Impact of health insurance, ADAP, and income on HIV viral suppression among US women in the Women's Interagency HIV Study, 2006–2009

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Abstract

Background—Implementation of the Affordable Care Act motivates assessment of health insurance and supplementary programs, such as the AIDS Drug Assistance Program (ADAP) on health outcomes of HIV-infected people in the United States. We assessed the effects of health insurance, ADAP, and income on HIV viral load suppression.

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Methods—We utilized existing cohort data from the HIV-infected participants of the Women's Interagency HIV Study (WIHS). Cox proportional hazards models were used to estimate the time from 2006 to unsuppressed HIV viral load (>200 copies/mL) among those with Medicaid, private, Medicare or other public insurance, and no insurance, stratified by use of ADAP.

Results—In 2006, 65% of women had Medicaid, 18% had private insurance, 3% had Medicare or other public insurance, and 14% reported no health insurance. ADAP coverage was reported by 284 women (20%); 56% of uninsured participants reported ADAP coverage. After accounting for study site, age, race, lowest observed CD4, and prior health insurance, the hazard ratio (HR) for unsuppressed viral load among those privately insured without ADAP, compared to those on Medicaid without ADAP (referent group), was 0.61 (95% CI: 0.48–0.77). Among the uninsured, those with ADAP had a lower relative hazard of unsuppressed viral load compared to the referent group (HR, 95% CI: 0.49, 0.28–0.85) than those without ADAP (HR, 95% CI: 1.00, 0.63–1.57).

Conclusions—While women with private insurance are most likely to be virally suppressed, ADAP also contributes to viral load suppression. Continued support of this program may be especially critical for states that have not expanded Medicaid.

INTRODUCTION

Health care availability, accessibility, and quality are important determinants of health.[1] About 15% of the US population lacked health insurance prior to the Affordable Care Act; Blacks and Hispanics, racial/ethnic groups that are disproportionately both poor and affected by HIV, were most likely to be uninsured.[2] In 2009, among US adults in HIV care, 41% had Medicaid coverage, 30% were privately insured, 17% were uninsured, 6% had Medicare coverage, and 5% had other public coverage.[3] In the same year, 40% of all HIV-infected people received services through the Ryan White HIV/AIDS program.[3] This program is a federal program that disburses funds to states and localities for a variety of HIV related programs including HIV counseling and testing, engagement in care, health insurance premium assistance, medical transportation, and case management.[4] The AIDS Drug Assistance Program (ADAP) is a part of the Ryan White program that provides HIV-related prescription drugs to low-income individuals with limited or no prescription drug coverage. Health insurance and prescription drug coverage increase use of antiretroviral therapy (ART),[5–8] a lifesaving therapy for those with HIV infection. To better understand the effects of the expansion of services and health insurance coverage resulting from the Affordable Care Act, estimates of the effects of insurance prior to implementation are needed.

Suppression of plasma HIV viral load with ART has critical implications for the health of HIV-infected individuals and their ability to transmit infection.[9,10] Consistent use of ART is necessary for HIV suppression; failure to establish or sustain viral suppression can result from poor adherence[11] and interrupted access to medication.[12] Given the high cost of HIV treatment in the US,[13] financial resources and health insurance[6,14] or ART provision through other means, such as ADAP, are crucial to maintaining uninterrupted access to ART, averting

disease progression and death, and limiting HIV transmission. While the link between health insurance and ART prescription[6,8] and initiation[7] has been established, to our knowledge there has been no research that bridges these intermediaries to study the effects of health insurance on viral load suppression.

We used prospective data from the Women's Interagency HIV Study (WIHS) to estimate the effect of health insurance status and type on unsuppressed HIV viral load in the era of modern ART and to estimate the effect of income on unsuppressed HIV viral load among participants with Medicaid. We address both initial and ongoing access to ART by including those who have never received ART and those who are already on therapy. Because many states began enacting policy changes as early as 2010 in anticipation of the Affordable Care Act, we analyzed data from 2006 through 2009.

METHODS

Women's Interagency HIV Study

Recruitment, retention, and study characteristics of WIHS participants have been previously reported.[15,16] In brief, HIV-infected and -uninfected women were recruited to participate in this cohort study during four waves. For this analysis, we included HIV-infected women enrolled during 1994–5 and 2001–2 who had a viral load measurement at visit 24 (index date, April–September 2006) or at the subsequent visit, 6 months later. Study visits are conducted approximately every 6 months and consist of a structured interview, clinical examination, and specimen collection.

Ascertainment of Viral Load

Viral load was measured every 6 months using the Nuclisens HIV-1 QT assay, which has a lower limit of detection of 80 copies/mL and an upper limit of quantification of 3.47×10^6 copies/mL. Unsuppressed viral load was defined as a single viral load measurement of >200 copies/mL.[17]

Ascertainment of Health Insurance Status, Income, and Covariates

Insurance type at the index date was the primary exposure. We categorized the insured into four mutually exclusive groups using a classification hierarchy similar to the one used by the Kaiser Family Foundation.[3] Insurance categories were assigned in this order: Medicaid or Medi-Cal, private insurance (including student insurance), other insurance (including Medicare, Tricare/CHAMPUS, Veteran's Administration, and city or county coverage), and no health insurance. Participants also reported participation in ADAP for which eligibility depends on state of residence; insurance was stratified by ADAP participation.

Annual household income, self-reported at each visit, was a second exposure of interest. As most participants on Medicaid reported incomes in the lowest three categories (i.e., <$6,000, $6,001 to $12,000, $12,001 to $18,000), for select analyses we collapsed all individuals with incomes of >$18,000 per year into one category.

Birthdate, recruitment wave, and educational attainment (in categories of less than, equal to, or more than high school education) were collected at entry into the cohort. Race was

reported in the following categories: white and non-Hispanic, white and Hispanic, African American and non-Hispanic, African American and Hispanic, Other Hispanic, Asian/Pacific Islander, Native American/Alaskan, and Other. Given the small number of participants, we dichotomized race into African American and Other. We also created a variable for Hispanic ethnicity. At each visit, participants reported diagnoses of AIDS since the last visit. CD4+ T cell counts were measured at each visit; the nadir, or lowest observed value prior to index date, was used as a proxy for HIV disease progression.

Statistical Methods

Time was counted from the index date until the first observed unsuppressed viral load (>200 copies/mL) or censoring (death or loss to follow up (> 3 consecutive missed visits)). Time was administratively censored after 3 years. Hazard ratios were estimated using Cox proportional hazard models[18] with Efron's approximation for tied event times.[19] Wald-type 95% confidence intervals were estimated using the standard large-sample variance approximation in the crude and regression adjusted models, and robust variance for weighted models.[20] The proportional hazards assumption was assessed visually from the plot of the non-parametric estimates of the log cumulative hazard functions.

As requirements for Medicaid eligibility are based on income, inclusion of income as a confounder violates the positivity assumption (i.e., there are few high income participants on Medicaid; see Supplemental Figure 1).[21] A common solution to positivity violations is to restrict analysis to a subset in which there is positivity. Therefore, to estimate the effect of income on unsuppressed HIV viral load, we restricted this analysis to participants who were on Medicaid at visit 24.

Observed data were weighted by the product of stabilized inverse probability-of-exposure-and-censoring weights to account for confounding and selection bias by measured characteristics.[22,23] This method, conditional on a few assumptions, approximates a randomized trial by reweighting the population so that health insurance is randomly distributed conditional on confounders included in the weight estimation model.[24] Health insurance type was modeled using standard multinomial logistic models; censoring was modeled using pooled logistic regression. Confounders included age (using restricted quadratic splines (RQS)[25] with knots at 35.7, 41.6, 46.7, and 50.8 years), African American race, study site, lowest observed CD4 cell count (using RQS with knots at 94, 191, 269, and 383 cells/μL), prior HIV viral load (as the average of the $\log_{10}$ viral load for 3 visits prior to the index date, using RQS with knots at 4.4, 4.7, 7.4, and 9.7), and prior health insurance status (6 months prior). Not included as confounders in the final weight model were recruitment wave, Hispanic ethnicity, and prior AIDS diagnosis as these variables did not alter the variance or final effect estimate. A trial in which health insurance is randomized would have randomized on prior viral load, and therefore we included prior viral load as a potential confounder. However, due to concern about over-adjustment, we present results that do and do not account for prior viral load. Weights were stabilized by prior health insurance type. The resultant weights had a mean (standard deviation (SD)) of 1.10 (2.46) with a range of 0.003 to 86.24. Inverse probability of exposure weights trimmed at 0.1 and

10 yielded weights with a mean (SD) of 1.03 (0.90). Results using the trimmed weights are reported here[23]; use of untrimmed weights produced similar results.

Income was modeled in a similar fashion using multinomial logistic regression; censoring was modeled using pooled logistic regression. Candidate confounders included age, African American race, study site, nadir CD4 cell count, and prior viral load. Similar to the analysis of health insurance, we present results that do and do not account for prior viral load. The resultant weights had a mean (SD) of 0.99 (0.36) with a range of 0.15 to 4.48. All analyses were conducted using SAS 9.3 (SAS Institute, Cary, North Carolina).

RESULTS

Among 1,481 HIV-infected WIHS women, most (65%) reported Medicaid as their insurance provider, 18% had private insurance, 3% had Medicare or other public insurance, and 14% reported no health insurance (Table 1). Over the three year study period, 15% of participants reported a change in insurance type subsequent to the index date. Changes in insurance (loss or gain) were not differentially distributed by unsuppressed viral load.

The median age of participants with other public insurance (median; interquartile range (IQR): 38; 33, 46) was lower than those on Medicaid (median; IQR: 43; 38, 49). African Americans comprised 56% of the population; of the 963 participants on Medicaid, 62% were African American. Hispanics comprised 27% of the overall population, and represented 45% of the uninsured. The distribution of insurance type by WIHS site varied; 45% of the participants on Medicaid attended a site in New York. Half of the participants with other insurance attended a site in California. Participants with Medicaid were the most likely to have a yearly income of less than $12,000 a year (62%, for full distribution see Supplemental Materials), were less likely to be employed (21%), and fewer attained a high school education (45%) compared with other groups. While women with Medicaid group reported more prior AIDS diagnoses (46%), the median lowest observed CD4 cell count among all groups was similar.

About three quarters of the total population was using ART at the index visit. There were no differences in ART use by health insurance category. Women with no health insurance (56%) and those with other public insurance (31%) were more likely to participate in ADAP than those with private insurance (17%) or Medicaid (11%).

There were 898 women who had viral load measurements >200 copies/mL over the 4,917 visits that occurred during 2006–2009. The median time to first unsuppressed viral load was 525 days (IQR: 189, 1082) with a median unsuppressed viral load of 3,400 copies/mL (IQR: 710, 23,000). In the crude analysis, participants with Medicaid without ADAP (the referent group) had the highest hazard of a viral load >200 copies/mL (Table 2).

Weighted analyses are presented in Table 2. Weights for other insurance were not estimated because this group was a conglomeration of types of insurance with substantially different eligibility criteria. These weighted results represent marginal estimates, in this case the hazard ratio of virologic failure if all participants in the study received a given exposure compared to if all participants received the referent exposure (i.e., Medicaid without ADAP).

In models which account for study site, age, race, lowest CD4 cell count, and prior HIV viral load, ADAP only (HR: 0.49, 95% CI: 0.28, 0.85), private insurance without ADAP (HR: 0.61, 95% CI: 0.48, 0.77), and private insurance with ADAP (HR: 0.52 95% CI: 0.31, 0.91) all had lower hazards of virologic failure compared to Medicaid without ADAP.

Among participants on Medicaid, a yearly income of >$18,000 per year compared to < $6,000/year, yielded a hazard ratio of 0.79 (95% CI: 0.60, 1.02) when accounting for study site, age, race, and lowest CD4 cell count (Table 3). When we additionally accounted for prior viral load, the hazard ratio comparing these same groups moved to 1.06 (95% CI: 0.80, 1.41).

DISCUSSION

We evaluated the effect of health insurance status and type on risk of having an unsuppressed HIV viral load among HIV-infected women in the WIHS over the span of three years. Among participants who did not participate in ADAP, those with Medicaid or no insurance were most likely to have unsuppressed viral load compared to women with private insurance. Among HIV-infected women in all insurance categories except private insurance, ADAP increased the likelihood of virologic suppression, especially among otherwise uninsured women, who were twice as likely to achieve virologic suppression if on ADAP. These findings underscore the importance of this program.

In addition to antiretroviral medications, participants enrolled in ADAP may have accessed case management, patient transportation, and child-care during HIV-related appointments. Availability of these auxiliary programs may explain a portion of the beneficial effects of ADAP observed in this study.

Health insurance is likely to impact all steps along the HIV continuum of care: HIV diagnosis, linkage to care, retention in care, prescription of ART, and viral suppression. For example, in a cross-sectional analysis among WIHS women eligible for ART, ADAP participation was associated with increased use of ART.[26] Additionally, people living in states that did not contribute to the ADAP budget were more likely to have delayed initiation of ART after treatment was indicated.[27] Further along the continuum of care, McFall et al. showed that among white and Hispanic women on ART in the WIHS, lack of health insurance (compared with public health insurance) was associated with virologic failure following suppression.[28] These studies suggest that type and status of health insurance influence ART receipt and virologic failure after suppression. However, because health insurance strongly affects the likelihood that an individual will receive ART, the effect of health insurance on virologic suppression in a population with diverse health insurance coverage cannot be extrapolated only from participants who are on ART. The current study provides estimates of the effects of health insurance that include the pathway through access to ART, and thus evaluates the effect of health insurance on viral suppression in a study population that more closely approximates the general population of HIV-infected women in the US.

Poverty increases mortality among HIV-infected people,[29,30] but the pathways between poverty and death are not well established. In our study population, even among women with Medicaid (who by virtue of their Medicaid eligibility already have low income), those in the lowest income category were less likely to experience viral suppression even after adjustment for nadir CD4 cell count. Although initial viral load can affect future virologic response, adjustment for viral load prior to study entry could inappropriately nullify the relationship between income and subsequent virologic suppression: high income individuals with high initial viral loads likely have greater resources and ability to navigate complex care systems than those with much lower incomes.

This study has some limitations. First, participants may not have correctly self-reported their health insurance (status and type) and their incomes. Though we have no available confirmatory data on health insurance during this study period, we did compare current report of health insurance with clinic records among Chapel Hill WIHS participants. Among this group (n=67), 94% of self-reported insurance type matched the insurance type on file at the clinic (data not shown). In addition, studies have suggested[31–33] that those who self-reported no insurance are likely uninsured, and that there are few participants who self-reported Medicaid insurance when they were privately insured. Second, as in all observational studies, we rely on the assumption of no unmeasured confounding. For the relationship between health insurance and viral load suppression, an important confounder, income, was not accounted for. We were unable to account for this confounder because of positivity (i.e., no high income participants in Medicaid). Third, participants in the WIHS, a long-term cohort study in states with generous ADAP programs (see Supplemental Materials), may differ from the HIV-infected population in the US, limiting generalizability. Finally, we assume that the variations within types of insurance coverage were negligible with regards to viral load suppression (i.e., consistency). However, not all types of insurance coverage are homogeneous, and participants may have had different levels of coverage and services that likely had an impact on viral load suppression.[34] By adjusting for study site, we accounted for some of this variability between Medicaid plans as this type of insurance coverages is determined by the state.

In conclusion, our results underscore the importance of health insurance and ADAP coverage in suppression of HIV viral load. Suppression of viral load on the individual level has been identified as a crucial piece in HIV transmission,[9,10] and consequently impacts the public's health. A number of factors, including high comorbidities, inadequate access to health resources, and substance use contribute to the poor outcomes for those with Medicaid[35] and should not be interpreted as dissuasion to expand Medicaid coverage. Increasing provision of insurance to HIV-infected people will likely increase the proportion of virally suppressed individuals. However, not all states have expanded Medicaid coverage, leaving a gap in health care access for the working poor.[36] Participation in ADAP improves HIV outcomes; this program may be especially critical for HIV-infected people in states that have not expanded Medicaid.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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TABLE 1

Characteristics of HIV-infected WIHS participants in 2006, by insurance type

Characteristic	Medicaid n=963		Private n=265		None n=205		Other Public n=48		Total n=1,481	
	N	%	N	%	N	%	N	%	N	%
Median age (median, IQR)	43 (38, 49)		43 (38, 49)		45 (39, 51)		38 (33, 46)		43 (37, 49)	
African American	599	62.2	114	43.0	92	44.9	25	47.9	830	56.0
Hispanic ethnicity	252	26.2	43	16.2	93	45.4	16	33.3	404	27.3
WIHS site										
Bronx	230	23.9	18	6.8	8	3.9	5	10.4	261	17.6
Brooklyn	202	21.0	53	20.0	31	15.1	4	8.3	290	19.6
Washington DC	102	10.6	84	31.7	34	16.6	9	18.8	229	15.5
Los Angeles	141	14.6	40	15.1	83	20.5	16	33.3	280	18.9
San Francisco	155	16.1	35	13.2	11	5.4	10	20.8	211	14.3
Chicago	133	13.8	35	13.2	38	18.5	4	8.3	210	14.2
Using HAART	699	72.6	194	73.2	148	72.2	38	79.2	1,079	72.9
ADAP	109	11.3	45	17.0	115	56.1	15	31.3	284	19.2
Married	164	17.0	108	40.8	66	32.2	11	22.9	349	23.6
Median income $12,000/year	595	61.8	21	7.9	84	41.0	22	45.8	722	48.8
Educational attainment										
Less than high school	436	45.3	28	10.6	83	40.5	16	33.3	563	38.0
High school diploma	300	31.2	53	20.0	59	28.8	12	25.0	424	28.6
More than high school	226	23.5	184	69.4	61	29.8	20	41.7	491	33.2
Employed	204	21.2	220	83.0	109	53.2	13	27.1	546	36.9
Lowest observed CD4 (median, IQR)	215 (107, 333)		261 (153, 356)		191 (59, 338)		266 (171, 370)		228 (121, 346)	
Prior AIDS	438	45.5	80	30.2	53	25.9	21	43.8	592	40.0
Mode of HIV transmission										
Intravenous drug use	268	27.8	38	14.3	24	11.7	6	12.5	336	22.7
Heterosexual contact	395	41.0	133	50.2	75	36.6	20	41.7	623	42.1
None identified	278	28.9	81	30.6	101	49.3	22	45.8	482	32.6

TABLE 2

Weighted hazard of unsuppressed viral load by health insurance among WIHS women, 2006–2009

Insurance type		VL>200	Visits	Unadjusted		Weighted*		Weighted**	
				HR	95% CI	HR	95% CI	HR	95% CI
ADAP									
No insurance	No	57	90	0.91	0.69, 1.20	1.05	0.68, 1.63	1.00	0.63, 1.57
	Yes	59	115	0.67	0.51, 0.88	0.52	0.29, 0.92	0.49	0.28, 0.85
Medicaid insurance	No	561	854	1.		1.		1.	
	Yes	63	109	0.76	0.59, 0.99	0.81	0.50, 1.30	0.77	0.47, 1.27
Private insurance	No	111	220	0.65	0.52, 0.78	0.67	0.52, 0.85	0.61	0.48, 0.77
	Yes	24	45	0.71	0.47, 1.07	0.57	0.34, 0.98	0.52	0.31, 0.91
Medicare/other	No	18	33	0.76	0.47, 1.21				
public insurance ***	Yes	5	15	0.41	0.17, 1.00				

*
Accounting for study site, age, race, and lowest CD4 (at baseline), and average log10 (viral load) in the 3 visits prior to index date (spline)

**
Accounting for study site, age, race, and lowest CD4 (at baseline)

***
Weighted results for Medicare/other public insurance are not reported here as there were few participants and weights were not stable

TABLE 3

Weighted hazard of unsuppressed viral load by income among WHS women with Medicaid health insurance, 2006–2009

	VL>200	Visits	Unadjusted			Weighted[*]			Weighted[**]		
			HR	95% CI		HR	95% CI		HR	95% CI	
Income											
<$6,000/year	52	177	1.			1.			1.		
$6,001–$12,000/year	148	418	0.84	0.68, 1.03		1.09	0.84, 1.41		0.93	0.73, 1.18	
$12,001–$18,000/year	59	164	0.77	0.59, 1.00		1.08	0.80, 1.46		0.88	0.66, 1.17	
>$18,000/year	80	204	0.70	0.55, 0.90		1.06	0.80, 1.41		0.79	0.60, 1.02	

[*] Accounting for study site, age, race, and lowest CD4 (at baseline), and average log10 (viral load) in the 3 visits prior to index date (spline)

[**] Accounting for study site, age, race, and lowest CD4 (at baseline)