

Trends in ART Prescription and Viral Suppression Among HIV-Positive Young Adults in Care in the United States, 2009–2013

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Background: Only 13% of HIV-positive young adults are estimated to be virally suppressed and, even among those receiving medical care, HIV-positive young adults are less likely than older adults to take antiretroviral therapy (ART), be adherent, and be virally suppressed. We sought to examine trends in treatment and health outcomes from 2009 to 2013 among HIV-positive young adults (aged 18–24 years) in care.

Setting: The Medical Monitoring Project is a complex sample survey of HIV-infected adults receiving medical care in the United States.

Methods: We used weighted interview and medical record data collected from June 2009 to May 2014 to estimate trends in the prevalence of ART prescription, adherence, side effects, single-tablet ART regimens, regular care utilization, and viral suppression among young adults.

Results: From 2009 to 2013, there were significant increases in ART prescription (76%–87%) and the proportion of young adults taking ART who reported taking single-tablet regimens (49%–62%). There was no significant change in adherence, side effects, or regular care utilization. Although viral suppression at last test did not change (65% at both time periods), the proportion of young adults who were sustainably virally suppressed significantly increased (29%–46%). Accounting for ART prescription and single-tablet regimen use attenuated the sustained viral suppression trend.

Conclusions: Although the level of viral suppression among young adults in care remains suboptimal, the observed increases in

ART prescription and sustained viral suppression may be a cause for optimism regarding efforts to improve outcomes for this vulnerable population.

Key Words: HIV, youth, young MSM, antiretroviral therapy, viral load

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INTRODUCTION

HIV viral suppression is key to reducing the risk of HIV transmission, morbidity, and mortality,^{1,2} and thus it is crucial for prevention and care efforts. Only 13% of HIV-positive young adults are estimated to be virally suppressed³ and, even among those receiving medical care, HIV-positive young adults are less likely than older adults to take antiretroviral therapy (ART), be adherent, and be virally suppressed.^{4–6} Agwu et al found evidence of increasing ART use and decreasing viremia from 2002 to 2010 among a cohort of youth living with HIV who were perinatally infected.⁷ Recent developments in HIV care and treatment may have improved levels of viral suppression more broadly among young adults. Clinical guidelines now recommend the universal prescription of ART, and simpler, more tolerable ART regimens that may be more forgiving of nonadherence have been developed.^{8–10} There has also been enhanced focus across medical, public health, and community groups on improving the HIV care continuum among youth.^{11–13} However, the effect of these developments among HIV-positive youth nationally is unknown.

This analysis was guided by the following questions: have recent developments in HIV care and treatment been accompanied by increased ART prescription, adherence, and care utilization among young adults in care? If so, have these changes contributed to improvements in viral suppression? To answer these questions, we estimated temporal trends in these factors among HIV-positive young adults in care in the United States from 2009 to 2013.

METHODS

Medical Monitoring Project

We analyzed pooled data from the 2009–2013 cycles of the Medical Monitoring Project (MMP), an HIV surveillance system designed to produce annual nationally representative

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cross-sectional estimates of behavioral and clinical characteristics of HIV-infected adults receiving medical care in the United States and Puerto Rico. MMP methods, including sampling, weighting procedures, and response rates, have been described in detail elsewhere.¹⁴ During these years, MMP used a 3-stage, probability-proportional-to-size sampling method. First, US states and 1 territory were sampled, then facilities providing outpatient HIV care in those areas, and finally, eligible HIV-infected patients. All sampled states and territories participated in every cycle. The facility response rate ranged from 76% to 85%, and the patient response rate ranged from 49% to 55%. Eligible persons were HIV infected, were aged 18 years or older, and received medical care in participating facilities between January and April in the cycle year for which they were sampled. Interview and medical record abstraction data were collected from June 2009 through May 2014. Data were weighted on the basis of known probabilities of selection at state or territory, facility, and patient levels.¹⁵ In addition, predictors of nonresponse were determined from analysis of data from sampled facilities and patients, and data were then weighted to adjust for nonresponse, after established methods.^{16,17} Predictors of nonresponse varied by cycle year and project area, but in general, facility size, private practice, male gender, younger age, race/ethnicity, and shorter time since HIV diagnosis were associated with nonresponse and informed the weighting classes for the data.

In accordance with the federal human subject protection regulations¹⁸ and guidelines for defining public health research,¹⁹ MMP was determined to be a nonresearch, public health surveillance activity used for disease control program or policy purposes. Participating states or territories and facilities obtained local institutional review board approval to conduct MMP if required locally. Informed consent was obtained from all interviewed participants.

Analytic Methods

In this analysis, we included 636 young adults aged 18–24 years who were receiving HIV care in the United States. The sample sizes and proportions of the total MMP sample of all persons receiving HIV care by year were 2009, $n = 107$ (16%); 2010, $n = 125$ (21%); 2011, $n = 127$ (21%); 2012, $n = 144$ (22%); and 2013, $n = 133$ (21%). We estimated weighted percentages by year and used bivariate linear regression (ordinary least squares) to estimate trends from 2009 to 2013 in (1) ART prescription during the past 12 months, (2) regular care utilization (at least 1 viral load in each 6-month period during the past 12 months), (3) 100% adherence to ART doses during the past 3 days, (4) being bothered by ART side effects in the past 30 days, (5) taking a once-daily single-tablet ART regimen, (6) viral suppression (<200 copies/mL at last test), and (7) sustained viral suppression (<200 copies/mL at all tests during past 12 months). All measures were derived from medical record reviews except the adherence, side effects, and single-tablet regimen measures, which were self-reported. Beta-coefficients for year represent the average percentage point change from 1 year to the next. We considered trends to be statistically significant when $P < 0.05$. For the viral

suppression measures that showed a significant trend, we used multivariate linear regression to assess how much change in viral suppression was mediated by change over time in covariates that also significantly increased over the period. We also estimated trends in selected sociodemographic characteristics collected by interview (black non-Hispanic race versus other racial/ethnic groups, male gender versus female or transgender, homosexual or bisexual identity versus heterosexual, less than high school education versus higher, at or below household poverty guideline versus over, uninsured or only Ryan White HIV/AIDS Program coverage versus private or public insurance, 5 or more years since HIV diagnosis versus less than 5 years) and HIV disease stage derived from medical record review (AIDS or nadir $CD4^+$ 0–199 versus no AIDS and nadir $CD4^+$ 200+) to evaluate their roles as potential confounders of change over time in viral suppression. All data were weighted for unequal selection probabilities and nonresponse.

RESULTS

The characteristics of HIV-positive young adults in care in the United States during 2009–2013 have been reported elsewhere,⁴ but overall among the pooled data set ($n = 636$) 43% [95% confidence interval (CI): 37 to 50] were black men. Most had a gay or bisexual identity (62%, CI: 57 to 67) and were living in households at or below the poverty level (62%, CI: 56 to 66). Approximately 35% (CI: 28 to 41) were uninsured or only had Ryan White HIV/AIDS Program coverage. Over the 12 months before interview, 14% (CI: 10 to 18) reported being homeless and 11% (CI: 8 to 14) had been incarcerated. Most were diagnosed with HIV after the age of 10 years (88%, CI: 84 to 91), and three-quarters had been diagnosed for less than 5 years (75%, CI: 70 to 80). There were no significant changes in sociodemographic characteristics, time since HIV diagnosis, and HIV disease stage during 2009–2013 with the exception of an increasing proportion of men over the period (65% in 2009 to 74% in 2013, $\beta_{TRENDR} = 0.03$ $P_{TRENDR} = 0.03$, Table 1).

ART prescription among young adults significantly increased from 76% in 2009 to 87% in 2013 ($\beta_{TRENDR} = 0.04$ $P_{TRENDR} = 0.01$; Table 2). Among those taking ART, however, ART adherence and reported problems with side effects did not significantly change over the period. The proportion of young adults taking ART who reported taking a single-tablet regimen significantly increased from 49% in 2009 to 62% in 2013 ($\beta_{TRENDR} = 0.04$ $P_{TRENDR} = 0.04$). There was no significant change in regular care utilization over the period.

Although viral suppression at last test did not change over the period (65% in 2009 to 65% in 2013, $\beta_{TRENDR} = 0.02$ $P_{TRENDR} = 0.22$), the proportion of young adults who were sustainably virally suppressed significantly increased (29% in 2009 to 46% in 2013, $\beta_{TRENDR} = 0.05$ $P_{TRENDR} \leq 0.01$). Figure 1 illustrates these findings. The proportion of young adults who were virally suppressed at their last test and had sustained viral suppression increased from 2009 to 2013, but there was no concomitant increase in those who were virally suppressed only at their last test. Instead, the proportion who were only virally suppressed at their last visit decreased over

TABLE 1. Selected Characteristics of HIV-Positive Young Adults in Care by Year—Medical Monitoring Project, United States, 2009–2013

	2009		2010		2011	
	n (%)	95% CI	n (%)	95% CI	n (%)	95% CI
Race/ethnicity						
Not black, non-Hispanic	46 (45)	31% to 59%	57 (44)	34% to 54%	53 (39)	22% to 57%
Black, non-Hispanic	61 (55)	41% to 69%	68 (56)	46% to 66%	74 (61)	43% to 78%
Gender						
Not men	41 (35)	25% to 45%	40 (35)	25% to 45%	35 (26)	19% to 33%
Men	66 (65)	55% to 75%	85 (68)	55% to 75%	92 (74)	67% to 81%
Sexual orientation						
Not homosexual or bisexual	48 (40)	30% to 49%	47 (41)	29% to 53%	55 (41)	32% to 50%
Homosexual or bisexual	55 (60)	51% to 70%	75 (59)	47% to 71%	71 (59)	50% to 68%
Educational attainment						
Not < high school	86 (82)	74% to 90%	102 (79)	69% to 88%	97 (73)	65% to 82%
<High school	21 (18)	10% to 26%	23 (21)	12% to 31%	30 (27)	18% to 35%
At or below poverty guideline						
No	45 (48)	37% to 60%	44 (34)	25% to 43%	39 (37)	27% to 47%
Yes	54 (52)	40% to 63%	70 (66)	57% to 75%	75 (63)	53% to 73%
Health insurance/coverage						
Private or public insurance	75 (66)	55% to 77%	78 (64)	53% to 76%	82 (65)	52% to 78%
Ryan White only or uninsured	31 (34)	23% to 45%	44 (36)	24% to 47%	43 (35)	22% to 48%
Time since HIV diagnosis, yr						
<5	79 (76)	67% to 85%	91 (72)	60% to 85%	97 (79)	70% to 88%
5+	27 (24)	15% to 33%	34 (28)	15% to 40%	30 (21)	12% to 30%
HIV disease stage (medical record)						
AIDS or nadir CD4 ⁺ 0–199	47 (41)	32% to 51%	45 (37)	27% to 47%	57 (47)	37% to 57%
No AIDS and nadir CD4 ⁺ 200+	59 (59)	49% to 68%	80 (63)	53% to 73%	70 (53)	43% to 63%
	2012		2013		β _{TREND}	P _{TREND}
	n (%)	95% CI	n (%)	95% CI		
Race/ethnicity					0.02	0.34
Not black, non-Hispanic	56 (39)	29% to 50%	50 (37)	23% to 51%		
Black, non-Hispanic	88 (61)	50% to 71%	83 (63)	49% to 77%		
Gender					0.03	0.03
Not men	33 (24)	14% to 32%	32 (26)	19% to 32%		
Men	111 (76)	67% to 86%	101 (74)	68% to 81%		
Sexual orientation					0.02	0.23
Not homosexual or bisexual	54 (37)	26% to 48%	42 (31)	21% to 41%		
Homosexual or bisexual	87 (63)	52% to 74%	89 (69)	59% to 79%		
Educational attainment					−0.02	0.06
Not < high school	120 (86)	80% to 92%	115 (87)	81% to 92%		
<High school	24 (14)	8% to 20%	18 (13)	8% to 19%		
At or below poverty guideline					−0.01	0.49
No	44 (36)	24% to 48%	58 (51)	40% to 62%		
Yes	83 (64)	52% to 76%	55 (49)	38% to 60%		
Health insurance/coverage					0.00	0.88
Private or public insurance	93 (63)	52% to 74%	91 (68)	53% to 84%		
Ryan White only or uninsured	48 (37)	26% to 48%	40 (32)	16% to 47%		
Time since HIV diagnosis, yr					0.02	0.48
<5	99 (75)	67% to 84%	95 (74)	63% to 84%		
5+	45 (25)	16% to 33%	38 (26)	16% to 37%		
HIV disease stage (medical record)					0.00	0.89
AIDS or nadir CD4 ⁺ 0–199	55 (35)	27% to 43%	56 (43)	36% to 50%		
No AIDS and nadir CD4 ⁺ 200+	87 (65)	57% to 73%	76 (53)	50% to 64%		

All percentages are weighted; white and black persons were non-Hispanic, Hispanics may be of any race; all characteristics were self-reported unless otherwise noted. CI, confidence interval.

TABLE 2. Treatment and Health Outcome Characteristics of HIV-Positive Young Adults Receiving Medical Care by Year—Medical Monitoring Project, 2009–2013

	2009		2010		2011		2012		2013		2009–2013	
	n (%)	95% CI	n (%)	95% CI	n (%)	95% CI	n (%)	95% CI	n (%)	95% CI	β_{TREND}	P_{TREND}
Prescribed ART*	84 (76)	65 to 87	84 (66)	55 to 76	103 (81)	74 to 88	122 (82)	75 to 89	115 (87)	80 to 93	0.04	0.01
ART adherence, past 3 days†	63 (79)	68 to 89	59 (71)	57 to 83	65 (71)	61 to 82	96 (82)	76 to 88	90 (78)	71 to 85	0.01	0.36
Bothered by ART side effects at least half of the time, past 30 days†	17 (22)	12 to 32	12 (15)	8 to 23	16 (19)	11 to 27	24 (20)	13 to 27	22 (20)	11 to 29	0.001	0.92
Taking single-tablet ART regimen†	35 (49)	36 to 63	35 (43)	31 to 54	38 (41)	30 to 52	65 (56)	46 to 66	68 (62)	50 to 73	0.04	0.04
Regular care utilization†	79 (74)	64 to 84	91 (73)	64 to 82	95 (75)	66 to 83	102 (70)	63 to 78	93 (69)	60 to 78	−0.01	0.31
Viral suppression at last test*	67 (65)	54 to 77	64 (51)	44 to 58	72 (56)	49 to 63	93 (64)	57 to 71	85 (65)	58 to 72	0.02	0.22
Sustained viral suppression*	34 (29)	20 to 38	40 (31)	23 to 38	46 (38)	30 to 45	66 (45)	34 to 55	58 (46)	37 to 56	0.05	<0.01

Viral suppression, undetectable or <200 copies/mL; all variables measured in the past 12 months unless otherwise noted; all percentages are weighted.

*Documented in medical record.

†Interview self-report.

ART, antiretroviral therapy; CI, confidence interval.

the period. Adjusting for the increasing proportion of men among young adults over the period did not change the sustained viral suppression trend (adjusted $\beta_{\text{TREND}} = 0.05$, $P_{\text{TREND}} \leq 0.01$; data not shown in table). Accounting for ART prescription somewhat attenuated the sustained viral suppression trend (adjusted $\beta_{\text{TREND}} = 0.04$, $P_{\text{TREND}} = 0.02$), suggesting that some of the increase in sustained viral suppression was mediated by increased ART prescription. Adding to the model a variable measuring whether the person prescribed ART reported taking a single-tablet regimen further attenuated the sustained viral suppression trend (adjusted $\beta_{\text{TREND}} = 0.03$, $P_{\text{TREND}} = 0.04$).

DISCUSSION

We found significant improvements in sustained viral suppression from 2009 to 2013 among young adults in care, which were partially attributable to increases in the

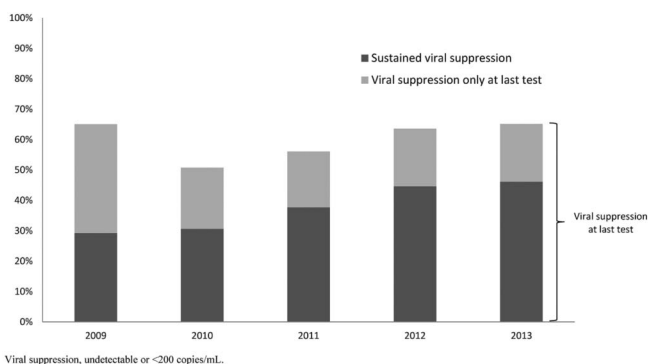


FIGURE 1. Viral suppression among HIV-positive young adults receiving medical care by year—Medical Monitoring Project, 2009–2013.

proportions of young adults who were prescribed ART and taking single-tablet regimens. However, we found no significant trend in viral suppression at last test. In any given year, only approximately 2/3 of young adults in HIV care were virally suppressed at last test, which is well short of the National HIV/AIDS Strategy 80% viral suppression goal for all diagnosed persons.¹³ However, increasingly more young adults were able to maintain suppression, and a smaller proportion were only suppressed at their last test, which indicates that some progress has been made in improving health among this disproportionately affected population.

Our data show that between 2009 and 2013, providers were more likely to prescribe ART to young adults in later years and also more likely to prescribe single-tablet regimens, both of which were associated with increased levels of sustained viral suppression. During this period, guidelines for initiating ART steadily moved away from using CD4 count as a criterion for initiation,⁸ and our data may reflect increasing provider adoption of these guidelines. Providers have often cited concerns about treatment readiness and other barriers to adherence as a reason to defer ART initiation for otherwise clinically eligible young people,^{20,21} who on average report lower adherence than older persons.⁴ However, providers may have grown less concerned about non-adherence as a reason to defer therapy among young adults because of the increasing evidence of the benefits of early ART and the availability of better regimen options that are more forgiving of nonadherence.⁹ The development of multiple single-tablet regimens during this period, which are associated with better adherence, lower cost, and increased patient satisfaction,¹⁰ also may have facilitated provider prescription of these regimens among young adults.

Despite improvements in sustained viral suppression, the prevalence of viral suppression at last test remained stable from

2009 to 2013. This stability may be due to the lack of improvement in adherence among young adults. Although one might expect that the increase in use of single-tablet regimens would be accompanied by increased adherence, it is important to note that our measure of adherence is self-reported and limited to the past 3 days, which may overestimate adherence and limit our ability to detect differences among persons due to ceiling effects.²² It is also possible that the use of single-tablet regimens has a greater effect on nonpersistence (treatment discontinuation) rather than nonadherence (treatment interruption over a specified period); Sweet et al found that nonpersistence was higher among persons taking multitablet regimens compared with single-tablet regimens.²³

Despite the limitations of the adherence measure, the lack of improvements observed among young adults suggests that wider development and implementation of effective strategies to improve adherence among young persons may be warranted. A recent systematic review of adherence interventions for youth found that most interventions were small pilots that need to be replicated; their findings indicated that a phone-based counseling approach with adherence monitors and weekly individual and family counseling may be effective strategies for improving adherence in this population.²⁴ Our findings on the contribution of single-tablet regimens to improvements in sustained viral suppression suggest that simplifying regimens might be an effective strategy to increase viral suppression among young adults. In addition, when selecting regimens providers may need to consider the relatively high prevalence of side effects reported by young adults, which did not decrease over the period. The development of injectable long-acting antiretrovirals may also prove to be a promising strategy for increasing viral suppression among this population.²⁵

This analysis has limitations. First, our patient response rates ranged from 49% to 55%, although our use of population-based sampling methods and weighting adjustments for nonresponse should reduce bias,²⁶ and the MMP population is demographically similar to all HIV-diagnosed persons in the United States.²⁷ Another potential limitation to the generalizability of our estimates is our selection of patients based on receipt of HIV care in the first 4 months of the calendar year. However, Sullivan et al²⁸ found that 88% of patients with HIV had a medical visit in the first 4 months of the year, although there were some clinical differences in this group compared with those seen later in the year. We should note, however, that our findings regarding trends should not be affected by these limitations, as they were consistent throughout the period. As noted earlier, our adherence measure is self-reported and only captures the past 3 days, which may overestimate adherence because of measurement error resulting from social desirability bias and limit our ability to assess changes in adherence because of ceiling effects.²² In addition, we did not assess other potential explanatory factors for changes in viral suppression, such as changes in ART regimens. Finally, we cannot assess temporality between the self-reported interview measures and viral suppression.

In conclusion, we saw significant improvements in sustained viral suppression among HIV-positive young adults

in care in the United States, which seem to be partially attributable to increases in ART prescription and use of single-tablet regimens. However, it is important to note that the level of viral suppression among young adults in care remains low; it falls short of the National HIV/AIDS Strategy goals and is significantly lower than that found for older age groups.¹³ Nevertheless, the observed increases in ART prescription and sustained viral suppression among young adults in care are encouraging and suggest there may be a cause for optimism regarding efforts to improve outcomes for this vulnerable population.

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