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## Changes in viral suppression status among HIV patients receiving care: United States, 2014

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### Abstract

**Objective:** To examine changes in viral suppression status among HIV patients receiving care in 2014 and the extent of viral suppression among persons with infrequent care visits.

**Methods:** Using data reported to the National HIV Surveillance System from 33 jurisdictions with complete reporting of CD4 and viral load tests, we created four viral suppression status groups based on their first and last viral loads in 2014: both suppressed, first unsuppressed and last suppressed (improved), first suppressed and last unsuppressed (worsened), and both unsuppressed. We also calculated the number and percentage of persons whose sole viral load in 2014 was suppressed and had a suppressed viral load at their last test in 2013.

**Results:** Among 339515 persons with at least two viral load tests in 2014, 72.6% had all viral loads suppressed (durably suppressed); 75.5% had the first and last tests suppressed, 10.5% improved, 4.2% worsened, and 9.9% had both unsuppressed. Among 92309 persons who had only one viral load test in 2014, 69960 (75.8%) were suppressed and, of those, 53834 (76.9%) also had a suppressed viral load at their last test in 2013.

**Conclusions:** National surveillance data show that the majority of patients in HIV care during 2014 were durably suppressed. More showed improved compared to worsened viral suppression status. Some patients who have less frequent care visits have sustained viral suppression. Yet one in ten who were in regular care did not have a suppressed viral load in 2014, indicating missed opportunities for clinical interventions to help patients achieve and sustain viral suppression.

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<sup>a</sup>Thirty-three jurisdictions are Alabama, Alaska, California, District of Columbia, Georgia, Hawaii, Illinois, Indiana, Iowa, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Hampshire, New Mexico, New York, North Dakota, Oregon, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

**Conflict of Interest.** All authors reported no conflicts.

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

## Introduction

Viral loads (VL) can fluctuate over time depending on patients' access to treatment, retention in care, response to HIV treatment, and medication adherence behavior. An increasing number of studies have called for using longitudinal data to investigate VL dynamics and transmission risk potentials.<sup>1-5</sup> One important aspect of examining VL dynamics is to gain a better understanding of changes in viral suppression (VS) status. To examine changes in VS status, one recent publication used a matched-pairs approach by using patient's first and last VL tests from a cohort of HIV patients from six U.S. clinics. The matched-pairs approach generated four groups: (1) sustained VS (both VL suppressed), (2) improved viral status (first unsuppressed, last suppressed), (3) worsened viral status (first suppressed, last unsuppressed), and (4) never achieved VS (both VL unsuppressed). The study found that among the 10,942 cohort patients, 69.7% had sustained VS, 13.3% improved, 5.6% worsened, and 11.4% had never achieved VS.<sup>1</sup> While these findings are informative, clinical cohorts may not be representative of all persons with diagnosed HIV receiving care in the United States. Examining changes in VS status using data from the National HIV Surveillance System (NHSS) can inform national HIV care and prevention efforts for improving health outcomes of persons living with HIV and mitigating HIV transmission.

One limitation of previously published studies that examined longitudinal VL status is excluding patients who had only one VL during an observation period (e.g., 12 months or 24 months) from the analyses.<sup>1,2</sup> It is plausible that some patients who receive stable HIV medical care may have sustained VS even though they have less frequent clinic visits and the time interval between two VL tests is longer.<sup>6</sup> If there is a sizable number of HIV patients who were virally suppressed but had less frequent VL testing (i.e., only one VL test) within a calendar year, excluding those patients from analyses on longitudinal VL status may affect the estimate of the percentage of persons with suppressed VLs. Therefore, it is important to investigate the extent of VS in the prior year among people who had only one VL test during the calendar year of study.

In this study, we used the CDC's NHSS data and the matched-pairs approach to examine the changes in VS status among HIV patients receiving care in 2014. We also used longitudinal VL data to assess whether patients who had infrequent care visits (i.e., only one VL test in 2014) had their last VL suppressed in prior year.

## Methods

We included data reported to NHSS through June 2016 from 33 jurisdictions with complete reporting of CD4 and VL tests. The analytic cohort included persons who were aged 13 years with HIV infection diagnosed by year-end 2013, whose most recent known residence was in the 33 jurisdictions and who were alive at year-end 2014, and had at least one VL test in 2014.<sup>7</sup>

To examine changes in VS status in a 12-month observation period, we created four groups based on first and last VL tests in 2014 among those who had at least two VLs in 2014

(an indicator of regular HIV care): both suppressed, first unsuppressed and last suppressed (improved), first suppressed and last unsuppressed (worsened), and both unsuppressed. Changes in VS status were also examined stratified by sex, race/ethnicity, transmission category, age, and diagnosis year.

For assessing whether some patients had infrequent care visits (i.e., only one VL in 2014) but sustained VS, we calculated (1) the number and percentage of persons whose sole VL in 2014 was suppressed and who also had a suppressed VL at their last test in 2013, and (2) the time interval between these two suppressed VLs tests.

The definition of VS in all analyses was <200 copies/mL, consistent with the definition used in the national indicator for VS.<sup>8</sup> We also used the calendar year (i.e., 2014) to be consistent with the time period used in the national indicator.<sup>8</sup> Multinomial logistic regressions were conducted to identify differences between groups. All analyses were performed in SAS version 9.3 (SAS Institute Inc., Cary, North Carolina).

## Results

A total of 912,915 persons aged 13 years with HIV infection diagnosed by year-end 2013 were alive at the end of 2014. Sixty-nine percent (630,965) resided in the 33 jurisdictions based on the most recent address as of year-end 2014. The demographic characteristics were similar among the persons from the 33 jurisdictions compared with all persons living with diagnosed HIV (Table 1).

Among the 630,965 persons, 339,515 (53.8%) had at least two VL tests, 92,309 (14.6%) had only one VL test, and 199,141 (31.6%) did not have any VL test in 2014. The median number of VL tests was two in 2014. Among 339,515 persons who had at least two VL tests, 40.1% had two VLs, 33.2% had three VLs, 17.1% had four VLs, and 9.5% had five and more VLs and, overall, 246,643 (72.6%) had all VLs suppressed in 2014. The proportion of persons with all VLs suppressed in 2014 decreased as the number of VL tests increased: 79.2%, 76.1%, 67.1%, and 42.8% for those with two, three, four, and five and more tests, respectively.

Further examination of the changes in VS status (Table 2) showed that 75.5% had first and last VL tests suppressed, 10.5% improved, 4.2% worsened, and 9.9% had both unsuppressed. For all of the demographic strata, there was a higher percentage of persons in care who had both first and last VL tests suppressed compared to any of the other three VS status groups (all  $p$ s < 0.05). The percentage of persons who showed an improved viral status was higher than the percentage of persons who showed worsened viral status across all strata (all  $p$ s < 0.05). A higher percentage of males, whites, persons with HIV infection attributed to male-to-male sexual contact (men who have sex with men, MSM), and persons 55 years and older, had both first and last VL tests suppressed or showed an improved status, compared to their counterparts (i.e., females, race/ethnic groups other than white, transmission categories other than MSM, and persons younger than 55 years old, all  $p$ s < 0.05). Conversely, a lower percentage of males, whites, MSM, and persons 55 years and older, had a worsened status or had both first and last VL tests unsuppressed, compared

to their counterparts (all  $ps < 0.05$ ). Persons with HIV infection diagnosed in 2013 were less likely to have both first and last VL tests suppressed but were more likely to show an improved VS status when compared to persons with HIV infection diagnosed prior to 2013 (all  $ps < 0.05$ ). Both groups were similar regarding the percentages of persons who showed a worsened status and who had first and last VL tests unsuppressed. The pattern of changes in viral suppression status is consistent with the overall findings for those who had two, three and four VL tests. Compared to these three groups, the five and more VL tests group had a lower proportion of persons with first and last VL tests suppressed.

Among 92,309 persons who were excluded from the matched-pairs analysis due to having only one VL test in 2014, 69,960 (75.8%) had VS on their single VL test in 2014. Of those 69,960 persons, 53,834 (76.9%) also had a suppressed VL at their last test in 2013 and the time interval between the last VL test in 2013 and the sole VL test in 2014 was, on average, 9.15 months (median = 9 months, interquartile range, 6 to 12 months).

## Discussion

National surveillance data showed that three-fourths of persons who received regular HIV care (i.e., had at least two VL in 2014) had their first and last VL tests suppressed during the calendar year. More than twice as many persons showed an improving than worsening VS status and this pattern was consistent across the sex, race/ethnicity, transmission category, and age groups. The pattern of changes in VS status in our findings is consistent to the pattern previously reported in a clinic-cohort study.<sup>1</sup> While these findings are encouraging, approximately one in 10 persons in regular HIV care nationally did not achieve VS on their first and last VL tests during the calendar year of 2014. Previous studies have shown that those who were in HIV care but not virally suppressed had a high level of cumulative plasma HIV burden that increases the risk of HIV transmission.<sup>2,3</sup> Additionally, 31.6% of 630,965 HIV-diagnosed persons did not have any VL test in 2014 and were not considered in HIV care. Many of these persons may not have had a suppressed VL. These findings highlight the need for intensified linkage and retention in care efforts to increase the number of patients who receive VL testing and clinical intervention if needed.

Comparable to the percentage of persons who had first and last VL tests suppressed, three-fourths of persons who received HIV medical care had their sole VL test in 2014 suppressed. Of these, three in four persons also had a suppressed VL at their last test in 2013 and the average interval between the two suppressed VL tests was 9 months. We also found that the proportion of persons with all VLs suppressed in 2014 decreased as the number of VL tests increased in 2014, suggesting that patients who were sicker were monitored more often. In light of HIV treatment guidelines of testing VL less often among those who have been shown to be adherent to HIV medication and have suppressed VL,<sup>6</sup> our finding provides additional evidence that some patients who have less frequent care visits have achieved and sustained VS. Future studies that examine sustained VS using longitudinal data may consider including data from patients with only one VL test in a calendar year.

Limitations of this analysis warrant comment. First, receipt of HIV care was measured by documentation of having VL tests performed during 2014. Having a VL test does

not necessarily mean that the person actually received appropriate medical care. Although NHSS does not collect patient-level data on antiretroviral therapy and clinic attendance to verify individual treatment and care status, the ultimate health outcome is VS, which has been continuously monitored in NHSS. Second, we used data from 33 jurisdictions with complete reporting of VL data. Persons whose latest address on record was in the 33 jurisdictions but who moved outside of these areas were excluded from this analysis.

In conclusion, the majority of patients in HIV care during 2014 were durably suppressed. Three-fourths had their first and last VL tests suppressed and more showed an improved than worsened VS status. Some patients who have less frequent care visits have achieved and sustained VS. Yet one in ten did not have a suppressed VL in their first and last tests within a 12-month period, pointing out the need for clinical interventions to help those patients achieve and sustain VS.

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Study concept: N.C. Study design: N.C., G.M., H.I.H. Data analysis: T.T. Data interpretation: all authors. Drafting of manuscript: N.C. Revision of manuscript: All authors. Final approval of manuscript: all authors.

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**Table 1.**

Characteristics of persons aged ≥ 13 years with HIV infection diagnosed at year-end 2013 and alive through 2014 from 33 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 28 jurisdictions without complete reporting

Characteristic	All 50 states and District of Columbia		33 jurisdictions with complete viral load reporting		28 jurisdictions without complete viral load reporting	
	No.	%	No.	%	No.	%
<b>Total</b>	<b>912915</b>	<b>100</b>	<b>630965</b>	<b>100</b>	<b>281950</b>	<b>100</b>
<b>Sex</b>						
Male	690286	75.6	484031	76.7	206255	73.2
Female	222629	24.4	146934	23.3	75695	26.8
<b>Race/Ethnicity</b>						
Hispanic/Latino	188890	20.7	135519	21.5	53371	18.9
Black/African American	386049	42.3	265551	42.1	120498	42.7
White	289308	31.7	193740	30.7	95568	33.9
Other races	48668	5.3	36155	5.7	12513	4.4
<b>Transmission Category</b>						
Male-to-male sexual contact	423050	46.3	301658	47.8	121392	43.1
Injection drug use-Male	61888	6.8	41554	6.6	20334	7.2
Injection drug use-Female	37117	4.1	24225	3.8	12892	4.6
Male-to-male sexual contact and injection drug use	45638	5.0	32833	5.2	12805	4.5
Heterosexual contact-Male	57389	6.3	32261	5.1	25128	8.9
Heterosexual contact-Female	117000	12.8	71474	11.3	45526	16.1
Other	170833	18.7	126960	20.1	43873	15.6
<b>Age at the End of 2013</b>						
13–24	38553	4.2	27183	4.3	11370	4.0
25–34	129992	14.2	92851	14.7	37141	13.2
35–44	200126	21.9	139648	22.1	60478	21.4
45–54	316313	34.6	216199	34.3	100114	35.5
≥55	227931	25.0	155084	24.6	72847	25.8

**Table 2.**

Changes in viral suppression status during 2014 among persons aged 13 years with HIV infection diagnosed at year-end 2013, alive through 2014, and in HIV care, by selected characteristics, 33 U.S. jurisdictions

Characteristic	All persons who had 2 VLs in 2014 No.	First and last VL tests suppressed		VL status improved		VL status worsened		First and last VL tests unsuppressed	
		No.	%	No.	%	No.	%	No.	%
<b>Total</b>	<b>339515</b>	<b>256176</b>	<b>75.5</b>	<b>35665</b>	<b>10.5</b>	<b>14172</b>	<b>4.2</b>	<b>33502</b>	<b>9.9</b>
<b>Sex</b>									
Male (referent)	260249	200212	76.9	26499	10.2	10350	4.0	23188	8.9
Female	79266	55964	70.6	9166	11.6	3822	4.8	10314	13.0
<b>Race/Ethnicity</b>									
Black/African American	135008	91734	67.9	17320	12.8	7018	5.2	18936	14.0
Hispanic/Latino	76248	58576	76.8	7786	10.2	3236	4.2	6650	8.7
Other races	22289	16699	74.9	2412	10.8	913	4.1	2265	10.2
White (referent)	105970	89167	84.1	8147	7.7	3005	2.8	5651	5.3
<b>Transmission Category</b>									
Male-to-male sexual contact (referent)	170999	135322	79.1	16454	9.6	6027	3.5	13196	7.7
Injection drug use-Male	19922	14205	71.3	2266	11.4	1073	5.4	2378	11.9
Injection drug use-Female	13300	8898	66.9	1630	12.3	793	6.0	1979	14.9
Male-to-male sexual contact and injection drug use	19820	13882	70.0	2416	12.2	1100	5.5	2422	12.2
Heterosexual contact-Male	16826	12237	72.7	1924	11.4	795	4.7	1870	11.1
Heterosexual contact-Female	40478	29268	72.3	4506	11.1	1788	4.4	4916	12.1
Other	58170	42364	72.8	6469	11.1	2596	4.5	6741	11.6
<b>Age at the End of 2013</b>									
13–24	14634	7929	54.2	2766	18.9	895	6.1	3044	20.8
25–34	48293	31350	64.9	7325	15.2	2378	4.9	7240	15.0
35–44	73332	53060	72.4	8693	11.9	3171	4.3	8408	11.5
45–54	119063	92704	77.9	11144	9.4	4942	4.2	10273	8.6
55 (referent)	84193	71133	84.5	5737	6.8	2786	3.3	4537	5.4
<b>Diagnosis year</b>									
Diagnosed in 2013	16410	10025	61.1	3923	23.9	569	3.5	1893	11.5
Diagnosed prior to 2013 (referent)	323105	246151	76.2	31742	9.8	13603	4.2	31609	9.8
<b>Number of VL tests in 2014</b>									
2	136422	108095	79.2	8923	6.5	5205	3.8	14199	10.4
3	112574	88443	78.6	10658	9.5	4391	3.9	9082	8.1



Characteristic	All persons who had 2 VLs in 2014 No.	First and last VL tests suppressed		VL status improved		VL status worsened		First and last VL tests unsuppressed	
		No.	%	No.	%	No.	%	No.	%
4	58257	42329	72.7	8119	13.9	2580	4.4	5229	9.0
5 or more (referent)	32262	17309	53.7	7965	24.7	1996	6.2	4992	15.5

VL, viral load.

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