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Trends in time spent viremic among persons newly diagnosed with HIV in San Francisco

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Abstract

Objective: To examine trends in time spent viremic and initiation into ART among persons newly diagnosed with HIV in San Francisco.

Methods: Using HIV surveillance data we included persons diagnosed with HIV during 2012–2020, a San Francisco resident at HIV diagnosis, alive 12 months after HIV diagnosis, and had ≥2 viral load tests within 12 months after diagnosis. Percent person-time spent (pPT) >200, pPT>1,500 , and pPT>10,000 copies/ml was calculated during the 12 months after HIV diagnosis. Multivariate regression models assessed year of diagnosis and time spent above each viral threshold and year of diagnosis and ART initiation within 0–7 days (rapid), 8–365 days (delayed), or no ART initiation.

Results: Of 2,471 new HIV diagnoses in San Francisco from 2012–2020, 1,921 (72%) were included. Newly diagnosed persons spent a mean of 40.4% pPT>200, 32.4% pPT>1,500, and 23.4% pPT>10,000 copies/ml; 33.8% had rapid ART initiation, 57.3% delayed, and 9% had no ART initiation. After adjustment, persons diagnosed in years 2014–2015, 2016–2017, 2018–2019, and 2020 were associated with less time spent above all viral thresholds and lower risk of delayed or no ART initiation compared to those diagnosed in 2012–2013. Greater time above thresholds correlated with injection drug use, ages 25–29 and 30–39 years, and homelessness.

Conclusions: Percent time spent above each viremic level decreased significantly, while rapid ART initiation increased among newly diagnosed persons from 2014 through 2020 compared to 2012–2013. Population differences in time spent unsuppressed highlight the need for targeted interventions to reduce new HIV infections and improve health.

Keywords

viral load; HIV care; HIV transmission; viremia; new HIV diagnoses

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Author Contributions

AH conceived of study hypothesis, methods, and wrote the first draft of the manuscript. AH and VN performed data analyses. VN conducted secondary analysis. All co-authors interpreted results, reviewed, and edited entire manuscript.

Conflicts of Interest

The authors have no conflicts of interest to disclose.

INTRODUCTION

Viral suppression for people living with HIV is beneficial for both the individual, by reducing morbidity and mortality, and at the population level, by reducing HIV transmission.[1,2] Persons newly diagnosed with HIV are at greater risk of transmitting HIV until they initiate antiretroviral treatment (ART) and achieve sustained viral suppression. Prior research on heterosexual HIV-serodiscordant couples indicate that risk of sexual HIV transmission is increased when HIV viral load is greater than 1,500 copies/ml and that sexual HIV transmission and viral load potentially follows a dose-response relationship.[3,4,5,6,7]

In 2014, the San Francisco city-wide and currently ongoing RAPID (Rapid ART Program Initiative for HIV Diagnoses) initiative to achieve the UNAIDS Getting to Zero goals was launched.[8,9] A key component of this initiative was the implementation of a program to provide antiretroviral therapy (ART) at the time of, or within five business days of diagnosis and thereby improve patient outcomes and reduce ongoing HIV transmission.[9] From 2012 through 2020, the number of new HIV diagnoses in San Francisco declined from 467 to 153, a 67% reduction.[10] During the same time period, viral suppression increased from 68% in 2012 to 80% in 2020 among persons newly diagnosed with HIV in San Francisco.[10,11] In these measures of viral suppression, the latest test in the first 12 months after diagnosis was used. More recently, Marks et. al. found that using a single viral load measurement overestimates viral suppression when compared to methods that capture all viral loads over a specified period of time.[12]

Using this new methodology, several studies among persons receiving HIV care documented sustained cumulative viral loads greater than 200, 1,500, and 10,000 copies/ml demonstrating substantial HIV transmission potential.[12,13,14,15,16] In a previous study of adults receiving HIV care in San Francisco from 2012 through 2014, we found that this population spent 12% of the time unsuppressed (viral load >200 copies/ml) and 7% transmissible (viral load >1,500 copies/ml).[14] Given that HIV transmission and virologic failure risk has been found to be greatest in the first 6 to 12 months after early initiation of ART, we expanded on our previous study to measure time spent unsuppressed and time spent transmissible among persons newly diagnosed with HIV in San Francisco including after the implementation of the RAPID initiative.[1,17] In addition, we compared time spent viremic and time to ART initiation by demographic and clinical factors to identify populations in greatest need of intervention to achieve sustained viral suppression.

METHODS

Study Population

Data from the San Francisco HIV surveillance registry was extracted to construct an analytic cohort. HIV is a reportable disease in California and the San Francisco Department of Public Health (SFDPH) receives all HIV-related laboratory tests, including positive HIV diagnostic tests, and subsequent HIV follow-up tests such as CD4 lymphocytes and HIV viral loads as mandated by California law (.[18] Demographic information, HIV risk history, health insurance status, residence and HIV testing results are captured at time of diagnosis

in a case report form.[10,19,20,21] We included persons diagnosed with HIV during 2012–2020, were San Francisco residents at time of diagnosis, alive 12 months after diagnosis, and had ≥2 viral load tests within 12 months after diagnosis. Date of HIV diagnosis was based on the earliest date of any of the following: positive HIV antibody test, positive HIV antigen/antibody combination test, detectable HIV viral load test, or physician-documented diagnosis in absence of laboratory evidence.

All viral load tests within 12 months of HIV diagnosis and the first CD4 lymphocyte count test on or after the date of diagnosis were extracted from the HIV surveillance registry.

Primary outcome: Viral Load Measures

Using previously described methods[12–14], consecutive viral load pairs were used to calculate percent of person-time (pPT) spent above 200 copies/ml (pPT>200), 1,500 copies/ml (pPT>1,500) and 10,000 copies/ml (pPT>10,000) during the 12 months after HIV diagnosis. Viral load values from the date of diagnosis to 365 days later were used to calculate viral outcome measures. The one-year follow-up period was divided into time segments using all consecutive viral load pairs. If both viral load values were above/below the viral threshold within each segment, it was assumed all days in the segment were also above/below the threshold. The difference between two viral load values and the time in days of the segment were used to calculate a rate of viral load change over time in instances where a segment contained one value above the viral threshold and one value below the threshold. This rate was used to calculate how many days in the segment were spent above the viral threshold. A linear rate of change was assumed between two viral load pairs. The time spent above the threshold for each segment was summed across all observed segments to yield a single measurement for each individual. The percentage of time spent above each viral threshold was calculated by dividing the number of days spent above by the total time observed (see figure, Supplemental Digital Content 1). If an individual did not have a viral load measure on the date of HIV diagnosis, the first viral load after diagnosis was used as the beginning of the observation period, and the last viral load test in the 12-month follow-up was used as the end of the observation period.

Secondary Outcome: ART Initiation

Our secondary outcome was time in days from HIV diagnosis to ART initiation categorized as rapid (0–7 days), delayed (8–365 days), or no ART initiation within the one year after diagnosis. Use of ART was collected at the time of initial case report and updated through subsequent chart review.

Covariates

Covariates for both viral and ART initiation outcomes were determined a priori and included: gender (cis men, cis women, trans women), HIV transmission category (MSM, people who inject drugs (PWID), MSM-PWID, heterosexual and other/unidentified), race/ethnicity (White, Black/African American, Hispanic/Latino, Asian/Pacific Islander, Multiracial/Other), age at diagnosis, housing status (homeless or housed), and health insurance type (public, private, no insurance, unknown). For the secondary outcome, first CD4+ count after diagnosis was also included. Homelessness was defined as living on the

street, in a shelter or car at time of diagnosis. All others were considered housed including persons with an unknown housing status. Transmission category is ascertained by self-report to diagnosing provider and extracted from the case report or chart review for information on sexual contact, gender of sex partners and injection drug use at any time before the date of diagnosis. All covariates were extracted from the HIV surveillance registry.

Data analysis

Chi-square tests examined potential differences between those included and excluded from analysis. For primary outcome, the Cochran Armitage test for trend was used to assess the bivariate relationship between year of HIV diagnosis and time spent viremic at the three thresholds. Mean percentage time spent above each of the viral thresholds was stratified by covariates. Multivariate zero-inflated negative binomial regression models were used to assess relationship between categorized year of diagnosis (2012 −2013, 2014–2015, 2016–2017, 2018–2019, 2020) and days spent above each viral threshold in the 12 months after diagnosis (relative to number of days observed), while controlling for the following covariates: gender, transmission category, race/ethnicity, age, housing status, and health insurance type. For secondary outcome, chi-square tests examined associations between covariates and ART initiation. Crude and adjusted odds ratios were computed using simple binary and multivariable multinomial logistic regression models between categorized year of diagnosis and covariates on ART initiation. Covariates for secondary outcome were the same as those for the primary outcome with the addition of CD4 count.

All analyses were conducted in SAS v9.4.

RESULTS

Of 2,471 persons newly diagnosed with HIV in San Francisco from 2012–2020, 1,921 (72%) met inclusion criteria for analysis (see diagram, Supplemental Digital Content 2). Included and excluded cases did not differ by gender. Included cases were statistically significantly more likely to be heterosexual, white and aged 50 years or older, while excluded cases were more likely to be aged less than 30 years, homeless, missing a CD4 count, lacking or missing health insurance, and not known to have initiated ART within 12 months of diagnosis ($p<0.003$; data not shown).

The study population was predominately cis men (89.0%), MSM (72.1%), white (40.8%), aged 30–39 years at the time of HIV diagnosis (32.0%), housed at diagnosis (89.1%), and had high CD4 cell counts at diagnosis (35.5% ≥ 500 cells/μl) and public (30.4%) or private (38.8%) insurance (Table 1).

Primary Outcome: Viral Load Measures

Persons newly diagnosed with HIV had a median of 4 viral load labs (IQR: 3–5 viral load labs) for the calculation of viral load outcome measures during the 1 year after diagnosis. The median number of days from diagnosis to first viral load lab was 6 days (IQR: 1–16 days), while the median number of days from diagnosis to last viral load lab was 287 days (IQR: 217–330 days). The median follow-up time was 269 days (IQR: 184–315 days) and the median number of days between viral load pairs was 63 days (32–104 days).

Overall, persons spent 40.4% pPT>200 copies/ml, 32.4% pPT>1,500 copies/ml, and 23.4% pPT>10,000 copies/ml. Women and trans women, PWID and MSM-PWID, and persons who identified as multiracial or other/unknown race spent more time viremic compared to men, persons without a history of injection drug use, and persons with single reported race or ethnicity, respectively (Table 1). Persons who were housed and had private insurance spent less time viremic compared to those who were homeless and uninsured, had public insurance, or had no data on insurance, respectively.

The pPT for all three thresholds decreased from 2012 through 2020 ($p<0.001$ Cochran-Armitage test for trend; Figure 1). However, there was an increase in the proportion of time spent viremic and above the transmissible thresholds beginning in 2017 relative to the nadir in pPT above the thresholds observed in 2016 ($p<0.05$ Cochran-Armitage test for trend).

In the multivariate models, significant differences for all three viral thresholds were found by transmission category, age, and housing status (Table 2). PWID, MSM-PWID, ages 25–29 and 30–39 years, and homelessness were associated with increased time spent above the three thresholds. Persons diagnosed in years 2014–2015, 2016–2017, 2018–2019, and 2020 were associated with less time spent above all three viral thresholds compared to those diagnosed in years 2012–2013. Less time spent >1,500 and >10,000 copies/ml was correlated with Asian/Pacific Islander race (aRR=0.85 and 0.81, respectively).

Secondary Outcome: ART Initiation

Among 1,921 newly diagnosed HIV cases in the study, 33.8% had rapid initiation of ART within 7 days of diagnosis, 57.3% had delayed initiation (8–365 days), and 9% were not known to have initiated ART during the 1 year after diagnosis (Table 3). Rapid ART initiation increased from 9.4% of cases diagnosed in years 2012–2013 to 70.2% in 2020 (70.2%), while delayed ART initiation decreased from 79.3% of cases to 15.8% (p-value < 0.001). The percentage of cases with no ART initiation was highest in 2012–2013 (11.3%) and 2020 (14.3%).

The risk of delayed or no ART initiation versus rapid ART initiation was lower for persons diagnosed in years 2014–2015, 2016–2017, 2018–2019, and 2020 compared to 2012–2013 in both crude and adjusted models (Table 4). Females were more likely than males to have delayed ART initiation (aOR=1.84), while Hispanic/Latinos were less likely than Whites to have delayed (aOR=0.66) or no ART initiation (aOR=0.50) compared to rapid ART initiation. Persons with missing CD4 count were at higher risk (aOR=3.29) than those with CD4 count ≥ 500 cells/μl for no ART initiation, while persons with CD4 count between 0–199 cells/μl were at lower risk (aOR=0.31). The risk of delayed (aOR=1.70) or no ART initiation (aOR=2.03) versus rapid ART initiation was higher for persons with unknown insurance status compared to those with public insurance.

DISCUSSION

We found that persons newly diagnosed with HIV in San Francisco spent considerable time with viral loads above 200, 1,500, and 10,000 copies/ml. The percent time above these

thresholds in our population is higher than some other studies of persons in care, although these studies were conducted prior to 2016, making direct comparison difficult.[12–16]

In our study, the mean percent time spent above each viremic threshold decreased from 2012 through 2020. The nadir in time spent viremic was reached in 2016, two years following the implementation of rapid ART interventions. In the multivariate analysis, we found persons spent less time spent above all three viral thresholds and were less likely to have delayed or no ART initiation in later diagnosis years compared to years 2012–2013, providing support for the effectiveness of San Francisco's RAPID program in 2014 to provide ART within a week and further evidence that increases in rapid ART initiation resulted in decreases in time spent unsuppressed or able to transmit HIV as expected.[10,22] In addition, the decrease in time spent with viral loads above 1,500 and 10,000 copies/ml, along with other care and prevention interventions, likely contributed to the decrease in new HIV diagnoses in recent years.[10]

Although the time spent viremic and at risk for transmission declined, the percent of time spent above 1,500 and 10,000 copies/ml remains high. In 2020, based on pPT ≥1500 of 29.1% for the year, newly diagnosed persons spent, on average, 106 days at risk of transmitting HIV. Also concerning is our finding of the significant increase in mean time spent viremic and at viral load levels with transmission potential after 2016 (Cochran Armitage test for trend $p < 0.05$ for all thresholds; data not shown). The reasons for the increase are not known but may reflect changes in care and ART use. In San Francisco, the proportion of persons who entered care within one month of diagnosis and remained in care 3–9 months later increased from 2012 (63%) to 2016 (71%) but declined to 64% in 2017 and was 65% in 2020 which may translate to inconsistent use of ART in more recent years.[10,23] We also found that despite the increase in the proportion of newly diagnosed persons who initiated ART within seven days of diagnosis over the study period, the proportion of cases who did not initiate ART in the first year following diagnosis increased from 7% in 2016–2017 to 14% in 2020.[10] Although these percentages are relatively small, the most likely drivers of increases in viral loads are those who are not on ART and, who may have a disproportionate impact on the time spent unsuppressed and at viral levels above the transmission thresholds in the study population.

We also found that less time spent above 10,000 copies/ml was associated with Asian/Pacific Islander race compared to Whites, although in our secondary multivariate analysis, Asian/Pacific Islanders were not less likely than Whites to have delayed or no ART initiation. We could not compare this finding to other similar studies because Asians and Pacific Islanders were included with other races[12–14,16], but in one of these studies, persons of 'other race,' which likely would have included Asians and Pacific Islanders, were associated with less time viremic.[16] Furthermore, we found Latinos were less likely to have delayed or no ART initiation but were not associated with less time spent above the viral thresholds compared to Whites. Another study also reported Latinos were more likely to start ART early (within one month) compared to Whites.[24] While Latinos may be likely to initiate ART early, other studies have noted barriers to retention in care and ART adherence in this population related to health literacy, unmet needs for ancillary services, HIV-related stigma, self-efficacy, and patient-provider trust, hindering viral suppression over time.[25,26]

We, and others, have previously found that vulnerable populations spent disproportionately more time viremic.[12–16] In the multivariable analysis, PWID (including MSM), those aged 25–29 years or 30–39 years, or were homeless experienced longer periods unsuppressed and at risk for transmission. Several studies have reported that PWID, PWID-MSM , younger persons , and homeless persons spent more time viremic compared to other transmission groups, older, and housed persons.[12–15,27] Although these subpopulations were not associated with delayed or no ART initiation in our secondary analysis, others have shown they have lower rates of retention in care and thus adherence to ART[28–30] which is likely a contributing factor for our findings. Furthermore, while the number of new HIV diagnoses decreased in recent years including among vulnerable subpopulations, some groups such as PWID saw smaller decreases in new diagnoses over time compared to MSM.[10] Given the numerous studies that have documented sociodemographic and behavioral disparities in HIV health outcomes, it is time to broaden efforts to ensure equitable access to and utilization of care required in addressing social determinants of health, such as housing, which underlie the disparities we and others have measured.[31,32]

Furthermore, we found that ART was more often prescribed within one week in patients with lower CD4 counts compared to those with CD4 counts of 500 cells/μl. Typically, those with acute infection (e.g. CD4 counts <200) are prioritized for ART treatment, including in San Francisco's RAPID program that stipulates acute cases begin ART within 48 hours.[33]

Our findings are subject to several limitations. First, among those newly diagnosed with HIV in San Francisco during the study period, 28% were excluded from analysis because they had fewer than two viral loads in the 12 months after diagnosis. This includes people who were not in care or did not receive consistent care. Therefore, our results likely underestimate time spent viremic among all newly diagnosed persons in San Francisco. These individuals are also not represented in the no ART initiation group in our secondary analysis, although the proportion of people not initiating ART by year of diagnosis is similar to that reported in the HIV Epidemiology Report 2021[10] based on overall surveillance data. Vulnerable populations such as those experiencing homelessness, lacking health insurance, and those under 30 years of age were more likely to be excluded from analysis, indicating that the adjusted rate ratios in our results are likely biased towards the null. Second, we were unable to examine time spent viremic after HIV acquisition but prior to diagnosis because we only had information following diagnosis and entry into the surveillance registry. Third, the outcomes of pPT spent over each viral threshold are subject to misclassification. A linear relationship between consecutive viral load pairs was assumed, which may not always be the case. The estimated time spent viremic may be less accurate if there is a longer time interval between consecutive viral load pairs, or the outcome may be misclassified for persons who dropped out of HIV care. However, given that individuals in the study had a median of 4 viral labs (IQR: 3–5 labs) during the 12-month period and only the first 12 months after HIV diagnosis was assessed, the possibility of having a long time in between viral loads or dropping out of care is lower than if individuals had fewer number of viral labs or were followed for a longer observation time. Fourth, test results and ART use may have been underreported because surveillance staff do not have access to a few small clinical sites and some research studies do not consistently report laboratory results. Lastly, it's possible that there was unmeasured confounding. For instance, we were only able to

include ART prescription and not actual adherence to ART. We also were not able to assess additional factors that may contribute to viral suppression, such as employment status or social support, because this data is not collected through HIV case reporting. And finally, the association between HIV viral load and transmission has been primarily focused on heterosexual populations[3,4,5,6,7] and not on other populations such as MSM and PWID, who make up the majority of people living with or at risk for HIV in San Francisco. Therefore, it is possible that the association found between HIV viral load and transmission among heterosexuals may be different than other populations. Nevertheless, we found that new HIV diagnoses decreased in recent years including among MSM and PWID, and while further examination among these populations is warranted, we expect the association is similar to that found among heterosexuals.

In conclusion, we found that time spent above each viral level decreased significantly among newly diagnosed persons in years 2014 through 2020 compared to 2012–2013. The decline in the amount of time spent viremic occurred in the setting of a citywide effort to rapidly get newly diagnosed persons into care and on ART, to follow up with patients with inconsistent care, andoffer pre-exposure prophylaxis to those at risk of infection. Evaluation of these programs have shown success[34,35] and these efforts, combined with the decline in time spent viremic, has resulted in a significant decline in new diagnoses. As such, these findings further indicate that San Francisco and other jurisdictions nationwide should prioritize regular HIV testing, rapid uptake of ART and retention in HIV care, particularly in vulnerable groups, in order to decrease HIV-related morbidity and mortality, and HIV transmission.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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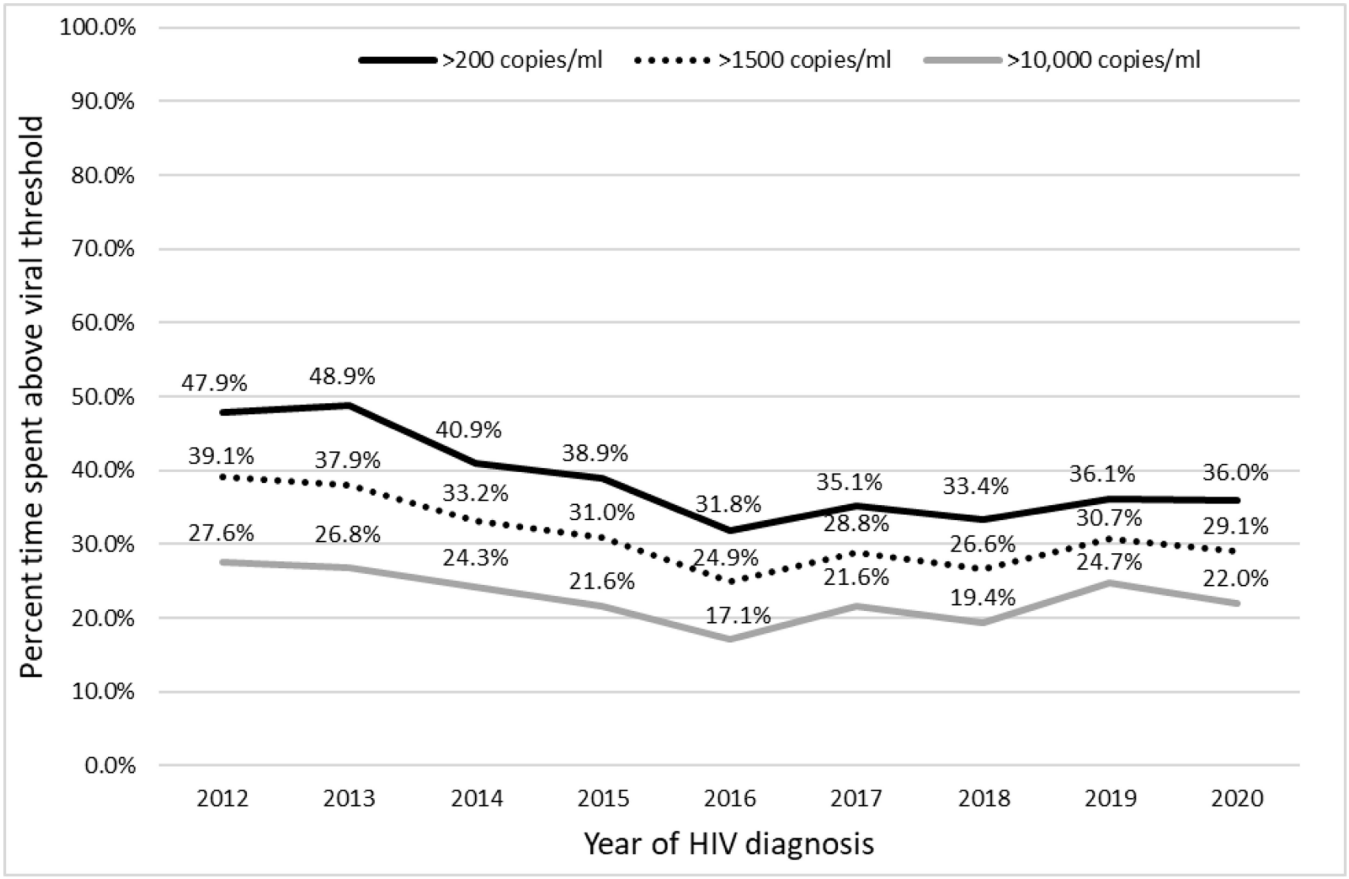

FIGURE 1:

Percent time spent below or above a viral threshold during 12 months after HIV diagnosis by year of HIV diagnosis, San Francisco, California, 2012–2020.

The Cochran Armitage test for trend was statistically significant for each of the three thresholds (p-value < 0.0001 for thresholds ≤200 copies/ml, >200 copies/ml and >1500 copies/ml, p-value = 0.0002 for threshold >10,000 copies/ml).

Table 1:

Characteristics and mean percent time spent above viral thresholds of persons newly diagnosed with HIV, San Francisco, California, 2012–2020.

Characteristic	n	%	Mean % time >200 copies/ml	Mean % time >1500 copies/ml	Mean % time >10,000 copies/ml
Total	**1921**	**100%**	**40.4%**	**32.4%**	**23.4%**
Year of HIV diagnosis					
2012 – 2013	618	17.7%	48.3%	38.6%	27.3%
2014 – 2015	474	12.7%	40.0%	32.1%	23.0%
2016 – 2017	385	10.4%	33.3%	26.7%	19.2%
2018 – 2019	330	9.3%	34.6%	28.4%	21.8%
2020	114	5.9%	36.0%	29.1%	22.0%
Gender					
Male *(reference)*	1709	89.0%	39.4%	31.7%	23.2%
Female	153	8.0%	47.4%	36.4%	23.7%
Trans female	59	3.1%	50.3%	42.7%	29.2%
Transmission category					
MSM *(reference)*	1384	72.1%	36.8%	29.1%	20.7%
PWID	132	6.9%	54.6%	44.8%	32.5%
MSM-PWID	231	12.0%	55.2%	47.6%	37.1%
Heterosexual	120	6.3%	39.1%	29.7%	19.5%
Other/Unidentified	54	2.8%	38.3%	29.7%	22.3%
Race/Ethnicity					
White *(reference)*	783	40.8%	40.6%	33.2%	24.8%
Black or African American	251	13.1%	42.6%	33.4%	22.1%
Hispanic or Latino	562	29.3%	40.2%	31.9%	23.2%
Asian/Pacific Islander	233	12.1%	33.8%	25.9%	17.7%
Multiracial/Other/Unknown	92	4.8%	50.3%	43.3%	31.1%
Age at HIV diagnosis					
16–24 years	214	11.1%	39.9%	30.7%	20.8%
25–29 years	334	17.4%	40.9%	32.7%	23.7%
30–39 years	614	32.0%	41.8%	34.1%	24.8%
40–49 years	441	23.0%	39.9%	32.3%	23.2%
50+ years *(reference)*	318	16.6%	38.0%	30.4%	22.5%
Housing Status at HIV diagnosis					
Housed *(reference)*	1711	89.1%	38.1%	30.5%	22.1%
Homeless	210	10.9%	58.3%	48.1%	33.9%
Insurance at HIV diagnosis					
Public *(reference)*	583	30.4%	44.1%	35.5%	25.5%
Private	745	38.8%	37.2%	29.3%	21.5%
None	444	23.1%	41.0%	33.7%	24.0%
Missing	149	7.8%	40.1%	32.7%	23.5%

Table 2:

Adjusted rate ratios (RR) for time spent above three viral thresholds for persons newly diagnosed with HIV, San Francisco, California, 2012–2020.

	>200 copies/ml	>1500 copies/ml	>10,000 copies/ml
Characteristic	**Adjusted RR (95% CI)**	**Adjusted RR (95% CI)**	**Adjusted RR (95% CI)**
Year of HIV diagnosis			
2012 – 2013 (reference)	ref	ref	ref
2014 – 2015	**0.82 (0.75, 0.90)**	**0.85 (0.76, 0.94)**	**0.81 (0.72, 0.92)**
2016 – 2017	**0.71 (0.64, 0.79)**	**0.73 (0.65, 0.82)**	**0.73 (0.63, 0.83)**
2018 – 2019	**0.66 (0.59, 0.73)**	**0.68 (0.60, 0.77)**	**0.66 (0.58, 0.76)**
2020	**0.77 (0.66, 0.91)**	**0.80 (0.66, 0.95)**	**0.77 (0.62, 0.94)**
Gender			
Male *(reference)*	ref	ref	ref
Female	1.10 (0.92, 1.32)	1.11 (0.90, 1.36)	1.13 (0.88, 1.45)
Trans female	1.16 (0.95, 1.43)	1.21 (0.96, 1.53)	1.20 (0.90, 1.59)
Transmission category			
MSM *(reference)*	ref	ref	ref
PWID	**1.24 (1.05, 1.47)**	**1.26 (1.04, 1.54)**	**1.38 (1.09, 1.73)**
MSM-PWID	**1.31 (1.17, 1.47)**	**1.39 (1.22, 1.58)**	**1.48 (1.28, 1.72)**
Heterosexual	0.96 (0.79, 1.16)	0.90 (0.73, 1.12)	0.93 (0.71, 1.20)
Other/Unidentified	1.09 (0.87, 1.37)	1.18 (0.90, 1.55)	1.29 (0.95, 1.77)
Race/Ethnicity			
White *(reference)*	ref	ref	ref
Black or African American	1.01 (0.90, 1.13)	0.99 (0.87, 1.13)	0.98 (0.83, 1.15)
Hispanic or Latino	1.00 (0.91, 1.09)	0.97 (0.88, 1.07)	0.96 (0.85, 1.08)
Asian/Pacific Islander	0.91 (0.81, 1.02)	**0.85 (0.74, 0.97)**	**0.81 (0.69, 0.94)**
Multiracial/Other/Unknown	1.16 (0.98, 1.37)	1.12 (0.93, 1.36)	1.07 (0.86, 1.33)
Age at HIV diagnosis			
16–24 years	1.09 (0.95, 1.26)	1.10 (0.94, 1.28)	1.08 (0.90, 1.30)
25–29 years	**1.20 (1.06, 1.36)**	**1.26 (1.09, 1.45)**	**1.27 (1.08, 1.50)**
30–39 years	**1.13 (1.01, 1.26)**	**1.17 (1.03, 1.32)**	**1.19 (1.04, 1.38)**
40–49 years	1.08 (0.96, 1.21)	1.11 (0.97, 1.26)	1.12 (0.97, 1.30)
50+ years *(reference)*	ref	ref	ref
Housing Status at HIV diagnosis			
Housed *(reference)*	ref	ref	ref
Homeless	**1.36 (1.20, 1.54)**	**1.34 (1.16, 1.54)**	**1.27 (1.08, 1.50)**
Insurance at HIV diagnosis			
Public *(reference)*	ref	ref	ref
Private	0.95 (0.87, 1.05)	0.95 (0.85, 1.05)	0.88 (0.78, 1.00)
None	0.92 (0.83, 1.02)	0.93 (0.83, 1.04)	0.89 (0.77, 1.02)
Missing	1.03 (0.89, 1.19)	1.01 (0.86, 1.19)	0.95 (0.78, 1.15)

Table 3:

Characteristics and rapid, delayed or no ART Initiation for persons newly diagnosed with HIV, San Francisco, California, 2012–2020.

	All		Rapid ART Initiation (0–7 Days)		Delayed ART Initiation (8–365 Days)		No ART Initiation		Chi-Square P-value
Characteristic	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	
Total	**1921**	**100.0%**	**649**	**100.0%**	**1100**	**100.0%**	**172**	**100.0%**	
Year of HIV diagnosis									
2012 – 2013	618	32.2%	58	8.9%	490	44.6%	70	40.7%	
2014 – 2015	474	24.7%	116	17.9%	321	29.2%	37	21.5%	
2016 – 2017	385	20.0%	170	26.2%	188	17.1%	27	15.7%	<0.001
2018 – 2019	330	17.2%	225	34.7%	83	7.6%	22	12.8%	
2020	114	5.9%	80	12.3%	18	1.6%	16	9.3%	
Gender									
Male	1709	89.0%	576	88.8%	985	89.6%	148	86.1%	
Female	153	8.0%	51	7.9%	85	7.7%	17	9.9%	0.701
Trans female	59	3.1%	22	3.4%	30	2.7%	7	4.1%	
Transmission category									
MSM	1384	72.0%	456	70.3%	811	73.7%	117	68.0%	
PWID	132	6.9%	41	6.3%	72	6.6%	19	11.1%	
MSM-PWID	231	12.0%	75	11.6%	133	12.1%	23	13.4%	0.046
Heterosexual	120	6.2%	49	7.6%	62	5.6%	9	5.2%	
Other/Unidentified	54	2.8%	28	4.3%	22	2.0%	4	2.3%	
Race/Ethnicity									
White	783	40.8%	212	32.7%	501	45.6%	70	40.7%	
Black or African American	251	13.1%	93	14.3%	123	11.2%	35	20.4%	
Hispanic or Latino	562	29.3%	235	36.2%	293	26.6%	34	19.8%	<0.001
Asian/Pacific Islander	233	12.1%	76	11.7%	130	11.8%	27	15.7%	
Multiracial/Other/Unknown	92	4.8%	33	5.1%	53	4.8%	6	3.5%	
Age at HIV diagnosis									
16–24 years	214	11.1%	77	11.9%	118	10.7%	19	11.1%	
25–29 years	334	17.4%	111	17.1%	195	17.7%	28	16.3%	0.905
30–39 years	614	32.0%	210	32.4%	349	31.7%	55	32.0%	

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Characteristic	All		Rapid ART Initiation (0–7 Days)		Delayed ART Initiation (8–365 Days)		No ART Initiation		Chi-Square P-value
	n	%	n	%	n	%	n	%	
40–49 years	441	23.0%	137	21.1%	265	24.1%	39	22.7%	
50+ years	318	16.6%	114	17.6%	173	15.7%	31	18.0%	
Housing Status at HIV diagnosis									
Housed	1711	89.1%	572	88.1%	995	90.5%	144	83.7%	0.026
Homeless	210	10.9%	77	11.9%	105	9.6%	28	16.3%	
CD4 count closest to HIV diagnosis									
Missing	130	6.8%	26	4.0%	75	6.8%	29	16.9%	
0–199	313	16.3%	124	19.1%	177	16.1%	12	7.0%	
200–349	387	20.1%	149	23.0%	209	19.0%	29	16.9%	<0.001
350–499	409	21.3%	131	20.2%	246	22.4%	32	18.6%	
≥500	682	35.5%	219	33.7%	393	35.7%	70	40.7%	
Insurance at HIV diagnosis									
Public	583	30.3%	226	34.8%	302	27.5%	55	32.0%	
Private	745	38.8%	242	37.3%	453	41.2%	50	29.1%	<0.001
None	444	23.1%	147	22.7%	250	22.7%	47	27.3%	
Missing	149	7.8%	34	5.2%	95	8.6%	20	11.6%	

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Table 4:

Crude and Adjusted Odds Ratios for delayed and no ART initiation compared to rapid (0–7 days) initiation for persons newly diagnosed with HIV, San Francisco, California, 2012–2020.

	Delayed ART Initiation (8–365 Days)	Delayed ART Initiation (8–365 Days)	No ART Initiation	No ART Initiation
Characteristic	**Crude OR (95% CI)**	**Adjusted OR (95% CI)**	**Crude OR (95% CI)**	**Adjusted OR (95% CI)**
Year of HIV diagnosis				
2012 – 2013 (reference)	ref	ref	ref	ref
2014 – 2015	**0.33 (0.23, 0.46)**	**0.32 (0.22, 0.45)**	**0.26 (0.16, 0.44)**	**0.24 (0.14, 0.40)**
2016 – 2017	**0.13 (0.09, 0.18)**	**0.12 (0.09, 0.17)**	**0.13 (0.08, 0.22)**	**0.11 (0.06, 0.19)**
2018 – 2019	**0.04 (0.03, 0.06)**	**0.04 (0.03, 0.06)**	**0.08 (0.05, 0.14)**	**0.07 (0.04, 0.13)**
2020	**0.03 (0.01, 0.05)**	**0.03 (0.01, 0.05)**	**0.17 (0.09, 0.31)**	**0.17 (0.08, 0.33)**
Gender				
Male *(reference)*	ref	ref	ref	ref
Female	0.97 (0.68, 1.40)	**1.84 (1.04, 3.23)**	1.30 (0.73, 2.31)	1.61 (0.68, 3.80)
Trans female	0.80 (0.46, 1.40)	1.44 (0.73, 2.81)	1.24 (0.52, 2.96)	1.82 (0.69, 4.79)
Transmission category				
MSM *(reference)*	ref	ref	ref	ref
PWID	0.99 (0.66, 1.47)	1.18 (0.69, 2.04)	0.72 (0.34, 1.50)	1.50 (0.68, 3.33)
MSM-PWID	1.00 (0.73, 1.35)	1.05 (0.72, 1.51)	1.20 (0.72, 1.99)	1.07 (0.60, 1.89)
Heterosexual	0.71 (0.48, 1.05)	0.63 (0.35, 1.12)	0.56 (0.19, 1.62)	0.60 (0.22, 1.60)
Other/Unidentified	**0.44 (0.25, 0.78)**	0.79 (0.39, 1.61)	**1.81 (1.01, 3.23)**	0.56 (0.17, 1.92)
Race/Ethnicity				
White *(reference)*	ref	ref	ref	ref
Black or African American	**0.56 (0.41, 0.77)**	0.79 (0.54, 1.16)	1.14 (0.71, 1.83)	1.37 (0.80, 2.35)
Hispanic or Latino	**0.53 (0.42, 0.67)**	**0.66 (0.50, 0.88)**	1.08 (0.64, 1.80)	**0.50 (0.30, 0.81)**
Asian/Pacific Islander	0.72 (0.52, 1.00)	0.87 (0.60, 1.28)	**0.44 (0.28, 0.69)**	1.41 (0.80, 2.50)
Multiracial/Other/Unknown	0.68 (0.43, 1.08)	0.63 (0.37, 1.08)	0.55 (0.22, 1.37)	0.49 (0.18, 1.29)
Age at HIV diagnosis				
16–24 years	1.01 (0.70, 1.46)	1.03 (0.65, 1.61)	0.91 (0.48, 1.72)	0.74 (0.36, 1.50)
25–29 years	1.16 (0.83, 1.61)	1.14 (0.76, 1.71)	0.93 (0.52, 1.65)	0.80 (0.42, 1.52)
30–39 years	1.10 (0.82, 1.47)	1.12 (0.79, 1.59)	0.96 (0.59, 1.58)	0.89 (0.52, 1.54)

Characteristic	Delayed ART Initiation (8–365 Days) Crude OR (95% CI)	Delayed ART Initiation (8–365 Days) Adjusted OR (95% CI)	No ART Initiation Crude OR (95% CI)	No ART Initiation Adjusted OR (95% CI)
40–49 years	1.27 (0.93, 1.74)	0.97 (0.67, 1.40)	1.05 (0.61, 1.78)	0.82 (0.46, 1.45)
50+ years *(reference)*	ref	ref	ref	ref
Housing Status at HIV diagnosis				
Housed *(reference)*	ref	ref	ref	ref
Homeless	0.78 (0.57, 1.07)	1.18 (0.79, 1.76)	1.44 (0.90, 2.31)	1.54 (0.87, 2.72)
CD4 count closest to HIV diagnosis				
Missing	**1.61 (1.00, 2.59)**	1.54 (0.91, 2.63)	**3.49 (1.93, 6.32)**	**3.29 (1.73, 6.26)**
0–199	0.80 (0.60, 1.06)	0.90 (0.64, 1.26)	**0.30 (0.16, 0.58)**	**0.31 (0.16, 0.62)**
200–349	0.78 (0.60, 1.02)	0.86 (0.63, 1.18)	**0.61 (0.38, 0.98)**	0.62 (0.37, 1.03)
350–499	1.05 (0.80, 1.37)	1.25 (0.92, 1.71)	0.76 (0.48, 1.22)	0.88 (0.53, 1.44)
≥500 (*reference*)	ref	ref	ref	ref
Insurance at HIV diagnosis				
Public *(reference)*	ref	ref	ref	ref
Private	**1.40 (1.11, 1.77)**	0.96 (0.71, 1.30)	0.85 (0.56, 1.30)	0.72 (0.44, 1.18)
None	1.27 (0.97, 1.66)	0.94 (0.68, 1.31)	1.31 (0.85, 2.04)	1.12 (0.68, 1.86)
Missing	**2.09 (1.36, 3.21)**	**1.70 (1.03, 2.80)**	**2.42 (1.29, 4.52)**	**2.03 (1.01, 4.05)**