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Syphilis Diagnosis After a Chlamydia, Gonorrhea, or HIV Diagnosis Among Reproductive Aged Women in Baltimore, MD

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Abstract

Background—Syphilis incidence is increasing among reproductive-aged women, and previous sexually transmitted infections (STIs) are a risk factor for subsequent STIs. This study aimed to determine syphilis incidence following a chlamydia, gonorrhea, or HIV diagnosis, and identify characteristics associated with higher syphilis incidence rates among reproductive-aged women in one mid-Atlantic city.

Methods—A retrospective cohort of 85,113 chlamydia, gonorrhea, and HIV diagnoses occurring between 2009-2021 and among women ages 13-50 was constructed using public health surveillance data. Cumulative incidence curves were estimated to examine time to early syphilis (i.e., primary, secondary, or early latent) diagnosis, and multivariable analyses determined incidence rate ratios by age (<25 vs. ≥25 years old) and number of prior STI diagnoses (0 vs. ≥1) during the study time period, stratified by STI.

Results—There were 85,113 reportable STI diagnoses and 646 syphilis diagnoses in the cohort. Approximately 1/150 chlamydia, 1/100 gonorrhea, and 1/50 HIV diagnoses were followed by a syphilis diagnosis within five years. Cumulative incidence of syphilis differed significantly by STI diagnosis ($p<0.001$). In multivariable analysis, syphilis incidence rates were higher among women diagnosed with ≥1 (vs. 0) prior STI regardless of STI type ($p<0.05$) and among women ≥25 (vs. <25) years old diagnosed with gonorrhea ($p<0.05$).

Conclusions—There were significant differences in syphilis incidence by prior STI type, number of STIs, and age. Our data support targeted screening for syphilis among women with a history of STIs, parwomen with ≥1 prior STI diagnosis, and older women diagnosed with gonorrhea.

Summary:

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Conflicts of Interest: None

Reproductive-aged women with sexually transmitted infections (STIs) diagnosed at an older age or with STI history are at increased risk for syphilis and should be screened regularly for syphilis.

Keywords

Syphilis; Sexually transmitted infections; Public health; Epidemiology

INTRODUCTION

Syphilis diagnosis rates have been increasing across the United States (U.S.).[1] In 2017, there were 9.4 reported cases of primary and secondary syphilis per 100,000 people, and by 2021, the incidence increased to 16.2 cases per 100,000, reflecting a 72% increase.[2] While the majority of cases are among men who have sex with men (MSM), rates of infection among women increased by 217% from 2017 to 2021.[2] This is of particular concern for reproductive-aged women, as pregnancy while infected with syphilis can result in vertical transmission and congenital syphilis cases, causing a host of negative effects such as bone deformities, hepatosplenomegaly, neurologic damage, meningitis, and even death.[3] A national increase in congenital syphilis cases has followed the increase in syphilis incidence among reproductive-aged women. In the U.S. in 2021, there were 2,855 cases of congenital syphilis, a 203% increase from 2017.[2]

The burden of syphilis infection varies widely by age group, race/ethnicity and region. Nationally, the highest rates of primary and secondary syphilis infection occur among 20-29 year-olds and among Black/African American, American Indian/Alaska Native, and Native Hawaiian/Pacific Islander individuals.[2] In 2020, the rate of reported primary and secondary syphilis cases in Maryland was 14.1 per 100,000 people, higher than the national average (12.6 cases per 100,000 people).[2] The high burden of primary and secondary syphilis in Maryland is driven largely by high rates of diagnosis in Baltimore City. In 2019, 36% of all primary and secondary syphilis cases statewide came from Baltimore City.[4]

A prior sexually transmitted infection (STI) diagnosis is a risk factor for subsequent STI diagnoses, which is likely due to a combination of biologic and behavioral factors.[5–7] Baltimore City is also a high prevalence area for other STIs, with rates of gonorrhea and chlamydia at 670.8 and 1,449.4, respectively, per 100,000 people in 2019 (compared to national rates of 187.8 and 551.0, respectively, per 100,000 people in the same year).[2,4] Studies have shown that most repeat STI cases occur in patients with fragmented care who are diagnosed at multiple different clinics and hospital systems, making it challenging for clinicians to be aware of a patient's past STI history.[8] Risk factors and characteristics associated with syphilis infection include young age, non-white race, multiple sexual partners in the past year, history of illicit drug use, and housing instability.[9–11] People with a history of incarceration or transactional sex also have been shown to be at higher risk of acquiring syphilis.[12] However , a study of U.S. national case report data showed that 49% of pregnant women with syphilis reported no high-risk sexual behavior or drug use in the past year.[13] This suggests a need for improved identification of syphilis risk factors among

reproductive age women and pregnant women in order to tailor prevention and treatment resources.

While prior studies have examined the incidence of HIV infection among males following a syphilis or gonorrhea diagnosis, there is little research on the incidence of a syphilis diagnosis following a prior STI diagnosis among cisgender women.[14] The objective of the current study is to determine the incidence of syphilis diagnosis following a prior STI diagnosis (chlamydia, gonorrhea, and/or HIV) and identify characteristics associated with higher syphilis incidence rates among cisgender women of reproductive age in one mid-Atlantic city with persistently high syphilis rates. Ultimately, we aim to improve targeting of public health syphilis screening efforts and increase early diagnosis and treatment for women of reproductive age in order to prevent congenital syphilis.

MATERIALS AND METHODS

Study Population

Data on all reportable early (i.e., primary, secondary, or early latent) syphilis diagnoses and other STI diagnoses in Baltimore City between January 1, 2009 and July 20, 2020 (for chlamydia, gonorrhea, and HIV) or 2021 (for syphilis) were obtained from routine Baltimore City Health Department (BCHD) public health surveillance data, which includes partner services interviews for early syphilis and HIV diagnoses. A subset of gonorrhea data was drawn from enhanced surveillance interviews conducted through the STD Surveillance Network (SSuN), which were conducted for a random sample of all gonorrhea cases.[15] A retrospective cohort of reproductive-aged women ages 13-50 with at least one chlamydia, gonorrhea, or HIV diagnosis during the study period was constructed to determine time to syphilis diagnosis. Any repeat infection with the same STI within 30 days of a prior infection was excluded from the cohort as a presumed duplicate report of the same underlying infection. Any infection with two different STIs (e.g., gonorrhea and chlamydia) within 30 days was coded as a coinfection and both records were retained. In order to ensure that participants with syphilis were newly infected during the study period, a 60-day run-in period was established from January 1 to March 1, 2009, and follow-up began on March 1, 2009. Participants with a recorded syphilis diagnosis within 30 days of a prior STI diagnosis were considered to be coinfected and were excluded from the cohort. Participants were followed until the date of syphilis diagnosis or were administratively censored on July 20, 2021. All analyses were conducted at the level of diagnosis. Therefore, women with multiple STI diagnoses contributed multiple records to the study.

Measures

The primary exposures of interest were a chlamydia, gonorrhea, and/or HIV diagnosis. The primary outcome of interest was an early syphilis diagnosis >30 days after a prior STI diagnosis. Covariates included age at STI diagnosis, race, number of previous STI diagnoses (excluding syphilis) during the study period, and STI diagnosing location, as well as number of sex partners, pregnancy status at STI diagnosis, history of transactional sex, and history of injection drug use (IDU). Age was recorded as a continuous variable and dichotomized into younger (<25 years) and older (≥25 years). Race was categorized as Black/African

American or non-Black/African American. Number of prior STI diagnoses was categorized as 0 or ≥1. Information on sexual risk behaviors (i.e., number of sex partners, transactional sex, and substance use) were ascertained during follow-up interviews, which were conducted routinely among all individuals newly diagnosed with HIV and among a random sample of individuals diagnosed with gonorrhea, but not routinely conducted chlamdyia diagnoses. Number of sex partners was categorized as 0-1, 2, or ≥3. As per BCHD and SSuN protocol, the recall period used for the number of sex partners is collected for all HIV diagnoses (for prior one year) and randomly sampled gonorrhea diagnoses (reported for the prior three months), or gonorrhea diagnoses not randomly sampled for SSuN. Pregnancy status at STI diagnosis was reported as yes (pregnant) or no (not pregnant). Transactional sex was reported as yes or no for the preceding 12 months. Participants were considered as having engaged in transactional sex if they reported giving or receiving money or drugs in exchange for sex. IDU was also reported as a binary (yes/no) variable for the preceding 12 months. Participants were considered an injection drug user if they reported IDU, sharing injection equipment, or having ≥1 needle sharing partner. STI diagnosing location was categorized as STI clinic, private provider, hospital, emergency department or urgent care, detention center, outreach, or other.

Statistical Testing

Summary statistics were calculated overall and by STI diagnosis at cohort entry (i.e. chlamydia alone, gonorrhea alone, HIV alone, chlamydia and gonorrhea coinfection, or HIV coinfection with any other STI). For subsequent analyses, diagnosis at cohort entry was characterized by STI separately regardless of coinfection status. Because coinfections were coded as two different STI diagnoses within 30 days of each other and were not necessarily diagnosed at the same clinical visit, all analyses other than summary statistics disregarded coinfection status in order to facilitate ease of interpretation. Cumulative incidence curves using a Kaplan-Meier survival function were constructed to examine time to syphilis diagnosis stratified by STI at cohort entry. Using Poisson regression modeling with time to syphilis diagnosis as the exposure, incidence rate ratios were calculated for older vs. younger age and number of previous STI diagnoses (≥1 vs. 0), stratified by STI type. Syphilis incidence rates were calculated by dividing the number of events (i.e., syphilis diagnoses) by the total time contributed since chlamydia, gonorrhea, or HIV diagnosis and are reported as events per 1,000 diagnosis-years. Since multiple diagnoses may have occurred in the same individual, a generalized estimating equation (GEE) model was used to account for non-independence of diagnoses. All statistical analyses were conducted in Stata 17.0 (Stata Corp, College Station, TX). This study was considered a public health surveillance activity and was conducted with de-identified data only, therefore it was considered exempt from human subjects research by the Johns Hopkins Institutional Review Board.

RESULTS

Study Population

Between January 1, 2009 and July 20, 2020 there were 86,080 diagnoses of chlamydia, gonorrhea, and HIV among females ages ≥13 reported to the BCHD. Of these, 0.07% (64)

were missing age data, 0.02% (17) were missing a unique patient identifier, and 1.03% (886) were among females >50 and were thus excluded from the cohort. The final cohort consisted of 85,113 diagnoses (Figure 1). At cohort entry the proportion diagnosed with each STI was 77.4% (65,910) chlamydia, 14.8% (12,600) gonorrhea and 0.95% (807) HIV. An additional 6.7% (5,723) were gonorrhea and chlamydia coinfections and 0.09% (73) were coinfections with HIV and another STI. The mean age at cohort entry was 22.3 years (SD 6.13 years), with 73.4% of diagnoses occurring in those <25 years old. Among STI diagnoses, 41.2% (35,090) were in individuals who identified as Black/African American, and 38.6% (32,836)were among people who had one or more prior STI diagnosis during the study period. The majority of records was missing information about number of sex partners, pregnancy, transactional sex, and IDU. However, among the remaining records, 12.4% (112/905) reported ≥3 sex partners, 15.8% (1094/6935) were pregnant at diagnosis, 5.0% (106/2116) reported transactional sex within the past 12 months, and 0.4% (62/16,279) reported IDU within the past 12 months. The majority of diagnoses was reported by a private provider (41.8%, 35,572), hospital (17.6%, 14,948), or emergency department/urgent care center (16.0%, 13,643). (Table 1)

Cumulative Syphilis Incidence by Chlamydia, Gonorrhea, or HIV Diagnosis

A total of 68,807 chlamydia, 15,463 gonorrhea, and 843 HIV diagnoses were included in the final analytic sample, contributing a total of 554,687 diagnosis-years. There were 646 syphilis diagnoses in the cohort. Approximately 1/150 chlamydia, 1/100 gonorrhea, and 1/50 HIV diagnoses among women of reproductive age were followed by a syphilis diagnosis within five years. Cumulative incidence of syphilis diagnosis differed significantly by STI diagnosis at cohort entry (log-rank test p-value<0.001). (Figure 2)

Syphilis Incidence Rates After a Chlamydia, Gonorrhea, or HIV Diagnosis

Overall, the incidence of syphilis diagnosis was 1.16 per 1,000 diagnosis-years following a prior chlamydia, gonorrhea, or HIV diagnosis. Adjusting for number of prior STI diagnoses, older (≥25 years) compared to younger (<25 years) women diagnosed with gonorrhea had a 2.1 (95% CI, 1.56 – 2.80) times higher syphilis incidence rate, while there was not a significant difference by age for women diagnosed with chlamydia (IRR, 1.3; 95% CI, 0.82 – 1.30). Adjusting for age, women who had a ≥1 (compared to those with no) prior STI diagnosis within five years and were diagnosed with chlamydia had a 2.5 (95% CI, 2.06 – 3.02) and separately, diagnosed with gonorrhea had a 3.7 (95% CI, 2.75 – 4.95) higher syphilis incidence rate (Table 2). Statistical testing among women with a prior HIV diagnosis was not conducted due to small numbers.

DISCUSSION

We determined risk of a syphilis diagnosis within five years following a chlamydia, gonorrhea, or HIV diagnosis among urban reproductive-aged women using public health surveillance data from 2009 to 2021. In this majority Black and younger population, chlamydia accounted for the vast majority of STI diagnoses and HIV was the least common diagnosis. A total of 6.81% of diagnoses were co-infections of two or more STIs. Seventy-

five percent of infections were diagnosed at a private provider, hospital, or emergency department/urgent care.

We found that approximately 1/150 chlamydia, 1/100 gonorrhea, and 1/50 HIV diagnoses were followed by a syphilis diagnosis within five years, and that the cumulative incidence of syphilis differed by type of prior STI. We also found that older age was associated with a 2.09-fold increase in syphilis incidence following a gonorrhea diagnosis as compared to younger age. While the reason for this is not clear it is possible that this finding is purely a function of time, as older women have more time to accumulate STI diagnoses, or may be related to other biologic or behavioral factors. Additionally, a history of one or more chlamydia or gonorrhea diagnoses (compared to none) was associated with a 2.50-and 3.69-fold increase in syphilis incidence, respectively. A post-hoc power analysis revealed insufficient power to detect differences in syphilis incidence rates following an HIV diagnosis by age and number of prior STI diagnoses.

While the results of this study can likely be generalized to other urban areas with high STI incidence in the United States, they may not be generalizable to rural areas and/or areas with low STI incidence. However, our findings are similar to prior work demonstrating that syphilis diagnosis is associated with age and STI history.[11,16] While other studies have explored rates of HIV infection among women following an STI, to the best of our knowledge this is the first study examining incidence rates of syphilis following an STI diagnosis in U.S. urban women, stratified by STI type.[17–20] Work looking at early syphilis trends among MSM in Baltimore City showed that two-thirds of syphilis infections in this population occurred in men coinfected with HIV.[21] This is similar to the current findings suggesting that syphilis incidence rates were greater among women living with HIV as compared to women diagnosed with other STIs. Additionally, a study evaluating the incidence of chlamydia, gonorrhea, and syphilis among people living with HIV in Washington, DC, found that 2% of HIV-infected individuals developed syphilis in a median of 32.5 months.[22] This is similar to our finding that approximately 1/50 (2%) HIV infections were followed by a syphilis infection within five years. The higher incidence rates of syphilis following HIV infection may be due to engagement in high-risk sexual behavior and/or co-factor transmission.[23]

These findings add to a growing body of literature regarding risk factors for syphilis in women. While over half of syphilis cases in the U.S. occur among MSM, the increasing incidence of syphilis in women and congenital syphilis indicates a need to understand syphilis risk factors in women of reproductive age.[24] In 2018, the rate of congenital syphilis in Baltimore City was 201.6 cases per 100,000 live births, compared to a state and national average of 40.8 and 34.6 cases per 100,000 population, respectively.[2,25] Currently, Maryland law requires syphilis screening in the first trimester and third trimester and again at delivery if at ‘increased risk’ and the CDC recommends screening at delivery for women who live in communities with high syphilis rates, including Baltimore City.[26–28] While our results may not be generalizable to pregnancy due to a high degree of missing data on pregnancy status in our dataset, our cohort was intentionally created to include entirely women of reproductive age, many of whom may become pregnant in the future. Our results may help clinicians identify characteristics of patients who are at increased risk, regardless of area of

residence or delivery, and thus should be screened again at delivery. There are, however, inherent limitations to using public health surveillance data. Information was obtained through both passive surveillance and partner services interviews, and, therefore, is subject to information bias given the heterogeneity in staff collecting and reporting information and the challenges associated with conducting partner service interviews. The high degree of missing data for some characteristics (i.e., pregnancy status, substance use, transactional sex) limited our ability to examine these factors which might otherwise yield additional information for screening protocols and insight into reasons for elevated syphilis risk among certain subsets of women including older women with a history of gonorrhea. Public health surveillance data is constrained in that it is only able to measure diagnoses, and it is possible that the people with the highest likelihood of syphilis infection may also be the most likely to remain infected but undiagnosed.

Previous work has shown that substance use and sex behaviors such as transactional sex, sex while intoxicated or high, and sex with anonymous partners is common in individuals diagnosed with syphilis; however, the these data were missing among the vast majority of individuals in our cohort.[29,30] Improved ascertainment of these variables included in the interview guide as part of routine chlamydia and gonorrhea surveillance may help to identify additional risk factors for a syphilis diagnosis among reproductive-aged women and inform syphilis screening protocols. These data could, for example, be collected through routine morbidity report forms. Finally, there is a need for improved communication between electronic health record (EHR) systems among providers in different practices and different practice locations. While almost half of the STIs in our cohort were diagnosed by private providers, many were diagnosed at hospitals, emergency departments/urgent cares, or other locations. This fragmentation of care means that providers screening for syphilis or other STIs at a subsequent visit may not have access to information regarding prior STI diagnoses. Since our work showed that a STI history was associated with increased risk of a syphilis diagnosis, having access to information about STIs diagnosed at different locations may help inform providers' decision-making regarding their patients' risk of syphilis and need for testing. In fact, this fragmentation of care and documentation is also a limitation of this study. Given the relatively long duration of the surveillance period, it is possible that women who were previously diagnosed with chlamydia, gonorrhea, or HIV died or moved before they received a syphilis diagnosis or were diagnosed with syphilis outside Baltimore City or vice versa. Women who had a previous STI diagnosed during the study period outside of Baltimore City and a subsequent syphilis diagnosis in Baltimore City would have also been excluded from the cohort due to lack of information about their prior STI in the surveillance data, leading to selection bias. Since these events are not captured in our data, participants may be contributing person-time when they are not truly at risk, thus underestimating the incidence rate. Additionally, cohort entry began at the date of diagnosis, which does not correspond to the actual date of infection and may have resulted in an underestimation of years at risk.

This results of this study may be used to guide the development of improved public health syphilis screening protocols. Healthcare providers should emphasize regular syphilis screening for women ≥ 25 years diagnosed with a chlamydia, gonorrhea, or HIV infection and those with a history of one or more STI diagnosis. Future studies should focus on

identifying trends in the geography and testing location of syphilis diagnoses and evaluating the cost-effectiveness of alternate syphilis screening protocols. Improvements in the quality of public health surveillance data are recommended.

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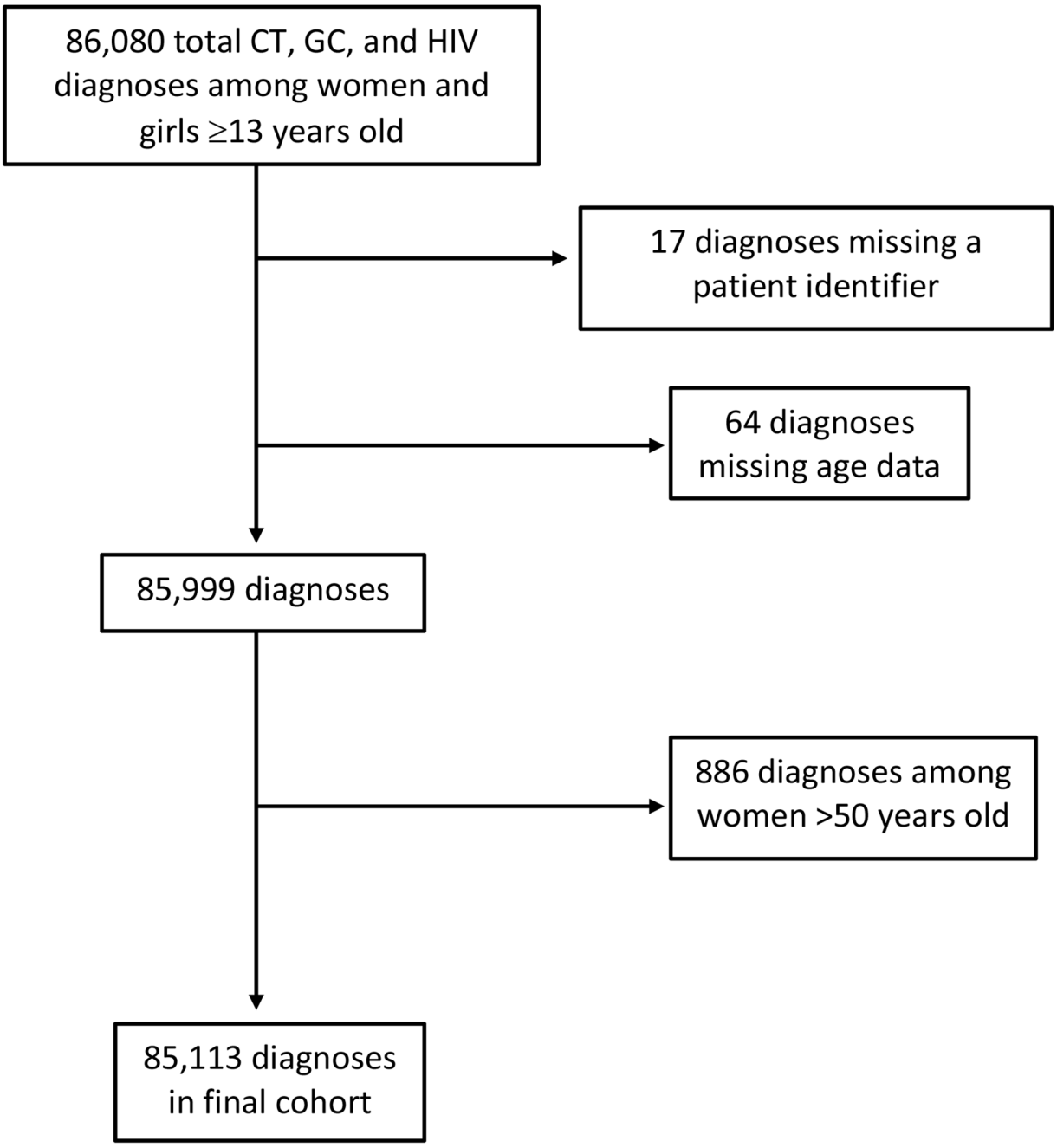

Figure 1.
Flow diagram of study cohort creation

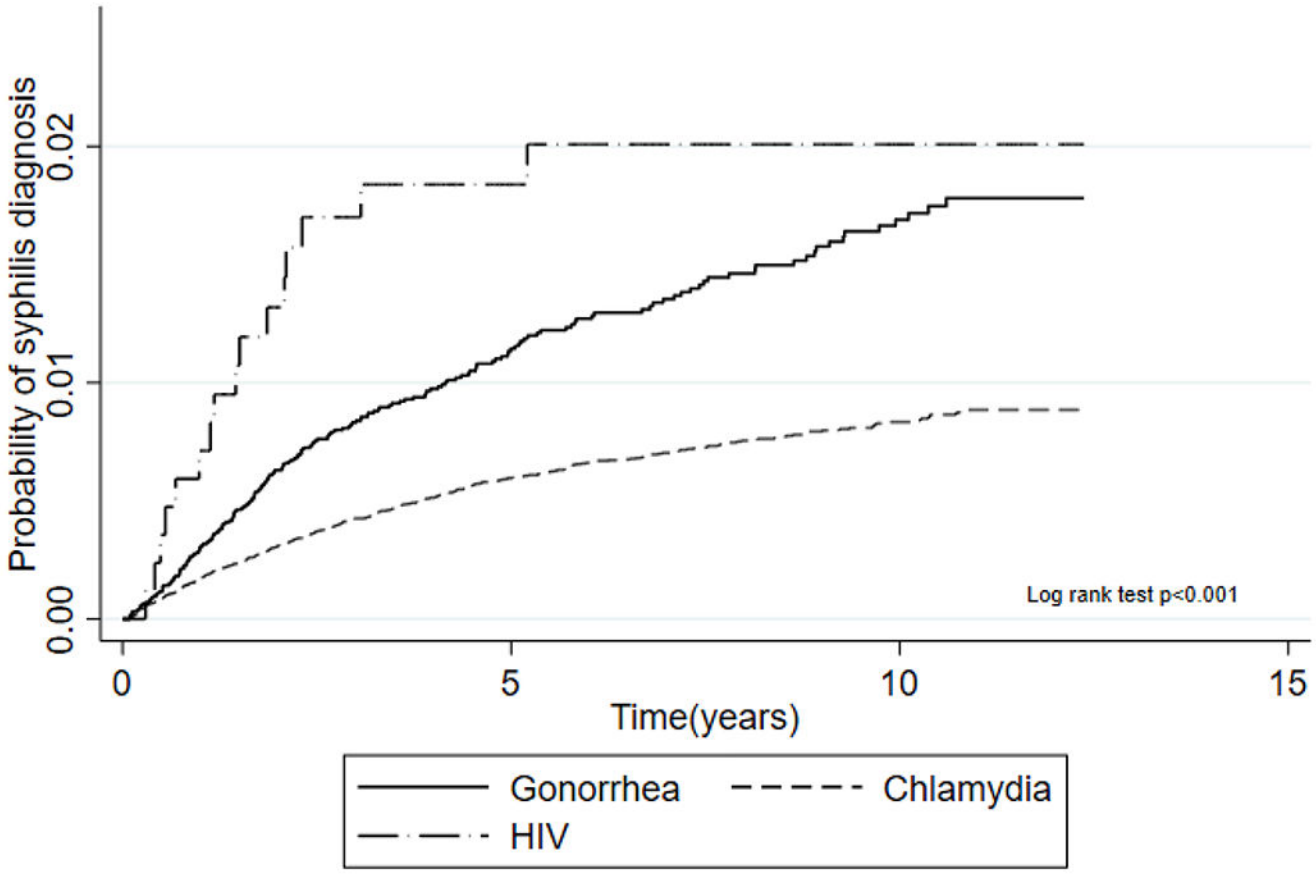

Figure 2.
Cumulative Risk of Syphilis Diagnosis Among Women After a Chlamydia, Gonorrhea, or HIV Diagnosis, Baltimore City, 2009-2021

Table 1.

Characteristics of Women Overall and by STI Diagnosis at Cohort Entry, Baltimore City, 2009-2021 (N=85,113)

		Cohort Entry Diagnosis[a]				
	Overall (n=85,113)	**Chlamydia (n=65,910)**	**Gonorrhea (n=12,600)**	**HIV (n=807)**	**Gonorrhea and Chlamydia (n=5,723)**	**HIV + Any Other STI[b] (n=73)**
Age at cohort entry, mean (SD)	22.27 (6.13)	21.95 (5.72)	23.79 (6.94)	34.74 (9.49)	20.78 (5.64)	28.34 (8.24)
<25 years, n(%)	62,494 (73.42)	49,613 (75.27)	8,076 (64.10)	147 (18.22)	4,630 (80.90)	28 (38.36)
≥25 years, n(%)	22,619 (26.58)	16,297 (24.73)	4,524 (35.90)	660 (81.78)	1,093 (19.10)	45 (61.64)
Race, n(%)						
Black/African American	35,090 (41.23)	19,944 (30.26)	10,273 (81.53)	659 (81.66)	4,166 (72.79)	48 (65.75)
Non-Black/African American	40,062 (47.07)	37,805 (57.36)	1,113 (8.83)	124 (15.37)	996 (17.40)	24 (32.88)
Missing/unknown	9,961 (11.70)	8,161 (12.38)	1,214 (9.63)	24 (2.97)	561 (9.80)	1 (1.37)
No. prior STI diagnoses in study period, n(%)						
0 prior diagnoses	52,277 (61.42)	41,667 (63.22)	8,651 (68.66)	708 (87.73)	1,227 (21.44)	24 (32.88)
≥1 prior diagnosis	32,836 (38.58)	24,243 (36.78)	3,949 (31.34)	99 (12.27)	4,496 (78.56)	49 (67.12)
No. of sex partners,[c] n(%)						
0-1	599 (0.70)	40 (0.06)	264 (2.10)	167 (20.69)	112 (1.96)	16 (21.92)
2	194 (0.23)	8 (0.01)	109 (0.87)	37 (4.58)	36 (0.63)	4 (5.48)
≥3	112 (0.13)	8 (0.01)	49 (0.39)	34 (4.21)	17 (0.30)	4 (5.48)
Missing/unknown	84,208 (98.94)	65,854 (99.92)	12,178 (96.65)	569 (70.51)	5,558 (97.12)	49 (67.12)
Pregnant at diagnosis, n(%)						
Yes	1,094 (1.29)	803 (1.22)	136 (1.08)	32 (3.97)	117 (2.04)	6 (8.22)
No	5,838 (6.86)	3,864 (5.86)	1,030 (8.17)	214 (26.52)	711 (12.42)	19 (26.03)
Missing/unknown	78,181 (91.86)	61,243 (92.92)	11,434 (90.75)	561 (69.52)	4,895 (85.53)	48 (65.75)
Any transactional sex in past 12 months, n(%)						
Yes	106 (0.12)	10 (0.02)	12 (0.10)	67 (8.30)	7 (0.12)	10 (13.70)
No	2,010 (2.36)	41 (0.06)	1,106 (8.78)	590 (73.11)	245 (4.28)	28 (38.36)
Missing/unknown	82,997 (97.51)	65,859 (99.92)	11,482 (91.13)	150 (18.59)	5,471 (95.60)	35 (47.95)
Any IDU in past 12 months, n(%)						
Yes	62 (0.07)	10 (0.02)	0 (0)	48 (5.95)	1 (0.02)	3 (4.11)
No	16,211 (19.05)	51 (0.08)	12,600 (100)	655 (81.16)	2,864 (50.04)	41 (56.16)

	Overall (n=85,113)	Cohort Entry Diagnosis[a]				
		Chlamydia (n=65,910)	Gonorrhea (n=12,600)	HIV (n=807)	Gonorrhea and Chlamydia (n=5,723)	HIV + Any Other STI[b] (n=73)
Missing/unknown	68,840 (80.88)	65,849 (99.91)	0 (0)	104 (12.89)	2,858 (49.94)	29 (39.73)
Diagnosing location, n(%)						
STI clinic	8,968 (10.54)	7,150 (10.85)	1,276 (10.13)	64 (7.93)	468 (8.18)	10 (13.70)
Private provider	35,572 (41.79)	28,542 (43.30)	4,739 (37.61)	207 (25.65)	2,060 (36.00)	24 (32.88)
Hospital	14,948 (17.56)	10,830 (16.43)	2,736 (21.71)	108 (13.38)	1,262 (22.05)	12 (16.44)
ED or urgent care	13,643 (16.03)	9,399 (14.26)	2,840 (22.54)	80 (9.91)	1,314 (22.96)	10 (13.70)
Detention center	1,149 (1.35)	681 (1.03)	264 (2.10)	23 (2.85)	181 (3.16)	0 (0)
Outreach	336 (0.39)	171 (0.26)	84 (0.67)	41 (5.08)	36 (0.63)	4 (5.48)
Other	9,562 (11.23)	8,575 (13.01)	513 (4.07)	83 (10.29)	383 (6.69)	8 (10.96)
Missing/unknown	935 (1.10)	562 (0.85)	148 (1.17)	201 (24.91)	19 (0.33)	5 (6.85)
Syphilis diagnoses, n(%)	646 (0.76)	386 (0.59)	145 (1.15)	15 (1.86)	98 (1.71)	2 (2.74)

STI = sexually transmitted infection; IDU = injection drug use

[a] Earliest diagnosis during study period

[b] Any other STI = chlamydia, gonorrhea, or chlamydia and gonorrhea

[c] In the past three months for patients with gonorrhea, in the past year for patients with HIV, data not collected for patients with chlamydia

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Table 2.

Incidence of Syphilis Diagnosis Stratified by Chlamydia or Gonorrhea Diagnosis Among Women Diagnosed with a Prior STI (Chlamydia, Gonorrhea, and/or HIV), Baltimore City, 2009-2021 (N = 85,113)

Characteristic	No. CT or GC Diagnoses	Diagnosis-Years at Risk	No. Syphilis Diagnoses	Syphilis Incidence per 1,000 Diagnosis-years	Unadjusted Syphilis IRR (95% CI)	Adjusted[b] Syphilis IRR	95% CI
Chlamydia							
Age, y							
≥25 years	16,864	99,775	91	0.91	0.92 (0.72 – 1.16)	1.30	(0.82 – 1.30)
<25 years	51,943	347,466	345	0.99			
≥1 prior STI diagnosis[a]							
Yes	26,250	154,939	248	1.60	2.49 (2.05 – 3.02)	2.50*	(2.06 – 3.02)
No	42,557	292,302	188	0.64			
Gonorrhea							
Age, y							
≥25 years	5,073	29,991	79	2.63	1.63 (1.21 – 2.19)	2.09*	(1.56 – 2.80)
<25 years	10,390	71,220	115	1.61			
≥1 prior STI diagnosis[a]							
Yes	6,468	32,338	117	3.62	3.24 (2.41 – 4.37)	3.69*	(2.75 – 4.95)
No	8,995	68,872	77	1.11			

[a] Including gonorrhea, chlamydia, or HIV

[b] Results by age are adjusted for history of ≥1 STI diagnosis; results by ≥1 STI diagnosis are adjusted for age

CT = chlamydia; GC = gonorrhea; STI = sexually transmitted infection; IRR = incidence rate ratio

Note: Statistical testing among women with a prior HIV diagnosis was not conducted due to small numbers.