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Trends in HIV prevalence by self-report among MSM diagnosed and reported with gonorrhea in six United States jurisdictions from 2010 to 2019

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Abstract

Background: HIV co-infection among persons diagnosed with gonorrhea is not well characterized. Trends in HIV prevalence among persons diagnosed with gonorrhea may have significant implications for HIV prevention interventions, especially for MSM. MSM are increasingly and disproportionately represented among incident gonorrhea cases reported in a multistate sentinel surveillance network. Using data from this network, we estimated HIV prevalence among MSM by self-report and explored trends in co-infection by key demographics.

Design: Observational study using enhanced surveillance data.

Methods: Six geographically diverse jurisdictions in the STD Surveillance Network (SSuN) 2010–2019 randomly sampled laboratory-confirmed gonorrhea cases. Enhanced investigations on sampled cases included patient interviews eliciting demographic, behavioral and HIV testing

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Conflicts of interest

There are no conflicts of interest.

history. These data were weighted to adjust for study design and nonresponse to estimate trends in HIV prevalence.

Results: Of 653 522 reported cases, 28 979 were sampled and investigated. The proportion of cases reporting living with diagnosed HIV at the time of their gonorrhea diagnosis increased 61% across the study period from 6.6% in 2010 to 10.8% in 2019. The observed increase in HIV prevalence is concurrent with an increase in the proportion of gonorrhea cases attributable to MSM. HIV prevalence among MSM decreased in two jurisdictions and increasing trends were observed among non-Hispanic Black and Hispanic MSM. HIV prevalence decreased among non-Hispanic white MSM, MSM under 20 and those 40 years of age or older.

Conclusion: Diagnosis with gonorrhea, especially among MSM, should be a sentinel event triggering screening for HIV, referral to high-impact HIV prevention interventions or to HIV primary care.

Keywords

co-infection; gonorrhea; HIV infections; HIV prevalence; *Neisseria gonorrhoeae* ; STDs; sexually transmitted infections

Introduction

Ending the HIV epidemic in the United States will require comprehensive information on persons at risk for, or living with HIV and on contexts where they may be encountered and referred to appropriate preventive services. Broad, effective uptake of biomedical interventions, such as preexposure prophylaxis (PrEP) and treatment as prevention (TasP) for persons living with HIV to reduce viral load depends on prompt identification and referral of persons infected with, or at risk for, HIV. Among persons living with HIV, or among those at risk for HIV, diagnosis of a sexually transmitted infection (STI) provides biologic evidence of potential HIV exposure. Diagnosis of STIs also presents unique opportunities for referral to HIV-related primary care for those living with HIV who may not have been linked to care yet, or re-engagement with care for those who may have lapsed in their HIV care. Moreover, *Neisseria gonorrhoeae* infections have been specifically associated with increased risk of HIV diagnoses among MSM [1–4]. These studies highlight the importance of routine screening for gonorrhea, especially for MSM, as part of a comprehensive HIV prevention strategy. Concurrent HIV testing in STI diagnostic settings should be used to assure engagement with HIV care for those living with HIV or immediate referral to HIV PrEP for all HIV-negative patients.

Yet the current understanding of the burden of HIV infection among those diagnosed with gonorrhea, especially MSM, is incomplete. The vast majority of gonorrhea cases reported by states to CDC do not include information on gender of sex partners or HIV status. These data are crucial to planning and deploying interventions of sufficient scope and scale in STI diagnostic settings to address HIV prevention priorities as well as for addressing related STI prevention objectives [5]. Recent analysis of national HIV surveillance data, which are far more complete with respect to behavioral risk factors than gonorrhea case report data, demonstrates that MSM continue to bear a disproportionally high burden of HIV incidence

and prevalence, with an estimated 12.4% of all MSM living with HIV in 2015 [6]. Such a high population prevalence of HIV, along with increasing gonorrhea incidence among MSM documented previously through sentinel surveillance, raises concerns for increased HIV transmission and highlights the need for a renewed focus on improving HIV prevention efforts in settings where sexual health services are delivered [7–9]. Prior studies have been limited in scope, assessing the burden of HIV infection either among MSM diagnosed with gonorrhea in selected sexual health clinical settings, or in limited geographic settings [10,11]. Although many MSM seek care for STIs in specialty settings, a larger proportion are diagnosed in primary care or emergent care settings. To broaden understanding of the prevalence of HIVamong all persons diagnosed with gonorrhea, we used data from the STD Surveillance Network (SSuN) to estimate 10-year trends in self-reported HIV prevalence among gonorrhea cases diagnosed across the full spectrum of diagnosing providers from multiple United States jurisdictions, stratified by MSM, women and men who have sex with women only (MSW).

Methods

Study population

Six geographically diverse United States jurisdictions participated in two consecutive SSuN data collection cycles (2010–2013 and 2015–2019), which is a sentinel surveillance activity conducted by the United States Centers for Disease Control and Prevention in collaboration with state and local health departments. In the current analysis, we use enhanced STI surveillance data contributed by health department collaborators in Baltimore, Maryland; California (excluding San Francisco, which is included separately); New York City, New York; Philadelphia, Pennsylvania; San Francisco, California and Washington state [12]. A random sample of gonorrhea cases reported from all provider settings in these jurisdictions was drawn, investigations of existing health department records were conducted, diagnosing providers contacted for additional information, and patient interviews attempted for all sampled cases. Interviews were conducted by trained investigators using standardized interview instruments. Reporting of all laboratory-confirmed gonorrhea cases is a legal requirement in all SSuN sites and all cases were eligible for sampling regardless of diagnosing provider type. Sample fractions varied by jurisdiction, depending on volume of reported cases and available resources for case investigations, with the goal of having complete investigations for at least 4% of all reported cases.

Data collection

Patients were asked detailed questions on demographics, sexual behaviors, HIV testing history and current HIV status. MSM were identified by self-report, collected as gender of sex partners in the last 12 months and supplemented by patient report of the specific number of male and/or female sex partners in the 3 months prior to their gonorrhea diagnosis. Men reporting any male sex partners in the last year, or one (or more) male sex partners in the 3 months preceding their gonorrhea diagnosis were categorized as MSM; those reporting only sex with women, or refusing to provide any sex partner or sexual orientation information (<2% of all men) were categorized as MSW. Transgender persons (<0.3% of all cases) are included in the analysis by their current gender identity (i.e. male-to-female transgender

patients are included as ‘women’). Current HIV status was elicited in response to several questions about HIV testing; those reporting being tested either ever or at their recent gonorrhea diagnosis, were then asked to report results of that HIV test. Patients reporting a previous or current positive HIV test were considered to be living with HIVat the time of their gonorrhea diagnosis.

Case sampling, provider investigations, patient recruitment and interviews were conducted using methods and data collection instruments collaboratively developed by CDC and local project staff (OMB Control #0172–920). As an enhancement to routine communicable disease case investigation authority at the local level, SSuN activities received a Determination of Non-Research; CDC human subjects review was not required. Collaborating jurisdictions sought and received local Institutional Review Board waivers or approvals, where appropriate, in compliance with local policies and institutional regulations. All de-identified case data were submitted to local quality assurance checks and securely transmitted to CDC in uniform datasets every 2 months during data collection cycles.

Analyses

Interviewed cases were weighted by inverse proportional weighting to represent all gonorrhea cases reported annually in each county, the primary stratification level in the participating SSuN sites. Weights were adjusted for nonresponse by sex and age group by iterative raking to produce estimates that fell within 2% of marginal totals of these strata in the underlying census of reported gonorrhea cases in each year. Resulting estimates of case characteristics, including self-reported HIV prevalence, are representative of all persons diagnosed and reported with gonorrhea in each jurisdiction annually. Trends in overall self-reported HIV prevalence, by sex, and among MSM by year were assessed using the Cochran-Armitage test of trend; MSM were further stratified by age group and race/Hispanic ethnicity to examine trends by these groupings. Data for 2014 were not available because of an interruption in data collection between project cycles and were estimated by linear interpolation across the entire study period. Taylor Series standard errors were used to calculate 95% confidence intervals (CIs) for annual point estimates of HIV prevalence. We also present a cross-sectional comparison of HIV prevalence among MSM diagnosed by participating SSuN site for the two data collection cycles and assessed differences between self-reported HIV prevalence in 2010–2013 and 2015–2019 by chi-square test with Yates correction. Methods of case sampling, data collection, and for eliciting HIV testing and results were the same in both data collection cycles. Statistical significance was assessed at the 95% confidence level with P values of 0.05 or less. All analyses were conducted using SAS 9.4 (SAS Institute, Cary, North Carolina, USA).

Results

Gonorrhea cases increased in all SSuN sites during the study period, with much steeper increases observed among men than among women. A total of 653 522 cases of gonorrhea were reported during the two data collection cycles covering 2010–2019 in the participating jurisdictions, including 219 174 (33.5%) cases among women and 434 348 (66.5%) cases among men (Table 1). Among all cases, 65 698 (10.1%) were randomly sampled and

completed investigations were obtained for 28 979 cases. The overall response rate among sampled cases was 44.1% across the entire study period. Among sampled cases for which a patient interview was not obtained (n = 36 719), only 4932 (13.4%) actively refused to participate. The balance of incomplete investigations were because of insufficient, incorrect or out-of-date locating information for the patient. No significant differences were observed for respondents versus nonrespondents based on information available on laboratory and/or case reports. The average margin of error for self-reported HIV status across all years of data collection was ±1.9% (range: 1.2–3.6%).

Figure 1a shows the estimated proportion of all gonorrhea patients living with HIV at the time of their gonorrhea diagnosis increasing 61% from 6.6% in 2010 to 10.8% in 2019 (P < 0.0001). Stratifying by sex, men were far more likely than women to report living with HIV in all years across the study period (Fig. 1b). The estimated proportion of all men living with HIV ranged from 11.5% (95% CI 5.7–17.2) in 2013 to a high of 16.8% (95% CI 14.2–18.8) in 2016 and increased significantly across the entire study period (P < 0.0001). Among women, the observed increase in the estimate of those living with HIV (from 0.18% in 2010 to 0.56% in 2019) was not statistically significant. Stratifying by sex demonstrates that while the estimated proportion of all gonorrhea cases living with HIV increased across the study period, the increases are primarily attributable to men.

Among men diagnosed and reported with gonorrhea, a large proportion were estimated to be MSM (43.6%, 95% CI 42.6–44.6) based on reported gender of sex partners. The proportion of gonorrhea cases attributable to MSM also increased steadily across the study period. The estimated proportion of men living with HIV by reported gender of sex partners is shown in Fig. 2a and b. Across all years, MSM (Fig. 2b) were more likely than MSW (Fig. 2a) to report living with HIV. Prevalence of HIV was relatively stable across the study period for both groups in stratified analysis, at approximately 1% for MSW and slightly over 20% among MSM.

Among MSM, differences in the estimated prevalence of those living with HIV were observed by age group and race/Hispanic ethnicity. We observed that self-reported HIV prevalence was highest among MSM 40 years of age and older across the entire study period, with a median estimated prevalence of 39.8% (95% CI 36.5–43.2). Among those 30–39 years of age, median estimated HIV prevalence was 23.4% (95% CI 21.0–25.8) followed by those 20–29 years of age and those under 20 years of age at 13.8% (95% CI 12.2–15.3) and 5.2% (95% CI 3.0–7.5), respectively.

Figure 3 shows the trend among MSM reporting living with HIVat the time of gonorrhea diagnosis by age group. Estimated prevalence of HIV among MSM diagnosed with gonorrhea was stable for most age groups across the study period with the exception of those under 20 years of age, which trended significantly downward between 2010 and 2019 (P < 0.0001). Figure 4a–d shows the trend in estimated HIV prevalence among MSM by race/Hispanic ethnicity. A significant increasing trend was observed among non-Hispanic black MSM and among Hispanic MSM (P < 0.0001, for both), whereas the percentage estimated to be living with HIV decreased significantly among non-Hispanic white MSM (P < 0.0001).

There were also significant changes in the proportion of MSM with gonorrhea reporting living with HIV by SSuN site between to the two data collection periods (2010–2013 and 2015–2019). Supplemental Digital Content 1, http://links.lww.com/QAD/C293 shows the site-specific changes in self-reported HIV prevalence across the two data collection cycles, with each cycle treated as a cross-section. Two sites, San Francisco and New York City showed significant decreases in HIV prevalence among MSM diagnosed with gonorrhea [decreases of 27% ($P < 0.00001$) and 5% ($P = 0.0114$), respectively]. Philadelphia and California (excluding San Francisco) showed significant increases in HIV prevalence among MSM [increases of 29% ($P < 0.00001$) and 23% ($P < 0.00001$), respectively]. Changes in HIV prevalence in other jurisdictions were not significant between the two SSuN data collection cycles.

Discussion

Our analysis demonstrates that self-reported HIV prevalence among MSM diagnosed with gonorrhea is consistently and significantly higher than among MSW and women. The characteristics of reported gonorrhea cases changed significantly across our study period as well with a steeply increasing proportion of all cases attributable to MSM. This accounts for the overall trend of increasing prevalence of self-reported HIV among all gonorrhea cases. In stratified analysis, HIV prevalence among MSM diagnosed with gonorrhea has been roughly stable in these sites across the 10-year study period, though some important differences by age group, race/Hispanic ethnicity, and site were observed. Moreover, HIV prevalence among MSM diagnosed with gonorrhea in our study sites is considerably higher than published estimates of HIV prevalence among all MSM nationally. Using national HIV surveillance data, Crepaz and colleagues estimated an overall prevalence of HIVamong MSM of 12.4% in 2015, compared with our estimated HIV prevalence of 19.3% among MSM diagnosed with gonorrhea that same year [6]. Our findings confirm that MSM being diagnosed with STIs constitue a subset of all MSM with greater community risk of exposure to HIV.

We also observed self-reported HIV diagnosis to be uniformly higher and trending upward among non-Hispanic black and Hispanic MSM diagnosed with gonorrhea, while the prevalence of HIV among non-Hispanic white MSM diagnosed with gonorrhea decreased across the study period. These divergent trends reflect those noted in HIV prevalence among the general population of MSM and are a troubling indication of continuing inequities in the burden of disease, perhaps explained by differential access to preventive interventions, such as PrEP among minority MSM [13]. We previously described differences in the proportion of HIV-negative persons diagnosed with gonorrhea in SSuN sites who report being offered PrEP by race/Hispanic ethnicity, and these differences align with observed inequities in HIV prevalence by race/Hispanic ethnicity among MSM in the current study [14]. Implementing interventions designed specifically to serve MSM of color, such as routine HIV testing in all sexual health settings and proactive referral to culturally appropriate PrEP services for HIV-negative MSM is essential to addressing these troubling trends among MSM of color. For MSM living with HIV, monitoring retention in care is also needed to assure long-term, sustainable viral suppression.

Prevalence of self-reported HIV among MSM diagnosed with gonorrhea decreased significantly in two metropolitan jurisdictions on the United States West and East Coasts in our network. This is a promising finding that may reflect early and intensified public health efforts in these jurisdictions to reduce the incidence of HIV through interventions including PrEP and TasP, in New York City's 'Undetectable=Untransmittable' (U = U) San Francisco's 'Getting to Zero' and campaigns. Key concepts of these campaigns are now an integral part of the national Ending the Epidemic (EHE) initiative [15–22]. Gonorrhea transmission may also have peaked among MSM living with HIV in these areas and shifted toward HIV-negative MSM. Areas not seeing similar reductions, or seeing modest increases in HIV prevalence among gonorrhea cases, may also be experiencing changes in gonorrhea incidence patterns, with more cases being diagnosed among sexual networks with a higher density of MSM living with HIV. Our findings also reflect a more generalized gonorrhea epidemic among MSM, regardless of HIV status, as documented by steeply increasing gonorrhea incidence among MSM observed during the study period [7–8]. Introduction or serial re-introduction of gonorrhea into sexual networks of mostly HIV-positive MSM would lead to higher proportion of all gonorrhea cases among MSM being attributable to those living with HIV.

Moreover, MSM may be more frequently screened for gonorrhea – either as a result of standards of care for those receiving PrEP – or for those living with diagnosed HIV who are engaged in routine care for HIV. Screening coverage data are not available in our study, though it has been suggested elsewhere that men on PrEP may be more likely to be diagnosed with bacterial STIs [23]. Given the well documented synergy between gonorrhea and HIV incidence, HIV prevalence among MSM diagnosed with gonorrhea warrants continued public health surveillance. Decreasing HIV positivity among MSM diagnosed with gonorrhea could indicate that more MSM are accessing PrEP; providers should redouble efforts to assure linkage to PrEP services wherever indicated. Increasing prevalence of HIVamong MSM diagnosed with gonorrhea also reinforces the importance of assuring continuing access to HIV treatment. Clinicians diagnosing gonorrhea among their patients known to be HIV positive should discuss the importance of viral suppression and actively re-engage patients with HIV treatment whenever needed. These clinician-initiated interventions are especially urgent for ethnic and racial minority MSM.

Future activities through the STD Surveillance Network will expand to collect information on HIV care status among patients living with HIV and implement routine HIV-surveillance registry matching to supplement patient self-report. Additional data from laboratory surveillance among patients living with HIV will provide for future analyses of viral suppression at the time of gonorrhea diagnosis and also allow characterization of differences in HIV prevalence by anatomic site of gonococcal infection.

Limitations

Our analysis is based on investigations among a probability sample of gonorrhea cases reported in six United States jurisdictions and are only generalizable to cases diagnosed and reported in those jurisdictions. Completed investigations were not obtained for a significant proportion of sampled cases, though a relatively small proportion of those actively refused

to participate. Nonresponse was mostly attributable to a lack of valid contact information for patients. Although we did not observe significant differences between respondents and nonrespondents by age or sex, unmeasured response bias may still exist. Ascertainment of HIV status was limited to patient self-report of HIV status and may not fully capture all persons diagnosed with gonorrhea who are living with HIV; analysis of recent registry matching data demonstrates that up to 22% of MSM with gonorrhea living with HIV in one jurisdiction did not disclose their HIV status to public health investigators [24]. For this reason, our estimates of HIV prevalence among MSM diagnosed with gonorrhea should be considered minimum estimates. Future analyses based on matched STI and HIV surveillance registries will address this limitation.

Men diagnosed with gonorrhea were counted as MSM if they reported any male partners in the previous 12 months; those not reporting male partners, or declining to provide all partner information, were presumed to be MSW in our analysis. As a consequence, a small number of MSM may be included in this grouping, with the result that HIV prevalence for MSW may be over-estimated. However, fewer than 2% of interviewed patients declined to provide sex partner information. Finally, our study of self-reported HIV prevalence among gonorrhea cases was not designed to reflect broader population-level trends in HIV prevalence but these data do contribute to our understanding of syndemic interactions between gonorrhea and HIV.

In conclusion, our analysis confirms that a gonorrhea diagnosis, especially among racial and ethnic minority or younger MSM, is a sentinel event that should trigger concurrent screening for HIV infection and/or referral for HIV preventive services, such as PrEP. These findings also reinforce the importance of TasP for all MSM living with HIV who are sexually active as demonstrated by one or more infections with bacterial STIs. Differences observed in our study also suggest that significant barriers to HIV testing, PrEP use or challenges accessing and maintaining HIV care among racial and ethnic minority MSM likely exist; inequities in the burden of HIV disease will persist if these are not specifically addressed.

HIV prevalence among younger MSM diagnosed and reported with gonorrhea appears to be trending downward across our study period, though small numbers of patients in this age group in our study argue for caution in interpreting this encouraging finding. Decreasing trends in self-reported HIV prevalence among all gonorrhea cases in several SSuN jurisdictions are also noteworthy and should reinforce the importance of universal, comprehensive, focused, and sustained HIV prevention efforts. Although the synergy between gonorrhea and HIV is complex and dynamically evolving, future efforts should focus on more fully integrating HIV and STI surveillance to inform the scope and targeting of HIV preventive services. Our estimates suggest that as many as one in five MSM diagnosed with gonorrhea may be living with HIV and leveraging opportunities for HIV prevention in all clinical settings where STIs are diagnosed should be a public health imperative. Moreover, the proportion of MSM diagnosed with gonorrhea who are not known to be living with HIV represents a population at demonstrably higher risk who should be prioritized for immediate linkage to effective prevention interventions, such as PrEP.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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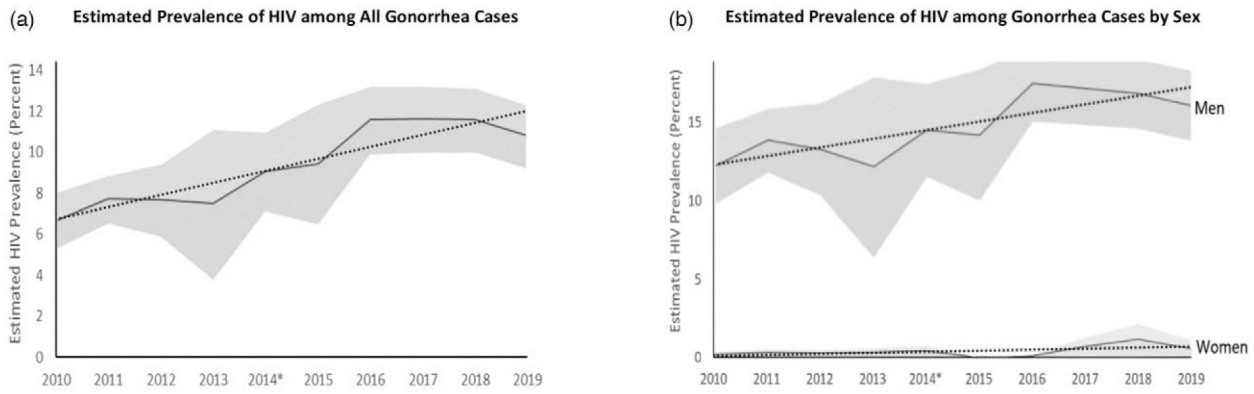

Fig. 1. (a and b) Estimated prevalence[ł] of HIV among all reported gonorrhea cases (a), and stratified by sex (b) STD Surveillance Network[ǂ], 2010–2019.

[ł] HIV status based on self-report; [ǂ] among six sites participating continuously during 2010–2019. *Data for 2014 not available, estimate shown is a linear interpolation. Shaded area represents 95% confidence interval of annual point estimates. Dotted line represents linear trend.

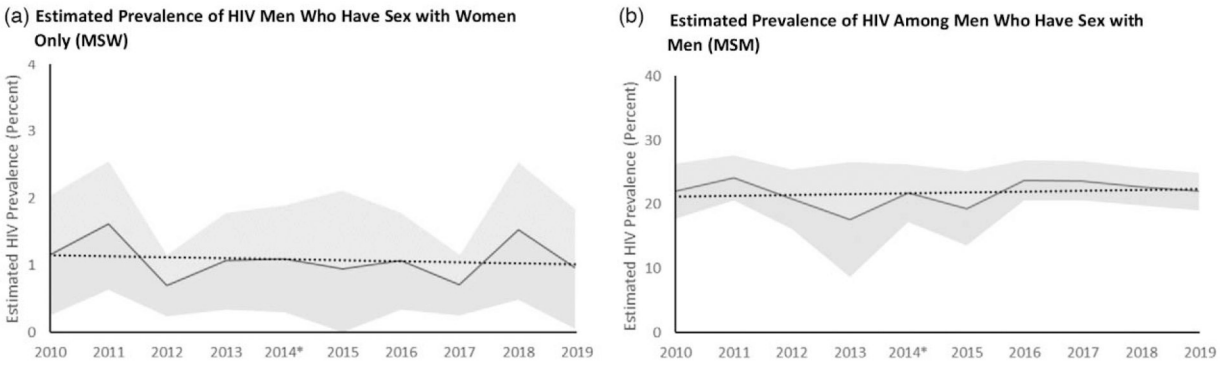

Fig. 2. (a and b) Estimated prevalence[ł] of HIV among male cases reported with gonorrhea by gender of sex partners, STD Surveillance Network[łł], 2010–2019.

[ł] HIV status based on self-report; [łł]among six sites participating continuously during 2010–2019. *Data for 2014 not available, estimate shown is a linear interpolation. Shaded area represents 95% confidence interval of annual point estimates. Dotted lines represent linear trends.

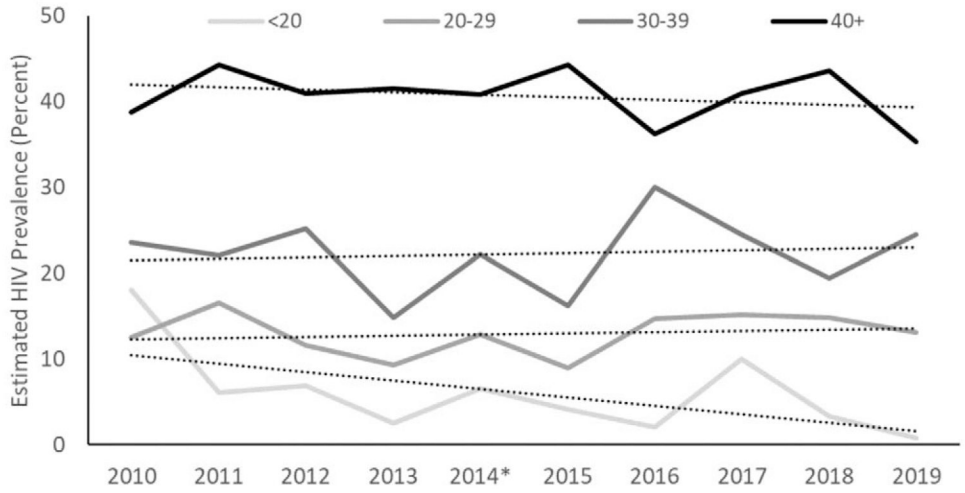

Fig. 3. Estimated prevalence[ł] of HIV among MSM gonorrhea cases by age group, STD Surveillance Network[ǂǂ], 2010–2019.

[ł] HIV status based on self-report; [ǂǂ]among six sites participating continuously during 2010–2019. *Data for 2014 not available, estimate plotted is a linear interpolation. Dotted lines represents linear trend.

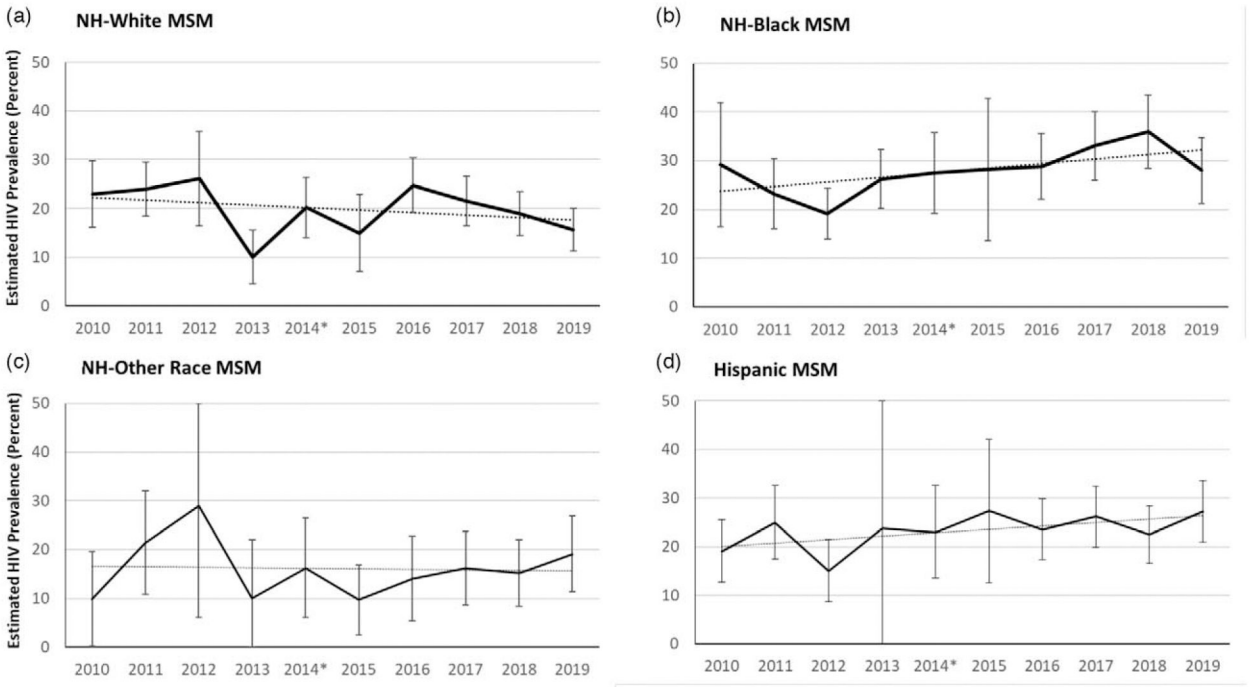

Fig. 4. (a–d) Estimated prevalence[ł] of HIV and trends among MSM diagnosed with gonorrhea by race and hispanic ethnicity, STD Surveillance Network[ǂǂ], 2010–2019.

[ł] HIV status based on self-report; [ǂǂ]among six sites participating continuously during 2010–2019. *Data for 2014 not available, estimate shown is a linear interpolation. Bars represent 95% confidence interval of annual point estimates, dotted line represents linear trend.

Table 1.

Total cases reported and completed case investigations by year and sex of patient, STD Surveillance Network, 2010–2019.

	Cases reported			Sampled and investigated		
Year	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
2010	27 669	20 846	48 515	1607	1240	2847
2011	28 120	20 843	48 963	1967	1548	3515
2012	32 893	22 090	54 983	2405	1623	4028
2013[a]	14 837	8304	23 141	1252	781	2033
2014[b]	*b*	*b*	*b*	*b*	*b*	*b*
2015[a]	23 535	10 205	33 740	681	402	1083
2016	65 364	29 578	94 942	2493	1116	3609
2017	78 178	34 717	112 895	2696	1195	3891
2018	82 093	35 913	118 006	2685	1141	3826
2019	81 659	36 678	118 337	2784	1363	4147
Total	434 348	219 174	653 522	18 570	10 409	28 979

[a]January to June data collection in 2013; July to December data collection in 2015.

[b]Data for 2014 not available.