issue. (9–15) We then calculated the *number* of prevalent and incident infections by multiplying each STI's updated per capita estimates by the 2018 full resident population estimates from the American Community Survey. (16)

To estimate the *total* number of incident and prevalent STIs, aggregated across all STIs, we first characterized each STI's empirical frequency distribution of prevalence and incidence by sampling from STI specific probability distributions of prevalence and incidence or using simulated estimates directly. In either case, this resulted in distributions consisting of 10,000 estimates of prevalence and incidence for each STI. Next, each distribution was shuffled to remove potential correlation between prevalence and incidence from simulated results. Then, all distributions were combined, where columns represented STI type and rows represented estimates (i.e., 8 STI columns by 10,000 rows). Finally, the total number of prevalent or incident infections was generated by taking the sum of each row. This resulted in distributions for total prevalence and incidence across all STIs consisting of 10,000 estimates each. These distributions were summarized by medians, which represent our primary estimates, and the 25th (Q1) and 75th (Q3) percentiles, which represent our uncertainty intervals. Total estimates are not the sum of individual estimates, but rather descriptions of multiple distributions that have been combined. As a result, individual estimates may not perfectly add up to total estimates.

The prevalence estimates in this manuscript represent point prevalence (the number of persons with an STI at a given point in 2018). HPV prevalence estimates specifically represent the number of people with ≥1 disease-associated HPV type considered (types 6, 11, 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66, or 68). Total prevalence estimates across all STIs overestimate the number of people with a prevalent STI because a person coinfected with >1 STI would count for multiple prevalent infections.

The incidence estimates presented here reflect subtly different approaches depending on the STI. For HPV, incidence estimates reflect the cumulative number of *people* acquiring a disease-associated HPV type in 2018, regardless of any prior disease-associated HPV infection. Only the first acquisition of a disease-associated HPV type in 2018 is counted, so a person can only account for one HPV infection in 2018. For the non-viral STIs, incidence estimates reflect the cumulative number of incident *infections* during 2018. Because reinfection during 2018 is possible, a person with repeat infections with a non-viral STI can count for >1 infection. For HBV, HIV, and genital herpes, incidence estimates represent the cumulative number of infections *and* the number of people with an incident infection; these numbers are equivalent since infection may only be acquired once. Like total prevalence, total incidence estimates across all STIs overestimate the number of people with an incident infection, since one person could have acquired >1 STI in 2018.

Tables 2 and 3 provide estimates for the number of prevalent and incident infections in 2018, both by STI and aggregated for all STIs, for all ages by sex, and for adolescents and young adults aged 15–24 years by sex. As "all ages" means something different for each STI (due to availability of data), the age range for each is provided. For all estimates generated from the National Health and Nutrition Examination Survey (NHANES), data were analyzed accounting for the complex survey design, multiple cycles were combined to increase estimate stability, and all estimates had a relative standard error ≤30% (indicating estimate stability), unless otherwise indicated.

Chlamydia

The prevalence of chlamydia was estimated using 2015–2018 NHANES data, which was then used to create a modeled prevalence in 2018. (17–19) Ordinary differential equation (ODE) based modeling, assuming equilibrium and static incidence, was used to estimate incidence. (20) Case reports and point prevalence were related to incidence via population size, case reporting fraction (the proportion of all diagnosed infections reported to public health), and natural clearance rate. (1, 9)

There were an estimated 2.4 million prevalent urogenital chlamydial infections among persons aged 15–39 years in 2018; 1.1 and 1.3 million infections among men and women, respectively. Men (595,000 infections) and women (990,000 infections) aged 15–24 years comprised 56.7% and 75.8% of all male and female infections, respectively. There were 1.6 million total prevalent chlamydial infections among 15–24-year-olds in 2018.

We estimated 4.0 million incident chlamydial infections among persons aged 15–39 years; 1.6 and 2.4 million infections among men and women, respectively. Men (910,000 infections) and women (1.7 million infections) aged 15–24 years comprised 56.1% and 73.4% of all male and female incident infections, respectively. There were 2.6 million total incident infections among 15–24-year-olds, representing 66.5% of all incident chlamydial infections in 2018.

Gonorrhea

ODE based modeling, assuming equilibrium and static incidence, was used to estimate both gonococcal prevalence and incidence. (20) Case reports were related to prevalence and incidence via population size, case reporting fraction, proportion of new infections that are asymptomatic, and rates of background screening, natural clearance, and symptomatic treatment seeking. (1, 9) The prevalence and incidence of antimicrobial resistant (AMR) gonorrhea was determined by multiplying the percentage of isolates demonstrating resistance to ciprofloxacin, tetracycline, or penicillin, or elevated minimum inhibitory concentrations (MICs) to azithromycin, ceftriaxone, or cefixime (51.3%) in the 2018 Gonococcal Isolate Surveillance Program by our prevalence and incidence estimates. (1, 9)

The number of prevalent urogenital gonococcal infections in 2018 among 15–39-year-old persons was 209,000 overall; 50,000 in men and 155,000 in women. Among all prevalent gonococcal infections, 107,000 demonstrated resistance or elevated MICs to antibiotics tested. Men and women aged 15–24 years accounted for 40.0% and 58.1% of all male and female prevalent infections, respectively (men: 20,000; women: 90,000). There were 113,000 total prevalent gonococcal infections among 15–24-year-olds, representing 54.1% of all incident gonococcal infections in 2018.

The number of incident gonococcal infections among all 15–39-year-old persons in 2018 was 1.6 million; 804,000 demonstrated resistance or elevated MICs to antibiotics tested. There were 697,000 and 853,000 infections among men and women, respectively. Men and women aged 15–24 years accounted for 39.7% and 58.9% of all male and female incident

gonococcal infections (men: 277,000; women: 502,000). There were 798,000 total incident infections among 15–24-year-olds, accounting for 50.9% of all incident infections.

Trichomoniasis

The prevalence of trichomoniasis was estimated using 2013–2018 NHANES data, which was then used to create a modeled prevalence in 2018. (17–19, 21) ODE based modeling, assuming equilibrium and static incidence, was used to estimate incidence. Prevalence was related to incidence using data for natural clearance and the expected number of treated infections annually, as well as expert opinion informing the proportion of new infections that are asymptomatic and the rate of symptomatic treatment seeking. (10, 20)

The number of prevalent trichomonas infections among 15–59-year-olds was 2.6 million, 470,000, and 2.1 million among all persons, men, and women, respectively in 2018. Persons aged 15–24 years comprised 15.6% of all prevalent infections, with 402,000 overall, 83,000 in men, and 314,000 in women.

The number of incident trichomonas infections was 6.9, 3.3, and 3.5 million among all persons, men, and women aged 15–59 years in 2018, respectively. Among 15–24-year-olds, there were 1.1 million infections, comprising 16.3% of all incident trichomonas infections in 2018; 568,000 in men and 520,000 in women.

Syphilis

ODE based modeling, assuming dynamic states and static incidence, was used to estimate prevalence and incidence of syphilis. (20) Case reports were related to incidence and prevalence using expert opinion and data (where available) for the frequency of symptoms among cases diagnosed in late or unknown stage of infection and rates of background screening and symptomatic testing. (1, 11)

The number of estimated prevalent syphilitic infections (all stages) among 14–49-year-old persons in 2018 was 156,000. Infections in men comprised 71.8% of all infections (112,000 infections); there were 38,000 prevalent infections in women. Infections among both men and women aged 14–24 years accounted for ~25% of all male and female infections (men: 24,000, 21.4%; women: 10,000, 26.3%). There were 36,000 total prevalent syphilitic infections among 14–24-year-olds in 2018.

The number of incident syphilitic infections (all stages) among 14–49-year-olds in 2018 was 146,000; 121,000 in men and 25,000 in women. Men comprised 82.9% of all incident infections; of all male infections, 19.8% occurred in those aged 14–24 years (n=24,000). Among women, infections among those aged 14–24 years comprised 32.0% of all incident female infections (n=8,000). In total, there were 32,000 incident syphilitic infections among 14–24-year-olds in 2018.

Genital Herpes (HSV-2)

The seroprevalence of HSV-2, an indication of genital herpes, was estimated using 2015–2018 NHANES data, which was then used to create a modeled prevalence in 2018. (17–19) ODE based modeling, assuming dynamic states and static incidence, was used to estimate

incidence. (20) We estimated prevalence first among 14–45-year-olds in the 2011–2014 NHANES cycles and then among 18–49-year-olds in the 2015–2018 NHANES cycles; we considered the observed increase in prevalence in this age cohort attributable to incident infection over four years. (12)

Among persons aged 15–49 years in 2018, there were 18.6 million prevalent HSV-2 infections; 6.4 million among men and 12.2 million among women. Infections among 15–24-year-olds comprised 7.1% of all prevalent HSV-2 infections (1.3 million); 398,000 among young men and 918,000 among young women.

We estimated 572,000 incident HSV-2 infections among persons aged 15–49 years in 2018. Most were among men (n=300,000, 52.4%) and 15–24-year-olds (n=242,000, 42.3%). Among women, there were an estimated 260,000 and 152,000 incident infections in those aged 15–49 and 15–24 years, respectively.

Human Papillomavirus

We used NHANES 2013–2016 data to estimate the prevalence of disease-associated HPV types, assuming prevalence was stable through 2018. (17, 19, 21) Estimates were used to create a modeled prevalence of disease-associated HPV types, which was defined as positivity to ≥1 of the following types: 6 or 11 (types causing almost all genital warts) or 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66, or 68 (types causing most HPV-attributable cancers and precancers). (22, 23) The HPV-ADVISE model, an individual-based transmission-dynamic model of multi-type HPV infection was used to estimate incidence in 2018. (14,24)

Among 15–59-year-olds, the number of persons, men, and women infected with ≥1 disease-associated HPV type in 2018 was 42.5, 23.4, and 19.2 million, respectively. Among 15–24-year-olds, there were 9.0 million infected persons, 3.6 million infected men, and 5.4 million infected women.

The number of persons, men, and women among 15–59-year-olds acquiring a new disease-associated HPV type infection in 2018 was estimated to be 13.0, 6.9, and 6.1 million, respectively. Among 15–24-year-olds in 2018, 7.1 million persons, 3.3 million men, and 3.8 million women acquired a disease-associated HPV type infection.

Hepatitis B Virus (Sexually Transmitted)

To estimate the proportion of incident HBV infections in 2018 due to sexual transmission, we used surveillance risk factor data from 14 states funded for enhanced viral hepatitis surveillance during 2013–2018. An acute hepatitis B case was classified as potentially sexually transmitted (ST_{acute}) if injection drug use was not reported and at least one of the following risk factors was reported during the six weeks to six months preceding the onset of illness: (1) sex with an HBV-infected person; (2) among men having sex with men; (3) multiple sex partners; or (4) treatment for a sexually transmitted disease. Among the 4,150 acute hepatitis B cases reported from these states, 3,516 (84.7%) had risk factor information available; 1,342 (38.2%) were classified as potentially sexually transmitted acute hepatitis B. (15) Applying the ST_{acute} proportion to the 21,600 acute hepatitis B infections estimated

nationally in 2018, there were 8,300 estimated sexually transmitted incident hepatitis B cases in 2018. (15, 25)

We used NHANES 2013–2018 data to estimate the prevalence of sexually transmitted chronic HBV infections in 2018. There were 877,400 estimated chronic HBV infections during 2013–2018, including 606,300 infections among non-U.S.-born and 271,100 infections among U.S.-born persons. (15) Risk factors for chronic hepatitis B infection cannot be reliably obtained given the indeterminate duration between exposure and diagnosis of chronic infection. For chronic HBV infections among non-U.S.-born persons in the United States, the attributable risk factors vary considerably based on the local epidemiology in the country of birth and age at migration to the United States. Given reports that up to 90% of persons with chronic HBV infection in hepatitis B-endemic countries are infected perinatally or in early childhood, and the fact that only 5–10% of persons infected later in life progress to chronic infection, we estimate that approximately 1% of chronic HBV infections among non-U.S.-born persons in the United States are attributable to sexual transmission. (26, 27) Applying 1% to the non-U.S.-born population and ST_{acute} (stratified by sex) to the U.S.-born population from NHANES, we estimate the number of prevalent sexually transmitted HBV infections among persons aged ≥15 years in 2018 to be 103,000, including 51,000 among men and 52,000 among women. The small sample size of NHANES participants aged 15–24 years with a chronic HBV infection led to unstable estimates; therefore, estimates for 15–24-year-olds are not presented.

Human Immunodeficiency Virus (Sexually Transmitted)

Data from the National HIV Surveillance System were used to estimate the prevalence and incidence of sexually transmitted HIV infections for persons aged ≥13 years in 2018. (13, 28) Using a CD4 depletion model, the date of HIV infection was estimated for each person with a CD4 test result, either at or after diagnosis (but presumed before treatment). (29) The number of persons with a CD4 test result was weighted accounting for those without a CD4 test result; weighting was based on the year of HIV diagnosis, sex at birth, race/ethnicity, transmission category, age at diagnosis, disease classification, and vital status at year-end 2018. Multiple imputations were used to account for cases with missing transmission category values. (30, 31s) The distribution of the time from HIV infection to diagnosis was used to estimate the number of incident HIV infections. (29, 32s) HIV prevalence (persons with diagnosed or undiagnosed HIV infection alive at the end of 2018), was estimated by subtracting reported cumulative deaths from estimated cumulative infections in 2018. (29)

There was a total of 32,600 new sexually transmitted HIV infections among persons aged ≥13 years in 2018. Most (82.5%) were among men (n=26,900); 5,700 (17.5%) infections were among women. Persons aged 13–24 years comprised 22.1% of all new sexually transmitted HIV infections in 2018, at 7,200; 6,300 were among men and 900 were among women.

There were 984,000 total persons aged ≥13 years living with sexually transmitted HIV at the end of 2018. Nearly 80% were men (n=775,600); 208,400 were women. Among persons aged 13–24 years, an estimated 45,400 were living with sexually transmitted HIV in 2018; 39,900 and 5,500 among men and women, respectively.

Discussion

There were an estimated 67.6 million prevalent and 26.2 million incident STIs in the United States in 2018. The number of all prevalent and incident STIs was similar among men and women, though this varied by infection. The 15–24-year-old population accounted for nearly one-fifth of all prevalent infections; however, they accounted for almost half of all incident STIs in 2018. Most infections among all ages were caused by chlamydia, trichomoniasis, genital herpes, and HPV, comprising 98% of all prevalent and 93% of all incident STIs; HPV alone accounted for 63% of all prevalent and 50% of all incident infections.

The number of prevalent and incident STIs in the US has been estimated previously, most recently for 2008. (2–4) While it is possible differences between the updated estimates and previously published estimates reflect true changes in disease burden, differences also reflect different methods and data sources used to calculate these estimates. For the 2018 estimates, we used techniques, like the Spectrum-STI methodology employed on the international scale, aimed at being as comprehensive and transparent as possible about the parameters included, the data informing those parameters, and uncertainty around the estimates. (5, 33s-36s) Because of these differences with the methodology used for previous estimates, the current results are meant to be considered independent of past estimates and comparisons to previous estimates should be interpreted with care.

The subsequent STI-specific manuscripts identify specific methodologic factors for each STI that impact the interpretability of the estimates; however, a few notable factors that cross multiple STIs are described here. First, our estimates of total prevalence and incidence across all STIs overestimate the number of people with a prevalent or incident infection in 2018 due to the possibility of co-infections and the inability to estimate the level of co-infection. In addition, repeat incident infections are possible for the non-viral STIs, and would count for >1 incident infection, despite only being one person. Second, uncertainty intervals presented here may differ from those presented in the corresponding STI-specific manuscripts; this arises from our showing the 25^{th}, 50^{th}, and 75^{th} percentiles of the distributions used to generate total prevalence and incidence estimates. (9–15) Lastly, sex is a key stratifying variable in these analyses; however, in many of the data sources used, it is not clear whether these data represent sex at birth or gender identity. As such, there could be misclassification of prevalent or incident cases based on sex at birth or gender identity.

There are several notable points about some of the individual diseases, as well. First, given the current inability of chlamydia and gonorrhea case report data to adequately capture all anatomic sites of infection of a reported case, we assumed they represented urogenital infections only. As a result, our estimates ignore the potential burden of extragenital chlamydia and gonorrhea.

Second, STI testing is limited to certain age ranges in NHANES; therefore, for estimates using NHANES data, we assumed no prevalent (or incident) infections occurred outside the respective STI-specific age ranges. Additionally, as NHANES estimates for chlamydia, trichomoniasis, and HPV are based on testing of urine or genital swabs, our estimates represent urogenital infections and exclude extragenital infections. As a result, our combined

estimates likely underestimate the total burden of STIs in the US. Also, by applying NHANES prevalence estimates, which are representative of the US non-institutionalized civilian population, to the ACS full US resident population estimates to calculate the number of prevalent infections, we assume that the prevalence of applicable STIs in the institutionalized and military population is equivalent to the prevalence in the non-institutionalized population, which could have also led to an underestimate of the total burden. Where multiple cycles of NHANES were combined to increase estimate stability, population prevalence was assumed stable across cycles.

Third, we did not adjust estimates for imperfect diagnostic test characteristics. Had we accounted for imperfect testing, in particular imperfect specificity, our incidence and prevalence estimates would likely have been lower. Fourth, where estimates are presented for genital herpes, the estimates are only inclusive of infections due to HSV-2 and do not include herpes simplex virus type 1 (HSV-1). Despite HSV-1 typically causing orolabial infections and HSV-2 causing most genital HSV infections in the US, there is recent evidence that HSV-1 is increasing as a cause of genital herpes. (37s, 38s) Therefore, the genital herpes estimates presented here likely underestimate the true burden of disease in the US.

Lastly, the markedly lower gonococcal prevalence estimates among men compared to women seems to contradict rates of reported gonorrhea cases, which were higher in men compared to women in 2018. (1) All else being equal, we would expect increased case reports to indicate increased prevalence. However, this effect is outweighed by the difference in the rate of natural clearance between men and women. Slower natural clearance causes increased prevalence in the models, as people remain infected longer. Because we assume the duration of natural infection is longer in women, we would expect their prevalence to be higher. Male prevalence is affected by countervailing forces—higher case reports but a shorter natural course of infection. In this case, the shorter duration outweighs higher case reports, causing a lower prevalence. If we assumed similar clearance rates between men and women, the difference in estimated prevalence would decrease. Finally, where estimates are provided for AMR gonorrhea, we assumed that the proportion of prevalent and incident gonococcal infections demonstrating resistance or elevated MICs to antibiotics tested is equivalent.

These findings highlight the ongoing need for better and more robust data to inform population-level prevalence and incidence estimates. For many model parameters, little to no data existed in the literature, and for others, data were outdated, not the exact data point needed, or were from a lone study with a low sample size and high uncertainty. Consequently, we were required to make many assumptions and/or rely on expert opinion for several parameters. (9–15) The parameters which proved most impactful on model outcomes also proved to be those where data were most likely to be missing or limited. Data on the natural clearance rate of non-viral STIs are limited, particularly for gonorrhea and trichomoniasis. The rate at which people seek care for symptoms related to STIs (stratified by sex and age group) was rarely available. Finally, population based STI screening estimates (not estimates of testing or estimates based on self-report) are greatly needed.

Our estimates are only as good as the data used to inform them and emphasize the critical need for more research into these areas.

This is one of several studies estimating the prevalence and incidence of STIs in the US but is the first to include measurements of uncertainty. Despite uncertainty, the estimates provided illustrate that the STI burden in the US is high, with infections due to chlamydia, trichomoniasis, genital herpes, and HPV accounting for most of that burden. In a population of over 320 million people and a prevalence estimate of 67.6 million STIs, this suggests that about 20% of the total US population had an STI at a given point in 2018, while nearly half of all incident infections occurred in people aged 15–24 years. Focusing STI prevention efforts on the 15–24-year-old population may be key to lowering the STI burden in the US.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Summary of Data Sources Used to Estimate the Number of Prevalent and Incident STIs in the United States, 2018.

Infection	Prevalence	Incidence
Chlamydia	NHANES 2015–2018 ODE modeling	ODE modeling
Gonorrhea	ODE modeling	ODE modeling
AMR Gonorrhea	GISP 2018 ODE modeling	ODE modeling
Trichomoniasis	NHANES 2013–2018	ODE modeling
Syphilis	ODE modeling	ODE modeling
Genital Herpes	NHANES 2015–2018 ODE modeling	ODE modeling
HPV	NHANES 2013–2016	HPV-ADVISE model
HBV	NHANES 2013–2018	NEDSS 2018
HIV	NHSS 2018 CD4 depletion model	NHSS 2018 CD4 depletion model

ACRONYMS: STI=sexually transmitted infection; NHANES=National Health and Nutrition Examination Survey; ODE=ordinary differential equations; AMR=antimicrobial resistant; GISP=Gonococcal Isolate Surveillance Program; HPV=human papillomavirus; HBV=hepatitis B virus; NEDSS=National Electronic Disease Surveillance System; HIV=human immunodeficiency virus; NHSS=National HIV Surveillance System.

Table 2.

Estimated Number of Prevalent Sexually Transmitted Infections, United States, 2018.*

	Men	Women	Total
	Median (25th–75th percentile) †	Median (25th–75th percentile) †	Median (25th–75th percentile) †‡
All ages §			
Chlamydia	1,050,000 (944,000–1,157,000)	1,306,000 (1,193,000–1,418,000)	2,353,000 (2,202,000–2,508,000)
Gonorrhea	50,000 (40,000–63,000)	155,000 (131,000–184,000)	209,000 (183,000–241,000)
AMR Gonorrhea‖	26,000 (21,000–32,000)	80,000 (67,000–94,000)	107,000 (94,000–124,000)
Trichomoniasis	470,000 (414,000–530,000)	2,103,000 (1,982,000–2,225,000)	2,576,000 (2,446,000–2,713,000)
Syphilis	112,000 (92,000–137,000)	38,000 (28,000–55,000)	156,000 (132,000–184,000)
Genital Herpes¶	6,354,000 (6,093,000–6,629,000)	12,203,000 (11,885,000–12,538,000)	18,574,000 (18,140,000–19,002,000)
HPV#	23,411,000 (22,669,000–24,200,000)	19,210,000 (18,700,000–19,776,000)	42,500,000 (41,400,000–43,700,000)
HBV**	51,000 (41,000–61,000)	52,000 (42,000–63,000)	103,000 (89,000–118,000)
HIV**	775,600 (769,200–781,900)	208,400 (205,600–211,200)	984,000 (977,000–990,900)
TOTAL ‡	**32,321,000 (31,519,000–33,124,000)**	**35,311,000 (34,656,000–35,980,000)**	**67,636,000 (66,599,000–68,668,000)**
Ages 15–24 years			
Chlamydia	595,000 (530,000–659,000)	990,000 (899,000–1,084,000)	1,583,000 (1,472,000–1,696,000)
Gonorrhea	20,000 (15,000–27,000)	90,000 (72,000–115,000)	113,000 (93,000–138,000)
AMR Gonorrhea‖	10,000 (8,000–14,000)	46,000 (37,000–59,000)	58,000 (48,000–71,000)
Trichomoniasis	83,000 (63,000–107,000) ††	314,000 (275,000–356,000)	402,000 (356,000–449,000)
Syphilis	24,000 (18,000–32,000)	10,000 (7,000–16,000)	36,000 (29,000–46,000)
Genital Herpes¶	398,000 (336,000–472,000)	918,000 (823,000–1,017,000)	1,325,000 (1,208,000–1,447,000)
HPV#	3,604,000 (3,383,000–3,826,000)	5,376,000 (5,091,000–5,645,000)	8,979,000 (8,625,000–9,500,000)

	Men	Women	Total
	Median (25th–75th percentile) †	Median (25th–75th percentile) †	Median (25th–75th percentile) †‡
HBV**	NC	NC	NC
HIV**‡‡	39,900 (38,200–41,500)	5,500 (4,900–6,000)	45,400 (43,600–47,100)
TOTAL ‡	**4,829,000 (4,587,000–5,062,000)**	**7,779,000 (7,467,000–8,096,000)**	**12,608,000 (12,219,000–12,988,000)**

*Prevalence estimates represent point prevalence (the number of persons with an STI at a given point in 2018). HPV estimates represent the number of people with ≥1 disease-associated types considered.

†All counts are rounded to the nearest 1,000, except for HIV, where numbers were rounded to the nearest 100 for estimates of >1,000 and to the nearest 10 for estimates of ≤1,000. The uncertainty interval surrounding each point estimate represents the 25th and 75th percentile of the empirical frequency distribution of the estimate for each infection. These intervals may differ from the uncertainty intervals presented in the manuscripts for each individual STI, as it was necessary to ensure the uncertainty intervals for all STIs were of the same format for the purposes of creating an overall estimate of the prevalence of all sexually transmitted infections.

‡Total estimates are not the sum of individual estimates, but rather descriptions of multiple distributions that have been combined. See Methods for details of the combination process.

§Based on availability of data, “all ages” represents different age groups by STI: chlamydia: 15–39 years; gonorrhea: 15–39 years; syphilis: 14–49 years; trichomoniasis: 15–59 years; genital herpes: 15–49 years; HPV: 15–59 years; HBV ≥15 years; HIV: ≥13 years.

‖The prevalence (and 25th/75th percentiles) of AMR gonorrhea was determined by multiplying the 2018 percentage of non-susceptible isolates (51.3%) from the Gonococcal Isolate Surveillance Program by the gonococcal prevalence estimates for 2018.

¶The prevalence of genital herpes includes only infection due to herpes simplex virus type 2. Infections due to herpes simplex virus type 1 are not included.

#HPV infection refers to infection with at least one of the following types associated with disease: HPV 6, 11, 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66, or 68.

**Sexual transmission only.

††National Health and Nutrition Examination Survey relative standard error >30% but <40%.

‡‡The prevalence of HIV was measured among 13–24-year-olds.

ACRONYMS: AMR=antimicrobial resistant; HPV=human papillomavirus; HBV=hepatitis B virus; NC=not calculated; HIV=human immunodeficiency virus.

Table 3.

Estimated Number of Incident Sexually Transmitted Infections, United States, 2018.*

	Men	Women	Total
	Median (25th–75th percentile) †	Median (25th–75th percentile) †	Median (25th–75th percentile) †‡
All ages §			
Chlamydia	1,621,000 (1,443,000–1,820,000)	2,354,000 (2,236,000–2,477,000)	3,983,000 (3,770,000–4,223,000)
Gonorrhea	697,000 (618,000–796,000)	853,000 (757,000–962,000)	1,568,000 (1,438,000–1,722,000)
AMR Gonorrhea‖	358,000 (317,000–408,000)	438,000 (388,000–494,000)	804,000 (738,000–883,000)
Trichomoniasis	3,278,000 (2,780,000–3,834,000)	3,536,000 (3,112,000–3,975,000)	6,861,000 (6,209,000–7,563,000)
Syphilis	121,000 (101,000–145,000)	25,000 (23,000–27,000)	146,000 (126,000–170,000)
Genital Herpes¶	300,000 (231,000–379,000)	260,000 (204,000–326,000)	572,000 (479,000–673,000)
HPV#	6,861,000 (5,506,000–7,493,000)	6,116,000 (4,710,000–7,400,000)	13,000,000 (10,300,000–15,300,000)
HBV**	NC	NC	8,300 (8,200–8,400)
HIV**	26,900 (26,200–27,600)	5,700 (5,400–6,000)	32,600 (31,800–33,400)
TOTAL ‡	**12,887,000 (11,828,000–14,220,000)**	**13,245,000 (12,040,000–14,558,000)**	**26,237,000 (24,018,000–28,672,000)**
Ages 15–24 years			
Chlamydia	910,000 (805,000–1,026,000)	1,728,000 (1,636,000–1,829,000)	2,648,000 (2,506,000–2,798,000)
Gonorrhea	277,000 (238,000–335,000)	502,000 (426,000–595,000)	798,000 (705,000–907,000)
AMR Gonorrhea‖	142,000 (122,000–172,000)	258,000 (219,000–305,000)	409,000 (362,000–465,000)
Trichomoniasis	568,000 (411,000–771,000) ††	520,000 (411,000–644,000)	1,115,000 (914,000–1,350,000)
Syphilis	24,000 (19,000–30,000)	8,000 (7,000–9,000)	32,000 (28,000–38,000)
Genital Herpes¶	89,000 (73,000–107,000)	152,000 (125,000–178,000)	242,000 (210,000–274,000)
HPV#	3,289,000 (2,819,000–3,672,000)	3,752,000 (3,118,000–4,426,000)	7,100,000 (5,900,000–7,800,000)

	Men	Women	Total
	Median (25th–75th percentile) †	**Median (25th–75th percentile) †**	**Median (25th–75th percentile) †‡**
HBV **	NC	NC	NC
HIV **‡‡	6,300 (6,000–6,600)	900 (790–1,000)	7,200 (6,800–7,600)
TOTAL ‡	**5,256,000 (4,840,000–5,776,000)**	**6,746,000 (6,175,000–7,336,000)**	**11,933,000 (11,000,000–12,873,000)**

* For the non-viral STIs, incidence estimates reflect the cumulative number of incident *infections* during 2018 (i.e., a person with repeat infections can count for >1 infection). For HPV, incidence estimates reflect the cumulative number of *people* acquiring a disease-associated HPV type in 2018; only the first acquisition of a disease-associated HPV type in 2018 is counted. For HBV, HIV, and genital herpes, incidence estimates represent the cumulative number of infections *and* the number of people with an incident infection; these numbers are equivalent since infection may only be acquired once.

† All counts are rounded to the nearest 1,000, except for HIV and HBV, where numbers were rounded to the nearest 100 for estimates of >1,000 and to the nearest 10 for estimates of ≤1,000. The uncertainty interval surrounding each point estimate represents the 25th and 75th percentile of the empirical frequency distribution of the estimate for each infection. These intervals may differ from the uncertainty intervals presented in the manuscripts for each individual STI, as it was necessary to ensure the uncertainty intervals for all STIs were of the same format for the purposes of creating an overall estimate of the incidence of all sexually transmitted infections.

‡ Total estimates are not the sum of individual estimates, but rather descriptions of multiple distributions that have been combined. See Methods for details of the combination process.

§ Based on availability of data, “all ages” represents different age groups by STI: chlamydia: 15–39 years; gonorrhea: 15–39 years; syphilis: 14–49 years; trichomoniasis: 15–59 years; genital herpes: 15–49 years; HPV: 15–59 years; HBV ≥15 years; HIV: ≥13 years.

‖ The incidence (and 25th/75th percentiles) of AMR gonorrhea was determined by multiplying the 2018 percentage of non-susceptible isolates (51.3%) from the Gonococcal Isolate Surveillance Program by the gonococcal incidence estimates for 2018.

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** Sexual transmission only.

†† National Health and Nutrition Examination Survey relative standard error >30% but <40%.

‡‡ The incidence of HIV was measured among 13–24-year-olds.

ACRONYMS: AMR=antimicrobial resistant; HPV=human papillomavirus; HBV=hepatitis B virus; NC=not calculated; HIV=human immunodeficiency virus.

STI Prevalence and Incidence Estimates, 2018