STD and HIV/AIDS Case Registry Matching to Estimate California STD-HIV/AIDS Co-infection

Nicole Olson, M.P.H.,[1]
Michael C. Samuel, Dr.P.H.,[1]
Jennifer Brodsky, M.P.H.,[1]
Denise Gilson,[1]
Mark Damesyn, Dr.P.H.,[2]
Kyle Bernstein, Ph.D., Sc.M.,[3]
Peter Kerndt, M.D., M.P.H.[4]

[1]Sexually Transmitted Diseases (STD) Control Branch,
Division of Communicable Disease Control (DCDC),
Center for Infectious Diseases (CID),
California Department of Public Health (CDPH),
Richmond, California

[2]Office of AIDS,
DCDC, CID, CDPH,
Sacramento, California

[3]STD Prevention and Control Services Program,
San Francisco Department of Public Health,
San Francisco, California

[4]Sexually Transmitted Disease Program,
Los Angeles County Department of Public Health,
Los Angeles, California

September 2011

INTRODUCTION

Knowledge of patterns and trends in rates of co-infection between HIV/AIDS and sexually transmitted diseases (STDs) is important for targeting services for individuals infected with multiple conditions and for preventing new infections. Such data will support the efforts of California (and the nation) in moving toward the Centers for Disease Control and Prevention's Program Collaboration and Service Integration (PCSI) strategic priority[1] and will help address the interrelated epidemics (or "syndemics") of HIV and STDs.

Matching case registries is an efficient and effective method to estimate co-infection rates in light of the fact that traditional "silo" surveillance systems rarely identify more than one infection or disease. In case registries, these data already exist; therefore, no special data collection effort is necessary. In line with the PCSI principles, the amalgamation of these two separate surveillance systems has the potential to facilitate a more complete understanding of co-infected populations; therefore, enabling a more effective delivery of services to those co-infected with HIV/AIDS and STDs.

Assessing co-infection is important because of the strong biological and behavioral links between STD and HIV transmission and acquisition. Evidence indicates that both ulcerative and non-ulcerative STDs increase the likelihood of HIV transmission, which may contribute to an infectious synergy as each infection is amplified.[2] The behavioral links between STDs and HIV are well-documented in the literature; the same high-risk behaviors increase risk of both STDs and HIV. As such, STD infection serves as a marker of recent high-risk behavior among persons living with HIV.

Currently, statewide estimates for HIV-gonoccocal and HIV-chlamydial co-infection are not available through existing data systems, and HIV-syphilis co-infection estimates rely on self-report in the standard syphilis interview record.

OBJECTIVES

The objectives for this project were to: (1) match population-based HIV/AIDS and STD case registries for the State of California; (2) examine demographic and risk profiles of co-infected individuals; and (3) identify populations with high STD-HIV co-morbidity for action.

METHODS

Data sources

The data for this project were from the HIV/AIDS case registry maintained by the California Department of Public Health (CDPH) Office of AIDS and from STD case reports from multiple data systems maintained by the CDPH Sexually Transmitted Diseases (STD) Control Branch. Data for this project included AIDS cases diagnosed

from 1981 through 2009; HIV cases diagnosed from 2007 through 2009; and chlamydia, gonorrhea, and primary and secondary (P&S) syphilis cases diagnosed from 2000 through 2009. HIV name-based reporting was implemented in April 2006; thus, 2007 was the first full year for which name-based HIV data were available. The analyses in this technical report focus on 2009: HIV/AIDS cases living in 2009 and STD cases diagnosed in 2009. For the purpose of this analysis, we defined co-infection as any person with an STD diagnosed in a given year who was living with HIV/AIDS at the time of STD infection or who was diagnosed with HIV within 30 days following an STD infection.

Data cleaning/preparation for match

Records missing first name, last name, date of birth, or date of HIV diagnosis and date of AIDS diagnosis were excluded prior to match. Punctuation such as apostrophes and suffixes such as "Jr" and "III" were removed and all character data were changed to uppercase to improve matching. A 'combo' variable was created in each dataset, consisting of the first three letters of the first name and the first three letters of the last name.

In some cases, the 'date of AIDS diagnosis' and 'date of HIV diagnosis' variables provided only month and year. As such, the 15th of the month was imputed as the day of AIDS or HIV diagnosis. For records with only a year of AIDS or HIV diagnosis, June 30th of that year was imputed as the day and month of AIDS or HIV diagnosis. The same data imputation was performed for the date of death variable. If the date of death was missing, it was assumed that the person was still alive.

Matching procedures

Each record in the STD case registry was compared to each record in the HIV/AIDS case registry. Proc SQL in Statistical Analysis System (SAS) was used to block variables and assign potential matches a score based on the number of variables that matched.

A total "match score" was calculated based on the data elements that matched between the two records and the individual score (i.e., weight) for that data element. For first and last name, the SAS 'complev' function, which allows for slight differences or misspellings between names, was used.

Scoring Rubric:

Data Element	**Score**
Exact or near-match on first name	10
Exact match on first letter of first name	10
Exact or near-match on last name	30
Exact match on combination variable (First 3 letters of first name; first 3 letters of last name)	20
Exact match on sex	5
Exact match on race	5
Exact match on birth date	30
Birth date within 42 days	20
TOTAL Match Score	130
Cut-off to be considered a match	95

Visual manual review of one initial matched dataset (AIDS and gonorrhea (GC) cases in 2003) was used to determine a match score cut-off point to be considered a "true" match for all subsequent analyses. In that review, all potential matches with scores between 80 and 105 were reviewed manually and a cut-off value of 95 points was determined to maximize sensitivity and specificity. For all analyses, records considered to be matches based on the cut-off value of 95 points were then joined back to the original datasets, with the use of a unique identifier. The full dataset provided all demographic and other variables used in analysis.

Data Analysis

For the purpose of this analysis, if a person was diagnosed with an STD in 2009 and did not match to a person diagnosed with HIV/AIDS either prior to or within one month of STD diagnosis, it was assumed that this person was HIV-negative at the time of STD diagnosis. Similarly, if a person was living with HIV/AIDS during 2009 and did not match to a person with an STD diagnosis in 2009, it was assumed that this person was negative for STDs during 2009.

In RESULTS, *Section 1*, HIV prevalence in 2009 was calculated among 2009 chlamydia, gonorrhea, and P&S syphilis cases for males (Table 1) and for females (Table 2), and was stratified by age group, race/ethnicity, and region.[*] Selected figures

[*] Northern Region: Alpine, Amador, Butte, Calaveras, Colusa, Del Norte, El Dorado, Glenn, Humboldt, Lake, Lassen, Mendocino, Modoc, Nevada, Placer, Plumas, Sacramento, San Joaquin, Shasta, Sierra, Siskiyou, Sutter, Tehama, Trinity, Yolo, Yuba. Bay Area Region: Alameda, Berkeley, Contra Costa, Marin, Napa, San Mateo, Santa Clara, Solano, Sonoma. Central Region: Fresno, Inyo, Kings, Madera, Mariposa, Merced, Mono, Monterey, San Benito, Santa Cruz, Stanislaus, Tulare, Tuolumne. Southern Region: Imperial, Kern, Long Beach, Orange, Pasadena, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, Ventura. Both San Francisco and Los Angeles were classified as independent regions.

and bullet summary points based on these data follow the tables. The third figure in *Section 1* compares the HIV prevalence from the matching procedures to the self-reported prevalence from the enhanced syphilis and gonorrhea surveillance data. The final figure in *Section 1* shows the trend in AIDS prevalence among P&S syphilis cases from 2000 to 2009 and compares the AIDS prevalence and HIV/AIDS prevalence for 2009.

In *Section 2*, STD incidence in 2009 was calculated among persons living with HIV/AIDS in 2009 for males (Table 3) and females (Table 4), and was also stratified by age group, race/ethnicity, and region. Selected figures and bullet summary points based on these data follow the tables. The second figure in *Section 2* shows the incidence of STDs among persons living with HIV/AIDS compared to persons not living with HIV/AIDS. In order to compare these rates, we subtracted the number of co-infected STD cases from the total number of STD cases in California in 2009, making the assumption that these cases were not co-infected with HIV/AIDS. Similarly, we subtracted the total number of persons living with HIV/AIDS in California in 2009 from the total 2009 state population, making the assumption that these persons were not living with HIV/AIDS. The third figure in *Section 2* shows the incidence of gonorrhea among males, stratified by HIV/AIDS exposure category; and the fourth figure shows the incidence of gonorrhea among men who have sex with men (MSM) HIV/AIDS cases, stratified by race/ethnicity. The final figure in *Section 2* shows the distribution of HIV/AIDS cases by clinical setting where HIV was diagnosed, and the gonorrhea incidence among these cases.

RESULTS

Section 1. HIV/AIDS prevalence among Sexually Transmitted Disease (STD) cases

Table 1. HIV/AIDS prevalence among all California STD cases, by demographic groups, males, 2009

NA/AN: Native American/ Alaska Native	Chlamydia			Gonorrhea			Primary and Secondary Syphilis		
	Number with STD	Number living with HIV/AIDS	Percent with HIV	Number with STD	Number living with HIV/AIDS	Percent with HIV	Number with STD	Number living with HIV/AIDS	Percent with HIV
Total STD cases	42,256	2,019	4.8	12,992	1,787	13.8	1,902	817	43.0
Age group									
13-19	8,226	17	0.2	1,675	22	1.3	65	8	12.3
20-29	23,070	523	2.3	5,918	511	8.6	596	185	31.0
30-39	6,805	628	9.2	2,860	570	19.9	487	237	48.7
40-49	2,995	637	21.3	1,821	523	28.7	540	293	54.3
50-59	888	183	20.6	548	136	24.8	178	81	45.5
60+	244	31	12.7	156	25	16.0	36	13	36.1
Race/ethnicity									
Asian	1,373	61	4.4	412	55	13.3	118	44	37.3
Black	7,543	281	3.7	3,339	308	9.2	237	122	51.5
Hispanic	12,590	556	4.4	2,522	425	16.9	645	245	38.0
NA/AN	100	6	6.0	29	4	13.8	8	4	50.0
Other/Unknown	14,299	460	3.2	3,988	413	10.4	62	27	43.5
White	6,351	655	10.3	2,702	582	21.5	832	375	45.1
Region									
Northern	4,034	62	1.5	1,161	68	5.9	92	40	43.5
Bay Area	5,694	197	3.5	1,779	182	10.2	212	82	38.7
San Francisco	1,982	461	23.3	1,424	393	27.6	301	152	50.5
Central	2,836	22	0.8	579	17	2.9	50	9	18
Southern	14,008	435	3.1	3,113	377	12.1	568	242	42.6
Los Angeles	13,702	842	6.1	4,936	750	15.2	679	292	43.0

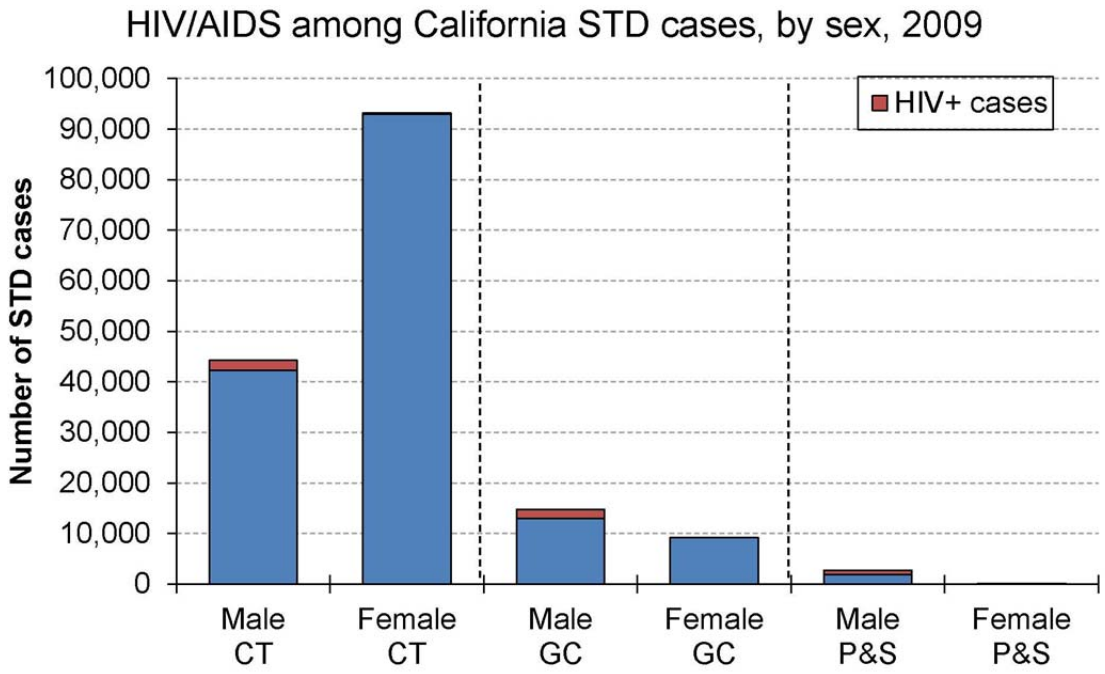
Prepared by California Department of Public Health.

Table 2. HIV/AIDS prevalence among all California STD cases, by demographic groups, females, 2009

NA/AN: Native American/ Alaska Native	Chlamydia			Gonorrhea			Primary and Secondary Syphilis		
	Number with STD	**Number living with HIV/AIDS**	**Percent with HIV**	**Number with STD**	**Number living with HIV/AIDS**	**Percent with HIV**	**Number with STD**	**Number living with HIV/AIDS**	**Percent with HIV**
Total STD cases	93,093	201	0.2	9,193	45	0.5	82	4	4.9
Age group									
13-19	30,913	13	0	3,035	4	0.1	8	0	0
20-29	49,845	75	0.2	4,609	17	0.4	29	0	0
30-39	9,290	72	0.8	1,080	12	1.1	19	3	15.8
40-49	2,221	26	1.2	318	7	2.2	17	0	0
50-59	569	15	2.6	111	4	3.6	8	1	12.5
60+	167	0	0	23	1	4.3	1	0	0
Race/ethnicity									
Asian	3,859	5	0.1	268	0	0	3	0	0
Black	13,410	27	0.2	3,064	19	0.6	26	1	3.8
Hispanic	31,268	109	0.3	1,687	9	0.5	28	0	0
NA/AN	301	2	0.7	30	1	3.3	0	0	0
Other/Unknown	31,711	42	0.1	2,979	11	0.4	5	0	0
White	12,544	16	0.1	1,165	5	0.4	20	3	15.0
Region									
Northern	9,857	11	0.1	1,296	3	0.2	14	1	7.1
Bay Area	13,460	24	0.2	1,523	13	0.9	12	1	8.3
San Francisco	1,737	8	0.5	206	3	1.5	3	1	33.3
Central	9,266	16	0.2	661	2	0.3	12	0	0
Southern	32,064	56	0.2	2,477	3	0.1	19	0	0
Los Angeles	26,709	86	0.3	3,030	21	0.7	22	1	4.5

Prepared by California Department of Public Health.

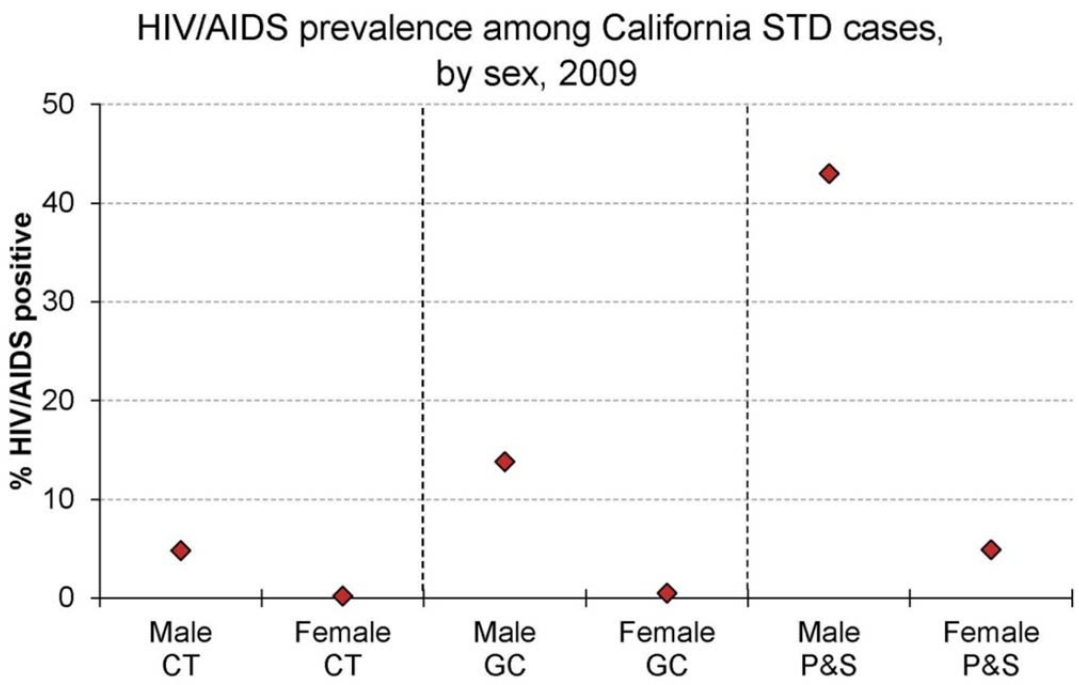
Selected Figures



CT = Chlamydia; GC = Gonorrhea; P&S = Primary and Secondary syphilis

- This stacked bar chart shows the proportion of STD cases who were HIV-positive.
- HIV-positive STD cases are shown in red, and the HIV-negative STD cases are represented in blue.
- There was a higher proportion of co-infected male cases compared to female cases, for each STD.

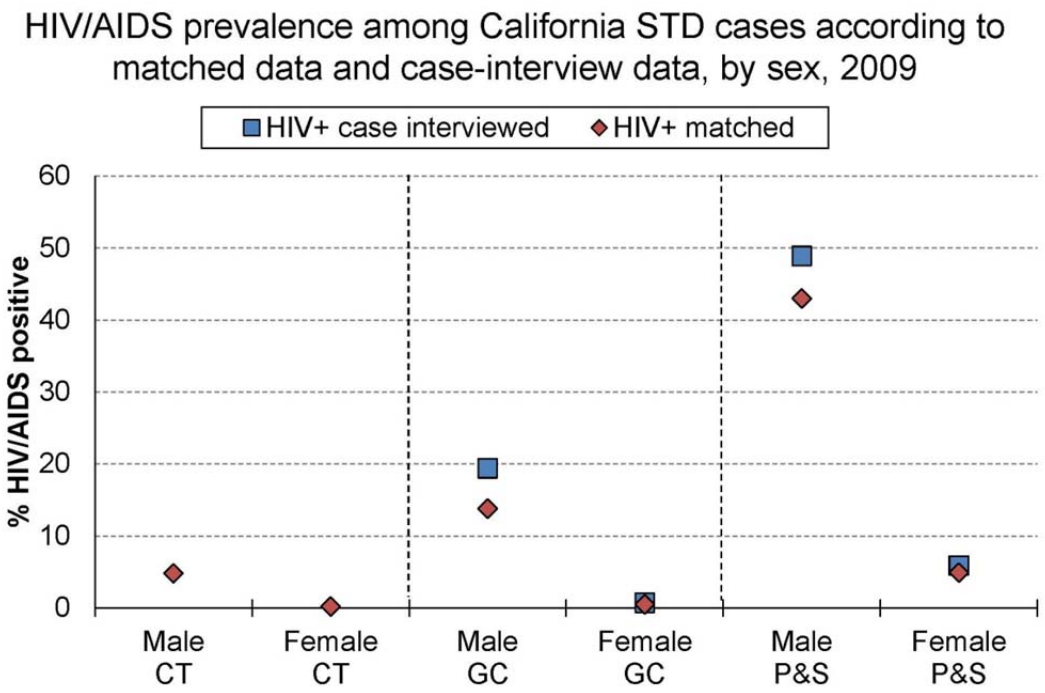
Prepared by California Department of Public Health.



CT = Chlamydia; GC = Gonorrhea; P&S = Primary and Secondary syphilis

- HIV prevalence was higher among males compared to females, for all three STDs.
- Among males, HIV prevalence among P&S syphilis cases was much higher than HIV prevalence among gonorrhea and chlamydia cases.

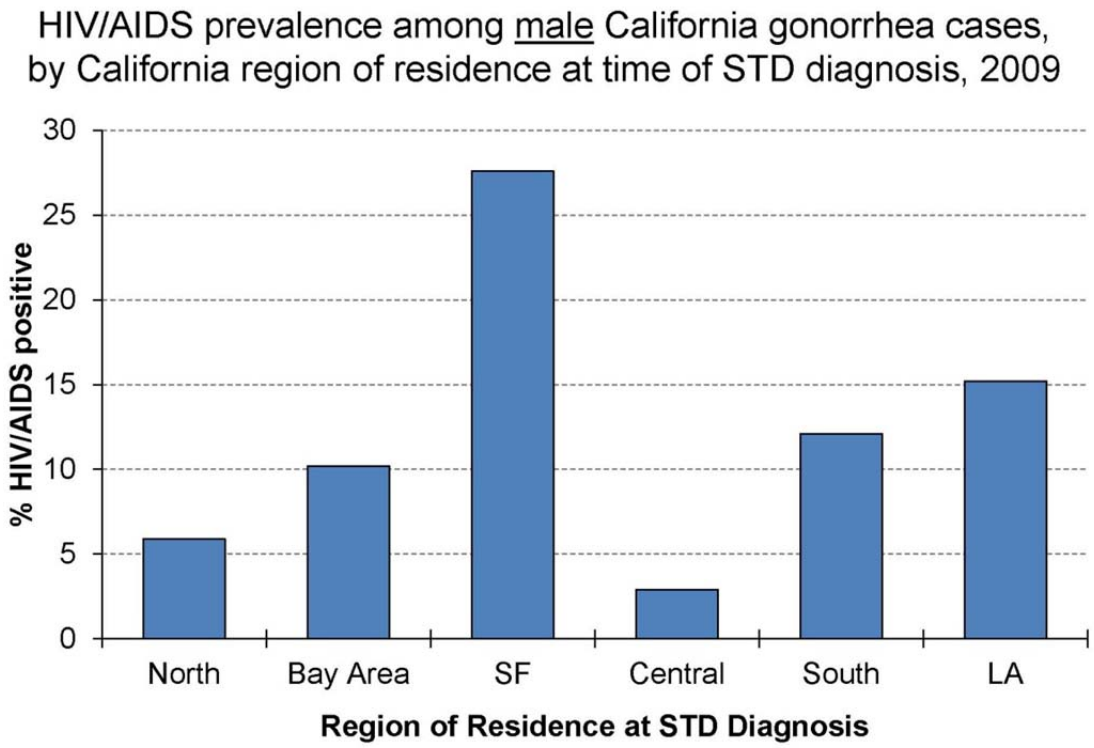
Prepared by California Department of Public Health.



CT = Chlamydia; GC = Gonorrhea; P&S = Primary and Secondary syphilis

- This graph compares HIV/AIDS prevalence estimated from our enhanced STD surveillance systems, with estimates from the matching algorithm. Enhanced surveillance for syphilis includes attempted interviews with all early syphilis cases in California, and includes questions regarding case self-reported HIV status. Enhanced surveillance for gonorrhea includes attempted interviews with a sample of gonorrhea cases in California, and also includes questions about case self-reported HIV status. No enhanced surveillance system currently exists for chlamydia.
- Among the STD cases, the percentage who were HIV-positive according to the matching algorithm (indicated by red diamonds) was lower than the percentage who were HIV-positive according to self-report in case-based enhanced surveillance (indicated by blue squares), for both gonorrhea and P&S syphilis.
- These data might help us detect target areas of HIV under-reporting in the HIV/AIDS Reporting System.

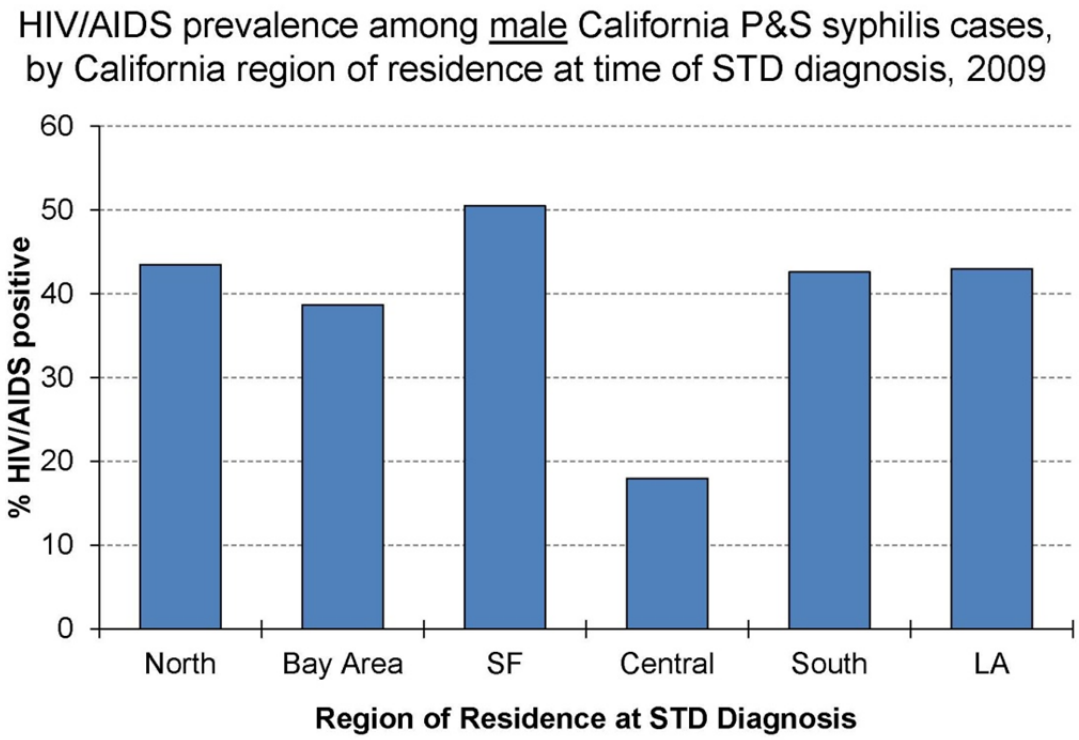
Prepared by California Department of Public Health.



SF = San Francisco; LA = Los Angeles

- This graph is stratified by region of residence at time of gonorrhea diagnosis.
- HIV/AIDS prevalence was much higher in San Francisco, at 28 percent, compared to other regions. Los Angeles was the next highest, at 15 percent.
- This pattern of HIV prevalence by regions reflects what is expected, based on the Office of AIDS surveillance data and other sources.

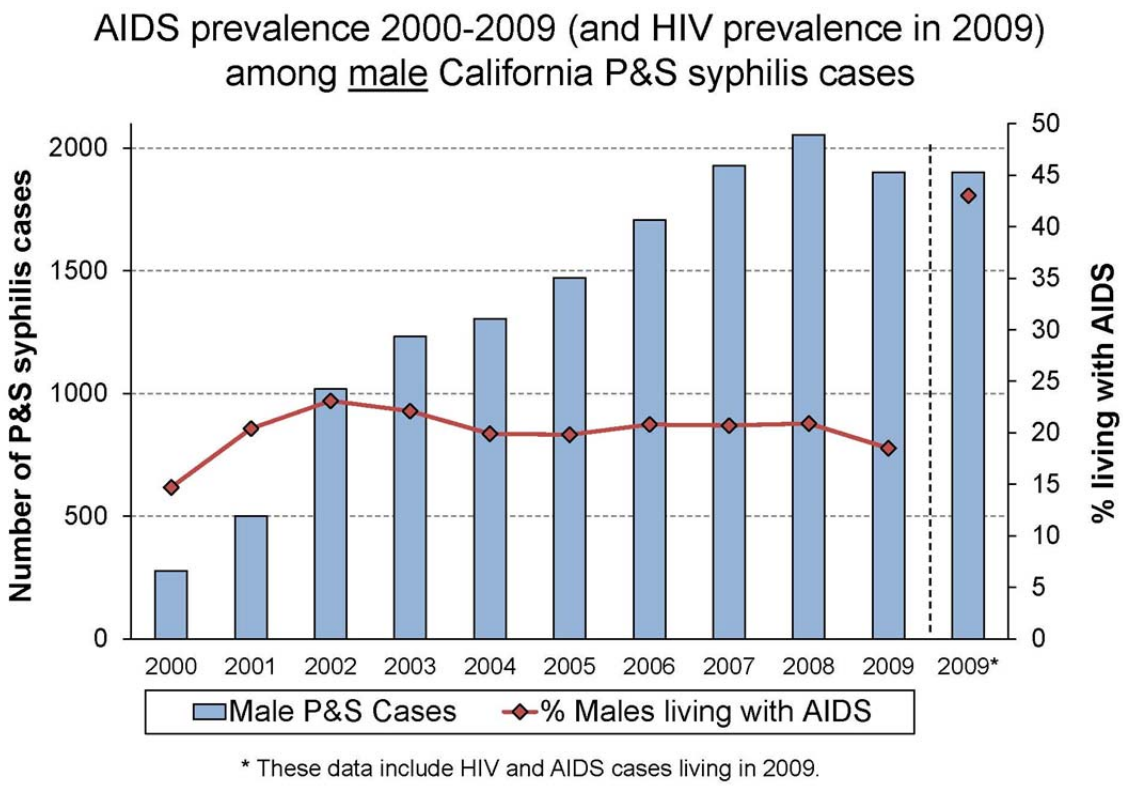
Prepared by California Department of Public Health.



P&S = Primary and Secondary; SF = San Francisco; LA = Los Angeles

- This graph is stratified by region of residence at time of syphilis diagnosis.
- HIV/AIDS prevalence was highest in San Francisco, at 50 percent; however, HIV/AIDS prevalence among syphilis cases was also elevated in other regions, especially when compared to the HIV/AIDS prevalence among gonorrhea cases in the previous figure.

Prepared by California Department of Public Health.



* These data include HIV and AIDS cases living in 2009.

P&S = Primary and Secondary

- This graph shows trend data from 2000 to 2009 regarding AIDS prevalence among P&S syphilis cases. HIV data did not become available until 2007, so a separate 2009 estimate is included for HIV/AIDS prevalence among P&S syphilis cases.
- From 2000 to 2008, the number of P&S syphilis cases rose dramatically, but the proportion of cases living with AIDS remained relatively steady over this time period.
- When HIV cases were included, the proportion of P&S syphilis cases living with HIV/AIDS was approximately twice as high as that of P&S syphilis cases living with AIDS alone.
- AIDS data is not as useful as HIV data, since it is an indicator of not just HIV infection but also of access to healthcare (since quality HIV therapy delays, perhaps indefinitely, the occurrence of an AIDS-defining condition). However, because name-based HIV reporting was only relatively recently introduced in California, the time trends in HIV diagnosis are not reliable, whereas the time trends in AIDS do provide a consistent series.

Prepared by California Department of Public Health.

Section 2. STD incidence among persons living with HIV/AIDS

Table 3. STD incidence among all persons living with HIV/AIDS in California, by demographic groups, males, 2009

NA/AN: Native American/ Alaska Native	Chlamydia			Gonorrhea			Primary and Secondary syphilis		
	Number living with HIV/AIDS	Number with STD	Percent STD	Number living with HIV/AIDS	Number with STD	Percent STD	Number living with HIV/AIDS	Number with STD	Percent STD
Total living with HIV/AIDS	98,972	2,068	2.1	98,972	1,798	1.8	98,972	812	0.8
Age group									
13-19	402	20	5.0	402	23	5.7	402	7	1.7
20-29	7,280	550	7.6	7,280	518	7.1	7,280	186	2.6
30-39	18,149	652	3.6	18,149	576	3.2	18,149	237	1.3
40-49	39,244	629	1.6	39,244	518	1.3	39,244	292	0.7
50-59	24,816	188	0.8	24,816	139	0.6	24,816	79	0.3
60+	8,975	29	0.3	8,975	24	0.3	8,975	11	0.1
Race/ethnicity									
Asian	3,328	82	2.5	3,328	71	2.1	3,328	37	1.1
Black	16,217	370	2.3	16,217	406	2.5	16,217	122	0.8
Hispanic	29,340	734	2.5	29,340	518	1.8	29,340	259	0.9
NA/AN	431	6	1.4	431	4	0.9	431	4	0.9
Other/Unknown	871	24	2.8	871	20	2.3	871	12	1.4
White	48,785	852	1.7	48,785	779	1.6	48,785	378	0.8
Region									
Northern	4,608	54	1.2	4,608	61	1.3	4,608	38	0.8
Bay Area	11,441	213	1.9	11,441	193	1.7	11,441	81	0.7
San Francisco	13,897	430	3.1	13,897	363	2.6	13,897	140	1.0
Central	2,246	21	0.9	2,246	18	0.8	2,246	6	0.3
Southern	25,418	408	1.6	25,418	355	1.4	25,418	191	0.8
Los Angeles	26,950	634	2.4	26,950	551	2.0	26,950	259	1.0

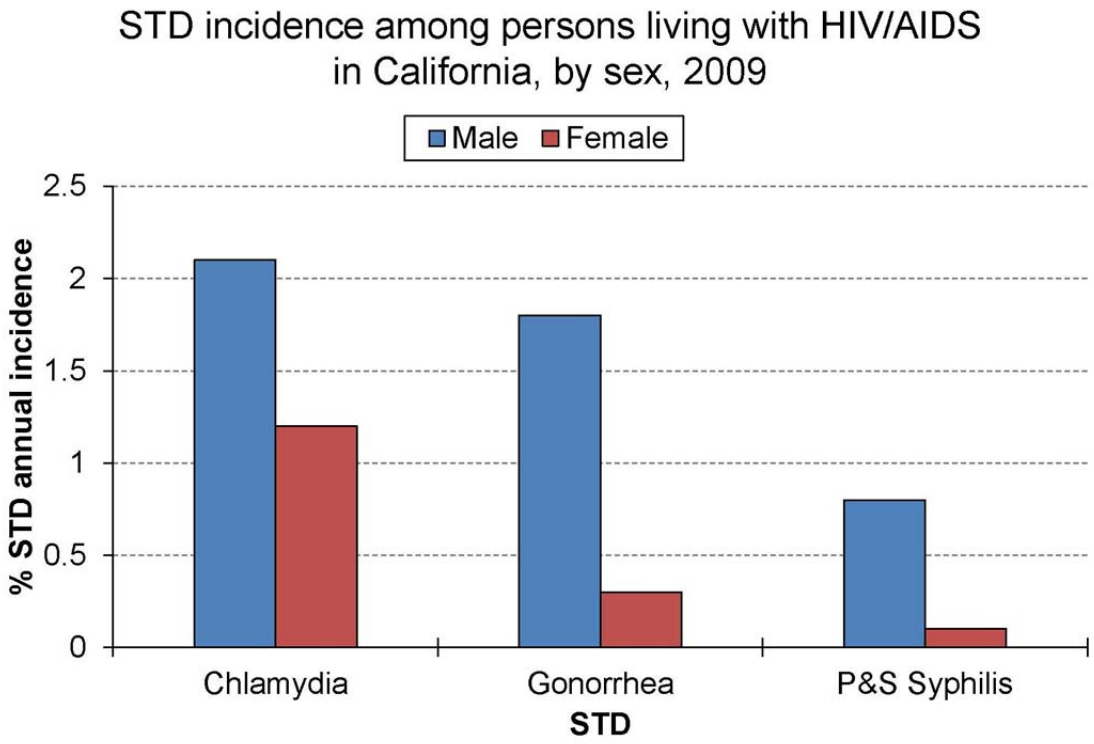
Prepared by California Department of Public Health.

Table 4. STD incidence among all persons living with HIV/AIDS in California, by demographic groups, females, 2009

NA/AN: Native American/ Alaska Native	Chlamydia			Gonorrhea			Primary and Secondary syphilis		
	Number living with HIV/AIDS	Number with STD	Percent STD	Number living with HIV/AIDS	Number with STD	Percent STD	Number living with HIV/AIDS	Number with STD	Percent STD
Total living with HIV/AIDS	13,492	160	1.2	13,492	43	0.3	13,492	8	0.1
Age group									
13-19	231	10	4.3	231	4	1.7	231	0	0
20-29	1,240	57	4.6	1,240	16	1.3	1,240	1	0.1
30-39	3,183	58	1.8	3,183	12	0.4	3,183	2	0.1
40-49	4,611	22	0.5	4,611	6	0.1	4,611	2	0
50-59	3,003	13	0.4	3,003	3	0.1	3,003	1	0
60+	1,116	0	0	1,116	2	0.2	1,116	2	0.2
Race/ethnicity									
Asian	522	4	0.8	522	0	0	522	0	0
Black	4,721	36	0.8	4,721	23	0.5	4,721	2	0
Hispanic	4,336	99	2.3	4,336	12	0.3	4,336	1	0
NA/AN	70	0	0	70	0	0	70	0	0
Other/Unknown	137	5	3.6	137	4	2.9	137	0	0
White	3,706	16	0.4	3,706	4	0.1	3,706	5	0.1
Region									
Northern	1,048	6	0.6	1,048	0	0	1,048	1	0.1
Bay Area	2,166	24	1.1	2,166	8	0.4	2,166	2	0.1
San Francisco	843	9	1.1	843	4	0.5	843	1	0.1
Central	610	6	1.0	610	2	0.3	610	0	0
Southern	3,153	38	1.2	3,153	5	0.2	3,153	0	0
Los Angeles	3,258	38	1.2	3,258	13	0.4	3,258	2	0.1

Prepared by California Department of Public Health.

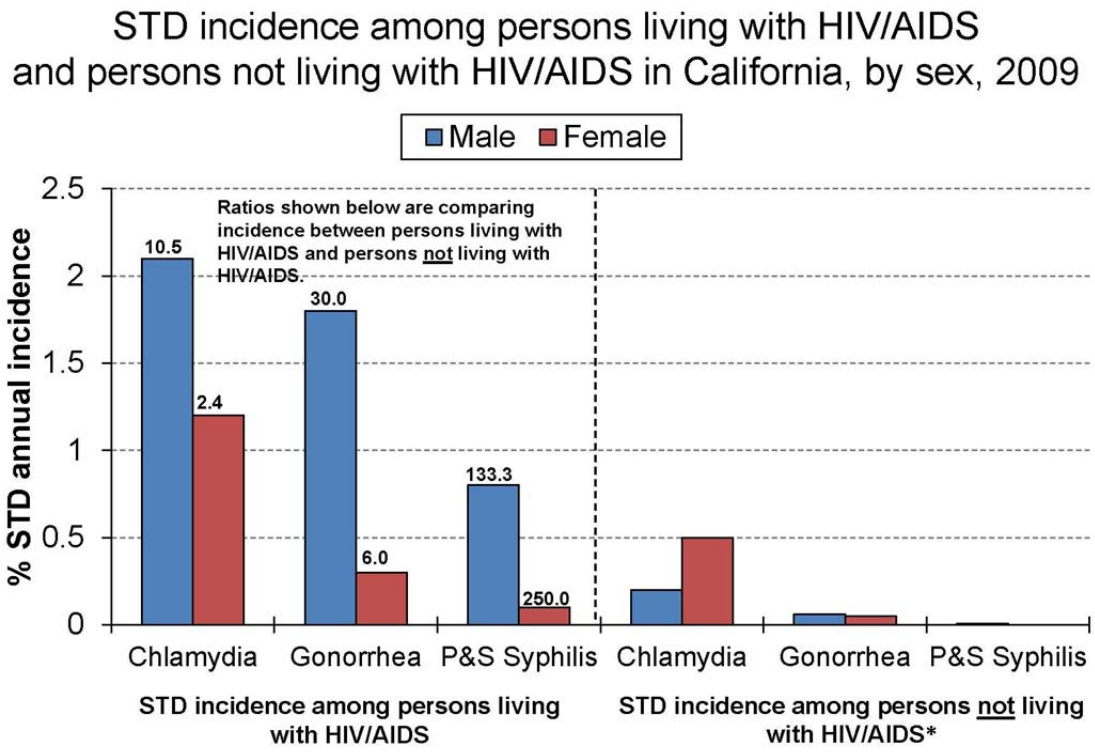
Selected Figures



P&S = Primary and Secondary

- Annual chlamydia and gonorrhea incidence among persons living with HIV/AIDS was higher than Primary and Secondary (P&S) syphilis incidence.
- Syphilis incidence was very low for females living with HIV/AIDS.
- The difference in chlamydia incidence between males and females was smaller than the differences by sex for gonorrhea or syphilis incidence.

Prepared by California Department of Public Health.

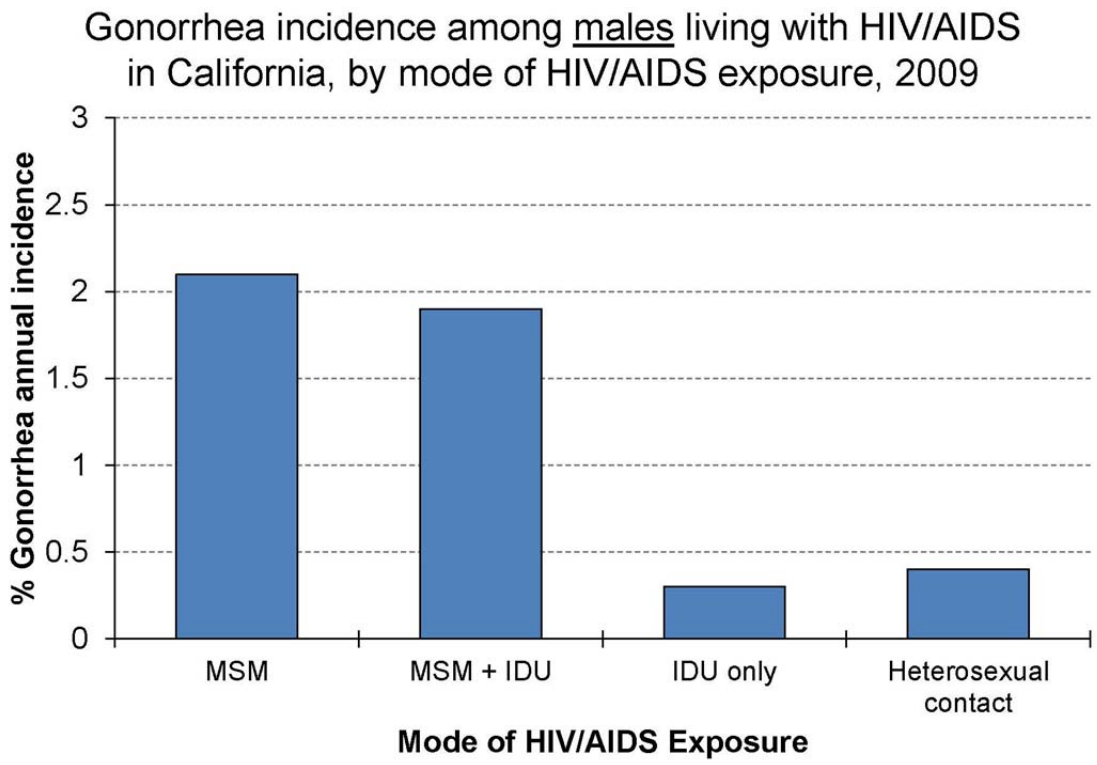


***Numerator is all STD cases, excluding those co-infected, denominator is the total population of California, excluding those living with HIV/AIDS.**

P&S = Primary and Secondary

- The incidence of all STDs in both sexes was higher among persons living with HIV/AIDS compared to persons not living with HIV/AIDS.
- In particular, the incidence of P&S syphilis was remarkably higher among persons living with HIV/AIDS compared to persons not living with HIV/AIDS, 133.3 and 250.0 times greater in males and females, respectively.

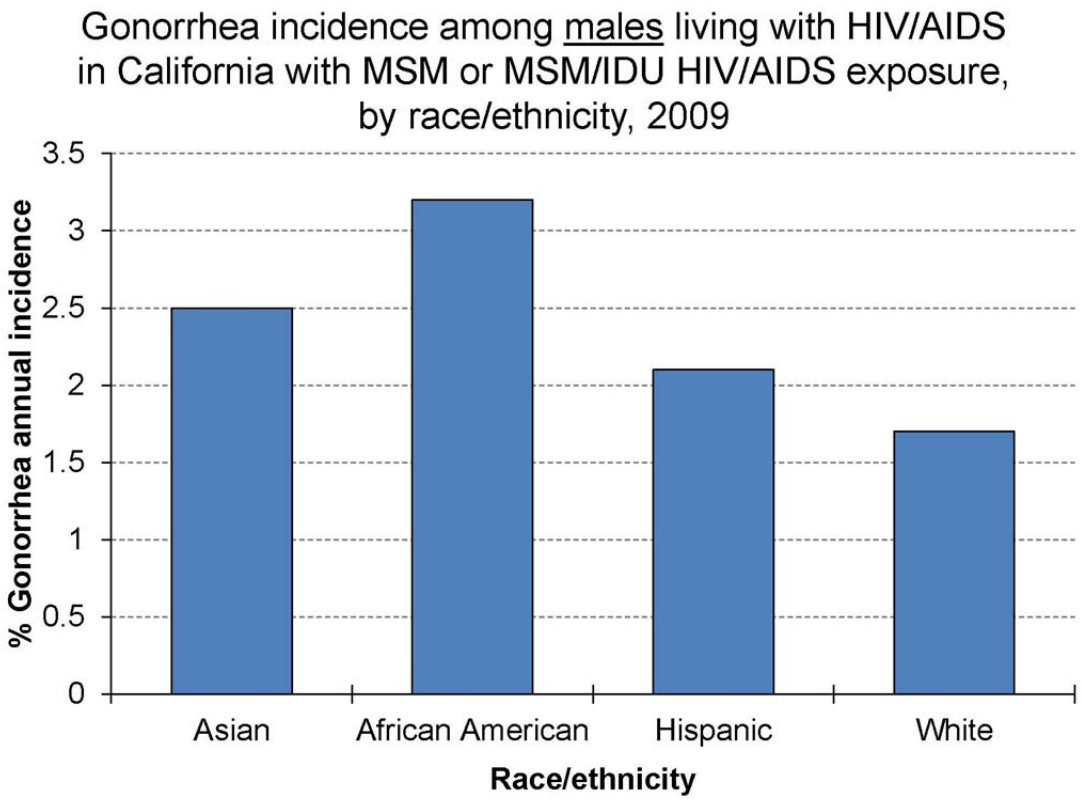
Prepared by California Department of Public Health.



MSM = men who have sex with men; IDU = injection drug use

- This graph shows gonorrhea incidence among males living with HIV/AIDS, stratified by mode of HIV/AIDS exposure.
- Gonorrhea incidence in 2009 was much higher among males living with HIV/AIDS whose HIV/AIDS mode of exposure was MSM or MSM plus injection drug use (IDU).
- Gonorrhea incidence was two percent among those groups, compared to 0.4 percent among those with only IDU or heterosexual contact as their mode of HIV/AIDS exposure.

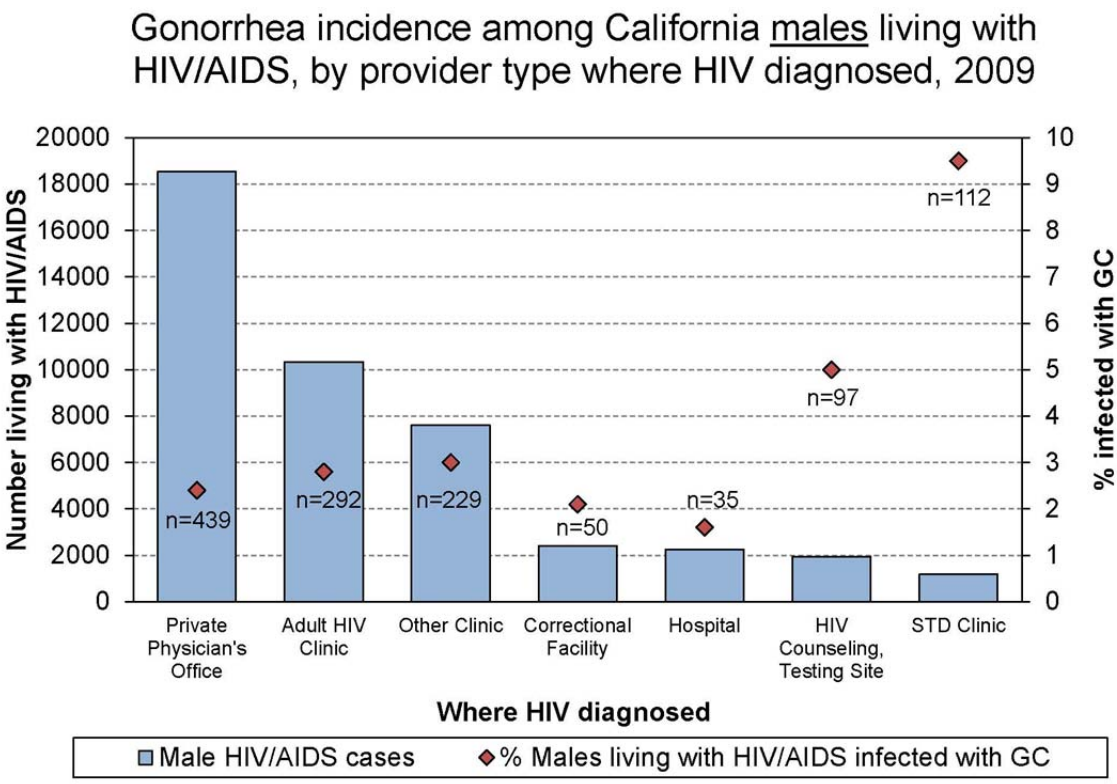
Prepared by California Department of Public Health.



MSM = men who have sex with men; IDU = injection drug use

- This graph shows gonorrhea incidence among males living with HIV/AIDS whose mode of exposure to HIV/AIDS was MSM or MSM/IDU, stratified by race/ethnicity.
- Gonorrhea incidence was higher among males who were African American compared to males of other racial/ethnic groups.
- While the gonorrhea incidence rate was somewhat higher among African Americans compared to Whites, the disparity was much lower than the statewide differential for gonorrhea cases overall, in which the incidence in 2009 among African Americans was approximately 12 times higher than among Whites.

Prepared by California Department of Public Health.



GC = Gonorrhea

- This graph shows the number of males living with HIV/AIDS in 2009, stratified by the clinical setting where HIV was diagnosed. In addition, the corresponding proportion of these males who were infected with gonorrhea in 2009 is shown on the secondary axis.
    - Note: The clinical setting of HIV diagnosis was recorded based on when the case was diagnosed, whereas the STD diagnosis occurred in 2009 and may not have occurred in the same clinical setting.
- While the majority of HIV/AIDS cases were diagnosed at private physicians' offices, the largest proportions of gonococcal co-infections occurred among those whose HIV diagnosis occurred at an STD Clinic.

Prepared by California Department of Public Health.

SUMMARY RESULTS/CONCLUSIONS

By using existing HIV/AIDS and STD databases along with straightforward matching algorithms, we were able to assess rates of and factors associated with HIV/AIDS and STD co-infection. These "value-added" data provide insight that should be used to inform future HIV and STD PCSI activities.

As noted in *Section 1*, high rates of HIV co-infection were observed among male P&S syphilis cases (43 percent) and male gonorrhea cases (14 percent) in 2009. HIV/AIDS prevalence was higher among male P&S syphilis cases than male gonorrhea or chlamydia cases. Additionally, HIV/AIDS prevalence across all STDs was highest among cases who were male, cases living in San Francisco, cases aged 40 to 49 years, and, for the most part, cases of White race/ethnicity.

The third figure in *Section 1* illustrates that by comparing HIV/AIDS prevalence among STD cases, using both those self-reported in the STD enhanced surveillance systems and those identified using the matching algorithm from the Office of AIDS registry, persons living with HIV/AIDS who have not been previously reported to the Office of AIDS may be identified.

From *Section 2*, key observations indicated that incident gonorrhea and chlamydia were higher than incident P&S syphilis among males living with HIV/AIDS. STD incidence among persons living with HIV/AIDS was highest among males, those aged 20 to 29 years, and those living in San Francisco. Gonorrhea incidence was highest among African American males. Chlamydia and P&S syphilis STD incidence were highest among persons of Asian or Hispanic race/ethnicity. Furthermore, incident gonorrhea was higher among African American males who were exposed to HIV/AIDS via MSM or MSM/IDU activity, compared to males of other racial/ethnic groups.

The second figure in *Section 2* highlights the striking differences in STD incidence among persons living with HIV/AIDS compared to those not living with HIV/AIDS. Given that HIV/AIDS and STDs share behavioral risk factors, this figure reiterates the importance of disease PCSI efforts when attempting to reduce morbidity.

Our results are subject to several limitations. There were data errors and incomplete records in both case registries, especially among STD case reports. Based on the matching procedures employed, small numbers of "false positives" and missed true matches most likely occurred. While these errors are unlikely to have a significant influence on the overall or key results, they may result in minor biases. In general, it is not possible to assess the direction of these biases with respect to all demographic or risk characteristics, but may be possible in some instances (e.g., comparison of the matched dataset to the syphilis interview data suggests, as has been suggested elsewhere, that a slight over-matching of Asians because of common Asian last names may have occurred). Also, this method of matching identifies only co-infected persons receiving care, who may differ from those not receiving care. Furthermore, the assumption that all persons living with HIV/AIDS who did not match to any STD cases

were STD-negative, and that persons diagnosed with an STD who did not match to any persons living with HIV/AIDS were HIV-negative almost certainly represents a bias in under-ascertainment of co-infection, but the magnitude of this bias cannot easily be determined.

Please contact Nicole Olson (Nicole.Olson@cdph.ca.gov) for additional data tables and charts from these analyses and/or with suggestions for new analyses of these data.

ACKNOWLEDGMENTS

The authors wish to acknowledge the work and collaboration of our partners at the CDPH Office of AIDS: Qiang Xia, Karen Mark, and Michelle Roland; our colleague in the CDPH STD Control Branch Epidemiology and Surveillance Section: Glenn Wright (formerly with CDPH); and our partner at the Washington Department of Health, Mark Stenger.

REFERENCES

1. Centers for Disease Control and Prevention. Program Collaboration and Service Integration: Enhancing the Prevention and Control of HIV/AIDS, Viral Hepatitis, Sexually Transmitted Diseases, and Tuberculosis in the United States. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2009.

2. Wasserheit JN. Epidemiological synergy. Interrelationships between human immunodeficiency virus infection and other sexually transmitted diseases. Sex Transm Dis. Mar-Apr 1992;19(2):61-77