



Published in final edited form as:

*Clin Infect Dis.* 2016 October 1; 63(7): 976–983. doi:10.1093/cid/ciw418.

## Durable Viral Suppression and Transmission Risk Potential among Persons with Diagnosed HIV Infection: United States, 2012–2013

Nicole Crepaz, PhD, Tian Tang, MS, Gary Marks, PhD, Michael J. Mugavero, MD, MHSc, Lorena Espinoza, DDS, MPH, and H. Irene Hall, PhD

Division of HIV/AIDS Prevention, the U.S. Centers for Disease Control and Prevention, Atlanta, Georgia (Crepaz, Marks, Espinoza, Hall); University of Alabama, Birmingham, Alabama (Mugavero); ICF International, Atlanta, Georgia (Tang)

### Abstract

**Background**—To examine durable viral suppression, cumulative viral load (VL) burden, and transmission risk potential among HIV-diagnosed persons in care.

**Methods**—Using data from the National HIV Surveillance System from 17 jurisdictions with complete reporting of VL test results, we determined the percentage of persons in HIV care who achieved durable viral suppression (*all* VL results <200 copies/mL) and examined viremia copy-years and time spent above VL levels that increase the risk of HIV transmission during 2012–2013.

**Results**—Of 265,264 persons in HIV care in 2011, 238,641 had at least two VLs in 2012–2013. The median number of VLs per individual during the 2-year period was five. Approximately 62% had durable viral suppression. The remaining 38% had high VL burden (geometric mean of viremia copy-years: 7,261) and spent an average of 438 days, 316 days, and 215 days (60%, 43.2%, and 29.5% of the 2-year time) above 200, 1,500, and 10,000 copies/mL. Women, blacks/African Americans, Hispanics/Latinos, persons with HIV infection attributed to transmission other than male-to-male sexual contact, younger age groups, and persons with gaps in care had higher viral burden and transmission risk potential.

**Conclusions**—Two-thirds of persons in HIV care had durable viral suppression during a 2-year period. One-third had high VL burden and spent substantial time above VL levels with increased risk of onward transmission. More intervention efforts are needed to improve retention in care and medication adherence so that more persons in HIV care achieve durable viral suppression.

---

Corresponding Author: Nicole Crepaz, PhD, Division of HIV/AIDS Prevention, The U.S. Centers for Disease Control and Prevention, 1600 Clifton Rd., Mailstop E-47, Atlanta, Georgia, 30329, USA, Phone: 1-404-639-6149, Fax: 1-404-639-2980, ncrepaz@cdc.gov.

**Disclaimer.** The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the U.S. Centers for Disease Control and Prevention.

**Conflict of Interest.** Crepaz, Tang, Marks, Espinoza, and Hall reported no conflicts. Dr. Mugavero has received consulting fees for participation on scientific advisory boards for Bristol Myers Squibb and Gilead Sciences, and received grant funding (to UAB) from Bristol Myers Squibb.

## Keywords

durable viral suppression; viral burden; HIV transmission risk; HIV-diagnosed persons; disparity

---

## Introduction

Clinicians routinely order laboratory tests to monitor plasma viral load (VL) among HIV-infected patients.<sup>1</sup> Patients with suppressed VL have reduced risk for morbidity and mortality and are less likely to transmit HIV to others.<sup>2–6</sup> Viral suppression is the ultimate clinical biomarker for the health outcome and transmission risk of HIV-infected persons. Increasing the percentage of HIV-diagnosed persons in care who are virally suppressed to at least 90% by 2020 is one of key priorities of the National HIV/AIDS Strategies (NHAS).<sup>7</sup>

The most common measure of viral suppression in clinical and surveillance studies is the most recent VL < 200 copies/mL in the past 12 months.<sup>8–12</sup> This single VL measure, however, does not allow a close examination of VL dynamics over time.<sup>4,13,14</sup> Several studies have begun to evaluate longitudinal VL measures.<sup>4,13–15</sup> Data from six HIV clinics showed that using a single VL measure to estimate the percentage of HIV patients with durable viral suppression (all VLs < 200 copies m/L) overestimated by 16% (relative difference) over a 12-month period.<sup>13</sup> Longitudinal VL measures capture an individual's cumulative exposure to viral replication over time, serving as a putative proxy biomarker of inflammation and immune system activation. Viremia copy-years, a measure of cumulative plasma burden, predict mortality risk.<sup>4</sup> Measurement of cumulative viral burden is also an important indicator of HIV transmission risk.<sup>4</sup> Using data from six clinics, one study examined the amount of person-time spent above 1,500 copies/mL, a VL level at which HIV transmission risk begins to increase.<sup>15</sup> While these findings are informative, clinical cohorts inherently have a degree of selection bias. In comparison, VL data available from the national HIV surveillance system provides a means for conducting population-level assessments of longitudinal plasma HIV burden and transmission risk potential.

Estimating the percentage of HIV-diagnosed persons with durable viral suppression, and examining cumulative plasma HIV burden and transmission risk potential can provide helpful indicators for monitoring NHAS priorities and guiding prevention and treatment efforts. In this analysis, we used data from the Centers for Disease Control and Prevention's (CDC's) National HIV Surveillance System (NHSS) to estimate the percentage of persons in HIV care who achieved durable viral suppression over a 2-year period. We also examined the cumulative plasma HIV burden and transmission risk potential among persons in care. These longitudinal measures were examined by sex, race and ethnicity, HIV transmission category, age, year of diagnosis, and gaps in care to identify subgroups of persons who may need more intensive clinical and behavioral interventions.

## Methods

### Analysis Cohort

HIV infection is reportable in all 50 states, the District of Columbia, and six U.S. dependent areas. However, not all areas have mandatory reporting of all HIV-related laboratory tests, including all values of CD4 cell counts (or percentages) and VL tests. We used the NHSS data reported to CDC through July 2015 from 17 jurisdictions (California, the District of Columbia, Hawaii, Illinois, Indiana, Iowa, Louisiana, Maryland, Michigan, Missouri, New Hampshire, New York, North Dakota, South Carolina, Texas, Utah, and West Virginia) with complete reporting of CD4 cell count and VL test results to NHSS for 2011 to 2013.

The analytic cohort included persons who were aged  $\geq 13$  years with HIV infection diagnosed before 2011, who resided in the 17 jurisdictions at time of diagnosis, were alive at the end of 2013, and had at least one VL test in 2011 (an indicator of at least one care visit) and at least two VL results during the 2-year observation period (2012–2013).

### Durable Viral Suppression

To be consistent with the most recent surveillance and care continuum studies as well as the NHAS indicator definition, a cut-point of  $<200$  copies/mL was used to define viral suppression. Durable viral suppression was defined as all VL values  $<200$  copies/mL over the 2-year period. We determined the viral suppression status for each patient and calculated the percentage who had durable viral suppression.

### Viremia Copy-years

Viremia copy-years were calculated to determine cumulative plasma HIV burden.<sup>4</sup> The 2-year observation period was first divided into smaller time intervals defined by pairs of consecutive VL tests. HIV plasma burden for each time interval between two consecutive VL values was calculated by multiplying the average of the two VL values by the time interval between the two VL measures. The viremia copy for each segment of a person's VL curve were then summed to calculate viremia copy-years for the 2-year period (2012 – 2013). For persons who did not have a VL at the beginning of the 2-year period (on 1/1/2012) or at the end of the 2-year period (on 12/31/2013), the last VL test result in 2011 and the first VL test in 2014 were used to proportionally interpolate the VL values on those dates when the VL tests were available; otherwise, the first VL test result and the last VL test result in the 2-year period were used on those dates. The distribution of the viremia copy-years was highly skewed, with a few having had extreme values. To normalize the ranges of viremia copy-years, we used the geometric mean instead of the arithmetic mean.

### Person-time above Selected Viral Load Levels

Using the method developed by Marks et al.,<sup>15</sup> we estimated the amount of time (in days) spent above 1,500 copies/mL for each pair of VL results, summed the estimated days above the 1,500 cut-point during consecutive pairs of VL results to yield a single value per person, and then aggregated the amount of person-time above the cut-point across the analytic cohort over the 2-year period. Given evidence suggesting a dose-response relationship between increasing plasma viremia and sexual transmission in serodiscordant couples,<sup>5</sup> we

also used a higher plasma level (10,000 copies/mL) to examine HIV transmission risk potential. In addition, we used the same method to calculate the amount of time a person spent above 200 copies/mL to better understand the length of time not maintaining viral suppression over a 2-year period. For persons who did not have a VL test at the beginning of the 2-year period (on 1/1/2012) or at the end of the 2-year period (on 12/31/2013), a similar linear proportional interpolation method described above for calculating viremia copy-years was used for calculating person-time above a cut-point.

### Statistical Analysis

We assessed the three VL measures by the following stratification variables: sex (male, female), race and ethnicity (black/African American, Hispanic/Latino, white, and other), age (based on the person's age at the end of 2010, with persons assigned to one of 5 groups: 13–24, 25–34, 35–44, 45–54, and 55 years), transmission category (based on a presumed hierarchical order of probability of infection by sex: for males, male-to-male sexual contact, injection drug use, male-to-male sexual contact and injection drug use, heterosexual contact; for females, heterosexual contact, injection drug use), year of diagnosis (diagnosed before 2008 or in 2008–2010), and gaps in care (had a gap [consecutive VL tests >12 months apart during the 2-year period], vs. no gap).

We determined the numbers and percentages of persons in HIV care who had durable viral suppression over two years and estimated univariate and multivariate prevalence ratios (PRs) with confidence intervals (CI), derived from binomial regression models, to identify differences between groups. For viremia copy-years and person-time measures, we used t-tests and multivariate regression models to examine group differences. Because the transmission categories were stratified by male and female, a separate sex variable (male vs. female) was not included in the multivariate models. All analyses were conducted in SAS version 9.3 (SAS Institute Inc, Cary, NC).

### Results

A total of 808,203 persons with HIV infection aged 13 years were diagnosed in the United States or the District of Columbia before 2011 and alive at the end of 2013. More than half (425,264 persons, 52.6%) resided in the 17 jurisdictions at time of diagnosis. The demographic characteristics were similar among the persons from the 17 jurisdictions compared to all persons living with diagnosed HIV (Table 1). There were fewer black/African American and more Hispanic/Latino persons in the 17 jurisdictions, when compared to the persons from the remaining 34 jurisdictions (39.4% vs. 45.2%; 24.4% vs 15.4%, respectively). These were the only two differences greater than 5%.

Sixty-two percent of the 425,264 persons in the 17 jurisdictions (n = 265,264) had at least one VL in 2011. The analytic cohort consisted of 238,641 persons with diagnosed HIV in care who had at least one VL in 2011 and at least two VLs in the two-year observation period (2012–2013). The median number of VL tests per individual during the 2-year period was five (IQR 3–6). The majority of the analytic cohort were male (76.1%), had infection attributed to male-to-male sexual contact (49.1%), and were aged 35 years and older (82.5%). Black/African American, white, Hispanic/Latino, and other races comprised

37.5%, 31.3%, 24.7% and 6.4%, respectively. Eighty-five percent were diagnosed prior to 2008, and 86.2% did not have gaps in care over the 2-year period (Table 2).

During the 2-year observation period, 82.9% of the analytic cohort had a suppressed VL on their latest test. However, only 61.8% had durable viral suppression during the same 2-year period. Regardless the number of VL test results an individual had, 28,777 persons had a single VL > 200 copies/mL during the 2-year observation period and the median was 907 copies/mL (range: 201 to 10,000,000 copies/mL). In the full analytic cohort, the geometric mean viremia copy-years was 345 and the mean numbers of days a person spent above 200, 1,500, and 10,000 copies/mL were 173, 124, and 84 days, corresponding to 23.7%, 17.0%, and 11.5% of the 2-year observation time. There were several significant group differences. Table 2 shows that the percentages of persons with durable viral suppression were lower among females (vs. males), and persons with gaps in care (vs. not). Compared with whites, significantly fewer Hispanic/Latino, other races, and blacks/African Americans had durable viral suppression over the two years. By transmission categories, the percentage who had durable viral suppression was significantly higher among MSM compared to all the other transmission groups. By age, the percentage of persons with durable viral suppression was lowest in the youngest age group (13–24 years) and the percentages increased with age. The only difference between univariate and multivariate results was observed in the year of diagnosis variable. This variable was affected by the age group in the multivariate model as higher percentages of younger age groups were diagnosed in 2008–2010 compared to older age groups.

Several group differences were also observed for cumulative plasma HIV burden and HIV transmission risk potential in the analyses of the full analytic cohort (Table 3). Women, racial/ethnic groups other than white, persons with HIV infection attributed to transmission other than male-to-male sexual contact, younger age groups, persons diagnosed in 2008–2010, and persons with a gap in care had significantly higher viremia copy-years and person-time above 200, 1500, and 10,000 copies/mL, compared to their respective counterparts. There were no differences in univariate and multivariate results.

Table 4 reports results for 91,120 persons (38.2% of the analytic cohort) who did not achieve durable viral suppression during the 2-year period, the geometric mean viremia copy-years was 7,261, approximately 21 times higher than the mean observed in the full analytic cohort. As seen in Table 4, the mean number of days spent above 200 copies was 438 days, corresponding to 60% of the 2-year time. The mean numbers of days above 1,500 copies and 10,000 copies/mL were 316 days and 215 days, corresponding to 43.2% and 29.5% of the 2-year time. The patterns in cumulative plasma burden and HIV transmission risk potential among groups were, in general, similar to the patterns observed for the full analytic cohort. Both univariate and multivariate analyses showed that greater viral burden was observed among women, blacks/African Americans, Hispanics/Latinos, persons with HIV infection attributed to transmission other than male-to-male sexual contact, younger age groups, persons diagnosed in 2008–2010, and persons with gaps in care. Three groups had viremia copy-years above 10,000 copies m/L, including persons aged 13–24, persons aged 25–34 years, and persons with gaps in care. The groups with higher copy-years, in general, also

spent greater numbers of days during the 2-year period having VLs above 1,500 and 10,000 copies/mL.

## Discussion

We used national HIV surveillance data to assess, for the first time, three longitudinal measures of VL dynamics on the population level: durable viral suppression, cumulative plasma HIV burden, and transmission risk potential. Approximately 62% of persons in HIV care had durable viral suppression for two years, indicating sustained treatment success. However, 38% of persons in care did not achieve durable viral suppression and the viral levels above 200 copies/mL were not simply blips but averaged 7,261 copies/mL. Those who did not sustain durable viral suppression also spent an average of 60% of the 2-year time with VL above 200 copies/mL as well as a considerable length of time above 1,500 and 10,000 copies/mL, posing risk for further transmission.<sup>5,15</sup> The dynamic VL trajectories are easily overlooked with the cross-sectional assessment of last VL measure, which revealed 82.9% suppression in the analytic cohort. Clearly, these longitudinal measures of VL dynamics provide more granular data with implications for HIV treatment and prevention.

Our analyses have several important implications for clinical practices, disease monitoring, and care and prevention efforts. First, evidence shows that patients who missed clinic appointments (i.e., no-shows without prior cancellation) were less likely to maintain suppressed viral load.<sup>13</sup> To identify patients at risk of not maintaining viral suppression, clinicians might benefit from a closer examination of a patient's historical context of clinic attendance, missed visits, and VL patterns (e.g., instability, wide swings) to identify patients who may be at risk of not maintaining suppression, or not achieving durable VL suppression.

Second, brief counseling messages delivered by clinicians during routine HIV care visits have been found to reduce HIV transmission risk behaviors among HIV patients.<sup>16</sup> Findings from the Medical Monitoring Project (MMP) showed that HIV patients who were not virally suppressed were more likely to receive HIV/STD prevention messages from a health care provider than those who were virally suppressed (49% vs. 42%).<sup>17</sup> However, there is still considerable room to increase provider's delivery of brief prevention messages, especially to those who are not durably suppressed as recommended by the prevention, treatment, and care guidelines.<sup>2,18, 19</sup> Several integrated interventions that target multiple risk behaviors simultaneously have shown to improve risk reduction behaviors and care outcomes of HIV-infected person.<sup>20</sup> Those integrated interventions are additional resources for providers to consider when referring patients to more intensive interventions.

Third, we detected disparities in durable viral suppression, cumulative plasma burden, and transmission risk potential, similar to disparities in HIV infection, care engagement, and treatment outcomes that have been highlighted through HIV surveillance data in the United States.<sup>2,12,21</sup> Factors other than individual attributes related to sex, race and ethnicity, age, and care history may be contributing to these disparities. Social and structural factors such as income, employment, education, housing, health insurance coverage, and access to care have been shown to be associated with disparities in HIV infection<sup>21</sup> and engagement in

HIV-related medical care,<sup>7, 22</sup> which may have affected viral burden and HIV transmission risk potential.

Fourth, as HIV surveillance laboratory results are being increasingly used to inform initiatives to enhance HIV care engagement,<sup>23</sup> our longitudinal indicators may be helpful for public health planning and guiding resource allocation. Beyond using the most recent VL value to estimate population-level viral suppression in a given jurisdiction when constructing an annual care continuum, the totality of VL measures reported to surveillance can be used to assess durable viral suppression longitudinally, as well as identify persons with particularly high cumulative viral burden and proportion time above VL levels that elevate the risk of HIV transmission for targeted outreach interventions.

Fifth, knowing the degree of cumulative viremia burden and the amount of time an individual patient spent above VL levels that increase the risk of HIV transmission can improve the accuracy of estimates of HIV clinical events and onward transmission. Along with risk behavior data, transmission risk modeling efforts can more accurately estimate how many partners are placed at high risk of infection during a window of time, relative to estimates based upon a single cross-sectional VL value.

Our analyses are subject to the following limitations. First, the analysis cohort consisted of persons who had at least one VL test in 2011 as an indicator of at least one care visit during that time. Persons who had no evidence of being in care in 2011 and not included in our analyses may have had unsuppressed VL and elevated HIV transmission risk during the observation period, unless they moved to another jurisdiction and entered care there. The absence of data on transmission potential from persons without a VL complicates the prediction of HIV transmission in the general population. Second, how the three longitudinal indicators examined here predict actual HIV transmission is beyond the scope of the present study; however, with additional jurisdictions implementing complete laboratory reporting such assessments may be feasible in the future. Third, findings are based on persons who had at least one VL in 2011 reported to NHSS. Having a VL test does not necessarily mean that the person actually received appropriate HIV medical care. Patient-level data on antiretroviral therapy are not available to verify individual treatment status. Fourth, we used data from 17 jurisdictions with complete reporting of VL data. For persons who moved to another jurisdiction outside of the 17 jurisdictions during 2012–2013, records may not be available on VL tests. Fifth, data on income and insurance status are not collected in NHSS for directly examining their relationship with viral burden and transmission risk potential.

In summary, about two-thirds of persons in HIV care had durable viral suppression over a 2-year period. The remaining one-third had high cumulative plasma HIV burden and spent a considerable amount of time with their viral loads at levels that increase the risk for transmitting HIV to others. More intervention efforts are needed to improve retention in care and medication adherence so that more persons in HIV care achieve durable viral suppression.

## Acknowledgments

**Funding.** This work was supported by the Division of HIV/AIDS Prevention at the U.S. Centers for Disease Control and Prevention and was not funded by any other organization.

## References

1. Panel on Antiretroviral Guidelines for Adults and Adolescents. Guidelines for the use of antiretroviral agents in HIV-1-infected adults and adolescents. Department of Health and Human Services; Available at <http://www.aidsinfo.nih.gov/ContentFiles/AdultandAdolescentGL.pdf> [Accessed January 30, 2016]
2. Centers for Disease Control and Prevention, Health Resources and Services Administration, National Institutes of Health, American Academy of HIV Medicine, Association of Nurses in AIDS Care, International Association of Providers in AIDS Care, the National of Minority AIDS Council, and Urban Coalition for HIV/AIDS Prevention Services. [Accessed January 30, 2016] Recommendations for HIV Prevention with Adults and Adolescents with HIV in the United States. 2014. <http://stacks.cdc.gov/view/cdc/26062>
3. Cohen MS, Chen YQ, McCauley M, et al. Prevention of HIV-1 infection with early antiretroviral therapy. *N Engl J Med.* 2011; 365(6):493–505. [PubMed: 21767103]
4. Mugavero MJ, Napravnik S, Cole SR, et al. Viremia copy-years predicts mortality among treatment-naïve HIV-infected patients initiating antiretroviral therapy. *Clin Infect Dis.* 2011; 53(9):927–935. [PubMed: 21890751]
5. Quinn TC, Wawer MJ, Sewankambo N, et al. Viral load and heterosexual transmission of human immunodeficiency virus type 1. Rakai Project Study Group. *N Engl J Med.* 2000; 342(13):921–929. [PubMed: 10738050]
6. Zoufaly A, Stellbrink HJ, Heiden MA, et al. Cumulative HIV viremia during highly active antiretroviral therapy is a strong predictor of AIDS-related lymphoma. *J Infect Dis.* 2009; 200(1): 79–87. [PubMed: 19476437]
7. National Office on AIDS Policy. [Accessed January 30, 2016] National HIV/AIDS strategy for the United States: Updated to 2020. <https://www.aids.gov/federal-resources/national-hiv-aids-strategy/nhas-update.pdf>
8. Doshi RK, Milberg J, Isenberg D, et al. High rates of retention and viral suppression in the US HIV safety net system: HIV care continuum in the Ryan White HIV/AIDS program, 2011. *Clin Infect Dis.* 2015; 60(1):117–125. [PubMed: 25225233]
9. Althoff KN, Buchacz K, Hall HL, et al. U.S. trends in antiretroviral therapy use, HIV RNA plasma viral loads, and CD4 T-lymphocyte counts among HIV-infected persons, 2000 to 2008. *Ann Intern Med.* 2012; 157(5):325–335. [PubMed: 22944874]
10. Dombrowski JC, Kitahata MM, Van Rompaey SE, et al. High level of antiretroviral use and viral suppression among persons in HIV care in the United States, 2010. *J Acquir Immune Defic Syndr.* 2013; 63(3):299–306. [PubMed: 23572013]
11. Centers for Disease Control and Prevention. Monitoring selected national HIV prevention and care objectives by using HIV surveillance data—United States and 6 U.S. dependent areas—2013. HIV Surveillance Supplemental Report. 2015; 20(2) [Accessed January 30, 2016] <http://www.cdc.gov/hiv/library/reports/surveillance/>.
12. Centers for Disease Control and Prevention. Vital signs: HIV diagnosis, care, and treatment among persons living with HIV—United States, 2011. *MMWR Morb Mortal Wkly Rep.* 2014; 63(47):1–6. [PubMed: 24402465]
13. Marks G, Patel U, Stirratt MJ, et al. Single viral load measures overestimate stable viral suppression among HIV patients in care: Clinical and public health implications. *Acquir Immune Defic Syndr.* 2016 Apr 21. [Epub ahead of print].
14. Terzian AS, Bodach SD, Wiewel EW, et al. Novel use of surveillance data to detect HIV-infected persons with sustained high viral load and durable virologic suppression in New York City. *PLoS One.* 2012; 7(1):e29679. [PubMed: 22291892]



15. Marks G, Gardner LI, Rose CE, et al. Time above 1500 copies: a viral load measure for assessing transmission risk of HIV-positive patients in care. *AIDS*. 2015; 29(8):947–954. [PubMed: 25768835]
16. Crepaz N, Tungol MLV, Higa DH, et al. A systematic review of behavioral interventions for people living with HIV in the United States, 1988–2012. *AIDS*. 2014; 28(5):633–656. [PubMed: 24983541]
17. Mizuno Y, Zhu J, Crepaz N, et al. Receipt of HIV/STD prevention counseling by HIV-infected adults receiving medical care in the United States. *AIDS*. 2014; 28(3):407–415. [PubMed: 24056066]
18. International Advisory Panel on HIV Care Continuum Optimization. IAPAC guidelines for optimizing the HIV care continuum for adults and adolescents. *J Int Assoc Provid AIDS Care*. 2015; 14(Suppl 1):S3–S34. [PubMed: 26527218]
19. Marrazzo JM, Del Rio C, Holtgrave DR, et al. HIV prevention in clinical care settings: 2014 Recommendations of the International Antiviral Society-USA Panel. *JAMA*. 2014; 312(4):390–409. [PubMed: 25038358]
20. Crepaz N, Baack BN, Higa DH, Mullins MM. Effects of integrated interventions on transmission risk and care continuum outcomes in persons living with HIV: meta-analysis, 1996–2014. *AIDS*. 2015; 29(18):2371–2383. [PubMed: 26372483]
21. Centers for Disease Control and Prevention. Social determinants of health among adults with diagnosed HIV in 11 states, the District of Columbia and Puerto Rico, 2013. HIV Surveillance Supplemental Report. 2015; 20(5):1–38. [Accessed January 30, 2016] <http://www.cdc.gov/hiv/library/reports/surveillance/>. Published November 2015.
22. Weiser J, Beer L, Frazier EL, Patel R, Dempsey A, Hauck H, Skarbinski J. Service delivery and patient outcomes in Ryan White HIV/AIDS Program-funded and -nonfunded health care facilities in the United States. *JAMA Intern Med*. 2015; 175(10):1650–9. [PubMed: 26322677]
23. [Accessed January 30, 2016] Data to Care. <https://effectiveinterventions.cdc.gov/en/highimpactprevention/publichealthstrategies/DatatoCare.aspx>

**Key Points**

Using National HIV Surveillance Data from 17 jurisdictions, 38% of HIV-diagnosed persons in care did not have sustained viral suppression in 2012–13, spending 60% and 30% of observation time with viral load greater than 200 c/mL and 10,000 c/mL, respectively.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 1

Characteristics of persons aged 13 years with HIV infection diagnosed before 2011 and alive through 2013 from 17 U.S. jurisdictions with complete viral load reporting, compared to all HIV-diagnosed persons aged 13 years from 50 states and District of Columbia and from 34 jurisdictions without complete reporting

Characteristic	All 50 states and District of Columbia		17 jurisdictions with complete viral load reporting		34 jurisdictions without complete viral load reporting	
	No.	%	No.	%	No.	%
<b>Total</b>	<b>808,203</b>	<b>100</b>	<b>425,264</b>	<b>100</b>	<b>382,939</b>	<b>100</b>
<b>Sex</b>						
Male	607,202	75.1	326,230	76.7	280,972	73.4
Female	201,001	24.9	99,034	23.3	101,967	26.6
<b>Race/ethnicity</b>						
Black/African American	340,802	42.2	167,679	39.4	173,123	45.2
Hispanic/Latino	162,497	20.1	103,692	24.4	58,805	15.4
Other races	40,521	5.0	23,563	5.5	16,958	4.4
White	264,383	32.7	130,330	30.6	134,053	35.0
<b>Transmission category</b>						
Male-to-male sexual contact	363,378	45.0	198,765	46.7	164,613	43.0
Injection drug use-Male	61,279	7.6	33,893	8.0	27,386	7.2
Injection drug use-Female	36,142	4.5	19,170	4.5	16,972	4.4
Male-to-male sexual contact and injection drug use	42,418	5.2	24,166	5.7	18,252	4.8
Heterosexual contact-Male	50,949	6.3	22,079	5.2	28,870	7.5
Heterosexual contact-Female	105,591	13.1	48,014	11.3	57,577	15.0
Other	148,446	18.4	79,177	18.6	69,269	18.1
<b>Age group at the end of 2010</b>						
13-24	36,755	4.5	18,986	4.5	17,769	4.6
25-34	114,205	14.1	59,370	14.0	54,835	14.3

Characteristic	All 50 states and District of Columbia		17 jurisdictions with complete viral load reporting		34 jurisdictions without complete viral load reporting	
	No.	%	No.	%	No.	%
35-44	217,419	26.9	112,717	26.5	104,702	27.3
45-54	287,503	35.6	151,035	35.5	136,468	35.6
>=55	152,321	18.8	83,156	19.6	69,165	18.1

**Table 2**

Characteristics of persons aged 13 years with HIV infection diagnosed before 2011, alive through 2013, and in care with durable viral suppression, 17 U.S. jurisdictions, 2012–2013

Characteristic	N	%	N had durable viral suppression	% had durable viral suppression	Univariate Prevalence Ratio and (95% CI)	Multivariate Prevalence Ratio and (95% CI)
<b>Total</b>	<b>238641</b>	<b>100</b>	<b>147521</b>	<b>61.8</b>		
<b>Sex</b>						
Male	181673	76.1	116311	64.0	Referent	---
Female	56968	23.9	31210	54.8	0.86 (0.85, 0.86)	---
<b>Race/ethnicity</b>						
Black/African American	89519	37.5	47055	52.6	0.72 (0.71, 0.72)	0.78 (0.78, 0.79)
Hispanic/Latino	58990	24.7	36182	61.3	0.84 (0.83, 0.84)	0.90 (0.89, 0.90)
Other races	15367	6.4	9407	61.2	0.83 (0.82, 0.85)	0.89 (0.88, 0.90)
White	74765	31.3	54877	73.4	Referent	Referent
<b>Transmission category</b>						
Male-to-male sexual contact	117110	49.1	79462	67.9	Referent	Referent
Injection drug use-Male	16156	6.8	8568	53.0	0.78 (0.77, 0.79)	0.80 (0.78, 0.81)
Injection drug use-Female	10730	4.5	5077	47.3	0.70 (0.68, 0.71)	0.73 (0.72, 0.75)
Male-to-male sexual contact and injection drug use	14689	6.2	7810	53.2	0.78 (0.77, 0.80)	0.80 (0.79, 0.81)
Heterosexual contact-Male	11993	5	7044	58.7	0.87 (0.85, 0.88)	0.92 (0.91, 0.94)
Heterosexual contact-Female	28858	12.1	16582	57.5	0.85 (0.84, 0.86)	0.93 (0.92, 0.94)
Other	39105	16.4	22978	58.8	0.87 (0.86, 0.87)	0.95 (0.94, 0.96)
<b>Age group at the end of 2010</b>						
13–24	10370	4.3	3986	38.4	0.53 (0.52, 0.55)	0.56 (0.54, 0.57)
25–34	31552	13.2	16292	51.6	0.71 (0.71, 0.72)	0.74 (0.73, 0.74)
35–44	62649	26.3	37199	59.4	0.82 (0.82, 0.83)	0.84 (0.84, 0.85)
45–54	87513	36.7	56417	64.5	0.89 (0.89, 0.90)	0.91 (0.91, 0.92)
>=55	46557	19.5	33627	72.2	Referent	Referent
<b>Year of diagnosis</b>						
Diagnosed in 2008–2010	35472	14.9	20868	58.8	0.94 (0.93, 0.95)	1.03 (1.03, 1.04)

Characteristic	N	%	N had durable viral suppression	% had durable viral suppression	Univariate Prevalence Ratio and (95% CI)	Multivariate Prevalence Ratio and (95% CI)
Diagnosed before 2008	203169	85.1	126653	62.3	<i>Referent</i>	<i>Referent</i>
<b>Gap in care (any two VL tests &gt;12 months apart)<sup>a</sup></b>						
No	205729	86.2	129308	62.9	<i>Referent</i>	<i>Referent</i>
Yes	32899	13.8	18213	55.4	0.88 (0.87, 0.89)	0.92 (0.91, 0.93)

Durable viral suppression is defined as all VL values were <200 copies/mL during 2012 and 2013

<sup>b</sup> Persons who had at least two VL tests during 2012 and 2013

<sup>a</sup> 13 cases had missing/invalid value on this variable

Table 3

Cumulative plasma HIV burden and transmission risk potential during a 2-year observation period among persons aged 13 years with HIV infection diagnosed before 2011, alive through 2013, and in care, by selected characteristics, 17 U.S. jurisdictions, 2012–2013<sup>1</sup>

Characteristics	N	Cumulative Plasma HIV Burden Viremia copy-years Geometric Mean	HIV Transmission Risk Potential		
			Person-time above 200 copies/mL Mean number of days	Person-time above 1,500 copies/mL Mean number of days	Person-time above 10,000 copies/mL Mean number of days
<b>Total<sup>2</sup></b>	<b>238628</b>	<b>345</b>	<b>173</b>	<b>124</b>	<b>84</b>
<b>Sex</b>					
Male ( <i>referent</i> )	181667	314	159	114	79
Female	56961	469 <sup>a</sup>	216 <sup>a</sup>	156 <sup>a</sup>	102 <sup>a</sup>
<b>Race/ethnicity</b>					
Black/African American	89510	604 <sup>a</sup>	229 <sup>a</sup>	167 <sup>a</sup>	112 <sup>a</sup>
Hispanic/Latino	58988	318 <sup>a</sup>	167 <sup>a</sup>	118 <sup>a</sup>	79 <sup>a</sup>
Other races	15366	372 <sup>a</sup>	176 <sup>a</sup>	129 <sup>a</sup>	89 <sup>a</sup>
White ( <i>referent</i> )	74764	186	110	77	53
<b>Transmission category</b>					
Male-to-male sexual contact ( <i>referent</i> )	117108	260	140	100	69
Injection drug use – Male	16155	538 <sup>a</sup>	211 <sup>a</sup>	149 <sup>a</sup>	100 <sup>a</sup>
Injection drug use – Female	10729	788 <sup>a</sup>	254 <sup>a</sup>	186 <sup>a</sup>	124 <sup>a</sup>
Male-to-male sexual contact and injection drug use	14687	676 <sup>a</sup>	218 <sup>a</sup>	163 <sup>a</sup>	116 <sup>a</sup>
Heterosexual contact – Male	11993	406 <sup>a</sup>	186 <sup>a</sup>	133 <sup>a</sup>	91 <sup>a</sup>
Heterosexual contact – Female	28853	420 <sup>a</sup>	203 <sup>a</sup>	147 <sup>a</sup>	96 <sup>a</sup>
Other	39103	345 <sup>a</sup>	190 <sup>a</sup>	134 <sup>a</sup>	88 <sup>a</sup>
<b>Age group at the end of 2010</b>					
13–24	10369	1664 <sup>a</sup>	338 <sup>a</sup>	265 <sup>a</sup>	172 <sup>a</sup>
25–34	31551	790 <sup>a</sup>	245 <sup>a</sup>	191 <sup>a</sup>	132 <sup>a</sup>
35–44	62647	437 <sup>a</sup>	189 <sup>a</sup>	139 <sup>a</sup>	97 <sup>a</sup>

Characteristics	N	Cumulative Plasma HIV Burden	HIV Transmission Risk Potential		
		Viremia copy-years Geometric Mean	Person-time above 200 copies/mL Mean number of days	Person-time above 1,500 copies/mL Mean number of days	Person-time above 10,000 copies/mL Mean number of days
45–54	87506	278 <sup>a</sup>	152 <sup>a</sup>	105 <sup>a</sup>	71 <sup>a</sup>
55 ( <i>referent</i> )	46555	152	105	65	41
<b>Year of diagnosis</b>					
Diagnosed in 2008–2010	35470	461 <sup>a</sup>	198 <sup>a</sup>	149 <sup>a</sup>	98 <sup>a</sup>
Diagnosed before 2008 ( <i>referent</i> )	203158	328	168	120	82
<b>Gap in care (any two VL tests &gt;12 months apart)</b>					
No ( <i>referent</i> )	205729	298	156	109	72
Yes	32899	876 <sup>a</sup>	276 <sup>a</sup>	219 <sup>a</sup>	157 <sup>a</sup>

<sup>1</sup> Geometric means and mean number of days presented in this table are based on univariate results

<sup>2</sup> Due to some missing/invalid data, results are based on 238,628 persons living with diagnosed HIV;

<sup>a</sup> p<.0001 (based on both univariate and multivariate results)



**Table 4**

Cumulative plasma HIV burden and transmission risk potential during a 2-year observation period among HIV-diagnosed persons in care without durable viral suppression, by selected characteristics, 17 U.S. jurisdictions, 2012–2013<sup>1</sup>

Characteristics	N	Cumulative Plasma HIV Burden Viremia copy-years Geometric Mean	HIV Transmission Risk Potential		
			Person-time above 200 copies/mL Mean number of days	Person-time above 1,500 copies/mL Mean number of days	Person-time above 10,000 copies/mL Mean number of days
<b>Total<sup>2</sup></b>	<b>91107</b>	<b>7261</b>	<b>438</b>	<b>316</b>	<b>215</b>
<b>Sex</b>					
Male ( <i>referent</i> )	65356	7010	427	308	213
Female	25751	7939 <sup>ae</sup>	466 <sup>ae</sup>	337 <sup>ae</sup>	221 <sup>ae</sup>
<b>Race/ethnicity</b>					
Black/African American	42455	8815 <sup>ae</sup>	469 <sup>ae</sup>	345 <sup>ae</sup>	233 <sup>ae</sup>
Hispanic/Latino	22806	6352 <sup>ae</sup>	419 <sup>ae</sup>	297 <sup>ae</sup>	201 <sup>bg</sup>
Other races	5959	8134 <sup>ae</sup>	438 <sup>ae</sup>	323 <sup>ae</sup>	224 <sup>ae</sup>
White ( <i>referent</i> )	19887	5408	396	276	192
<b>Transmission category</b>					
Male-to-male sexual contact ( <i>referent</i> )	37646	6620	419	302	209
Injection drug use – Male	7587	7280 <sup>ce</sup>	436 <sup>ae</sup>	310 <sup>ce</sup>	209 <sup>de</sup>
Injection drug use – Female	5652	9331 <sup>ae</sup>	470 <sup>ae</sup>	345 <sup>ae</sup>	232 <sup>ae</sup>
Male-to-male sexual contact and injection drug use	6877	9950 <sup>ae</sup>	452 <sup>ae</sup>	339 <sup>ae</sup>	243 <sup>ae</sup>
Heterosexual contact – Male	4949	7373 <sup>ce</sup>	438 <sup>ae</sup>	314 <sup>ce</sup>	216 <sup>df</sup>
Heterosexual contact – Female	12271	8001 <sup>ae</sup>	464 <sup>ae</sup>	337 <sup>ae</sup>	222 <sup>dh</sup>
Other	16125	6660 <sup>de</sup>	450 <sup>ae</sup>	319 <sup>dh</sup>	210 <sup>dh</sup>
<b>Age group at the end of 2010</b>					
13–24	6383	13254 <sup>ae</sup>	537 <sup>ae</sup>	422 <sup>ae</sup>	276 <sup>ae</sup>
25–34	15259	12377 <sup>ae</sup>	491 <sup>ae</sup>	383 <sup>ae</sup>	266 <sup>ae</sup>
35–44	25448	9006 <sup>ae</sup>	450 <sup>ae</sup>	332 <sup>ae</sup>	233 <sup>ae</sup>

Characteristics	N	Cumulative Plasma HIV Burden		HIV Transmission Risk Potential		
		Viremia copy-years Geometric Mean	Person-time above 200 copies/mL Mean number of days	Person-time above 1,500 copies/mL Mean number of days	Person-time above 10,000 copies/mL Mean number of days	
45–54	31089	5836 <sup>ae</sup>	413 <sup>ae</sup>	286 <sup>ae</sup>	194 <sup>ae</sup>	
55 ( <i>referent</i> )	12928	3181	365	226	143	
<b>Year of diagnosis</b>						
Diagnosed in 2008–2010	14602	8732 <sup>ae</sup>	459 <sup>ae</sup>	349 <sup>ab</sup>	231 <sup>ae</sup>	
Diagnosed before 2008 ( <i>referent</i> )	76505	7010	434	310	212	
<b>Gap in care (any two VL tests &gt;12 months apart)</b>						
No ( <i>referent</i> )	76421	6052	411	288	192	
Yes	14686	18739 <sup>ae</sup>	582 <sup>ae</sup>	467 <sup>ae</sup>	337 <sup>ae</sup>	

<sup>1</sup> Geometric means and mean number of days presented in this table are based on univariate results

<sup>2</sup> Due to some missing/invalid data, results are based on 91,107 persons living with diagnosed HIV

<sup>a</sup> p<.0001 (based on univariate results)

<sup>b</sup> p<.001 (based on univariate results)

<sup>c</sup> p<.01 (based on univariate results)

<sup>d</sup> p>.05 (based on univariate results)

<sup>e</sup> p<.0001 (based on multivariate results)

<sup>f</sup> p<.001 (based on multivariate results)

<sup>g</sup> p<.05 (based on multivariate results)

<sup>h</sup> p>.05 (based on multivariate results)