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Characterizing the association between alcohol and HIV virologic failure in a military HIV-infected cohort on antiretroviral therapy

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Abstract

Background—The effects of at-risk drinking on HIV infection remain controversial. We investigated the impact of self-reported alcohol consumption on surrogate markers of HIV progression among individuals initiated on highly active antiretroviral therapy (HAART).

Methods—We analyzed individuals who were surveyed on alcohol use within a year of HAART initiation between 2006–14. At-risk drinking was defined as consumption of at least three or four drinks/day, or seven and 14 drinks/week among women and men, respectively. We performed time-updated generalized estimating equation (GEE) logistic regression to determine the effect of at-risk drinking on virologic failure (VF) and mixed-effects linear regression on CD4 count reconstitution, controlling for potential confounders.

Results—Of 907 individuals initiated on HAART, 752 individuals with alcohol survey data were included in the analysis. Of these, 45% (n=336) met criteria for at-risk drinking at HAART initiation on at least one survey. The rates of VF were 4.30 per 100 person-years (95%CI [2.86, 6.21]) for at-risk drinkers and 2.45 per 100 person-years (95%CI [(1.57,3.65)] for individuals without at-risk drinking. At-risk drinking was not significantly associated with VF (OR 1.73, 95%

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CI [0.92, 3.25]) 0.087 or CD4 reconstitution (CD4 increase 11.4; 95% CI [-19.8, 42.7]) in univariate analyses; however, in our multivariate model, a statistically significant relationship between VF and at-risk drinking was observed (OR 2.28 [95% CI 1.01, 5.15]).

Conclusions—We found a high proportion of at-risk drinking in our military cohort, which was predictive of VF in multivariate analysis. Given alcohol's effect on myriad HIV and non-HIV outcomes, interventions to decrease the prevalence of at-risk drinking among HIV-infected individuals are warranted.

Keywords

HIV; alcohol; military; virologic failure; HAART

Introduction

Attention to drug and alcohol use disorders is an important, though sometimes overlooked, aspect of HIV treatment. HIV-infected individuals have higher prevalence of alcohol use disorders than do uninfected individuals, which has important implications for effective clinical management. While alcohol use and at-risk consumption have been associated with decreased medication adherence (Azar et al., 2010, Hendershot et al., 2009), treatment interruption (Conen et al., 2013) and increased sexual risk behavior (Stein et al., 2005), conclusive evidence on alcohol's effect on HIV disease progression has been more difficult to establish. In the absence of highly active antiretroviral therapy (HAART), alcohol consumption has been associated with lower CD4 counts (Samet et al., 2007), but not progression to AIDS (Hahn and Samet, 2010); in the post-HAART era, studies have yielded mixed results (Baum et al., 2010, Chander et al., 2006, Conen et al., 2013, Kowalski et al., 2012, Samet et al., 2007, Wu et al., 2011).

The effect of alcohol is thought to be mediated by direct immune toxicity and also indirectly through malnutrition and liver disease. Alcohol induces T cell apoptosis and inhibition of T cell responses and diminishes important functionality of natural killer (NK) cells (Barve et al., 2002, Kapasi et al., 2003) and macrophages (Watson et al., 1994). Thus, findings of increased disease progression in the pre-HAART era were likely related to diminished T cell immunity, with more dramatic effects seen at heavier levels of drinking (Hahn and Samet, 2010). More recent simian studies have provided evidence that chronic alcohol intake prior to and during HIV infection results in a higher viral set point, more rapid progression to end-stage disease, and AIDS wasting (Bagby et al., 2006, Molina et al., 2008, Molina et al., 2006). In humans, however, a direct effect has been more difficult to establish, as it is challenging to disentangle alcohol abuse from various related factors, including poor adherence and polysubstance abuse.

In the United States military, the prevalence of binge and heavy drinking are high, particularly among younger-aged individuals, while illicit drug use is relatively uncommon (2012, Bray et al., 2009, Bray et al., 2010). Prior reports have found that up to two-thirds of active duty military personnel below 25 years of age report binge drinking, placing them at risk for alcohol-related harm (Stahre et al., 2009). Nonetheless, despite the high prevalence of both alcohol abuse and sexual risk behavior in this population (Goyal et al., 2012),

alcohol use in the context of HIV infection has not been studied among active-duty military personnel. The question is of significant importance for a population where binge drinking and heavy drinking are commonplace, and the low level of illicit drug use offers an opportunity to better understand the effects of alcohol use on HIV outcomes. Using data from the prospective U.S. Military HIV Natural History Study (NHS), we examined the effect of at-risk drinking on HIV surrogate markers (virologic failure and CD4 increase) in a population receiving HAART.

Materials and Methods

The U.S. Military HIV Natural History Study (NHS) is a prospective observational cohort of consenting HIV-infected military personnel and beneficiaries. Active duty personnel must test negative for HIV infection prior to entry into U.S. military service, and subsequently, they undergo HIV screening every one to five years (approximately every two years in the most recent decade). HIV-positive service members are required to undergo routine medical evaluations at a military treatment facility (MTF) at least every 6-12 months. During one of these medical visits, service members are invited to participate in the voluntary NHS; since 1986, more than 5,700 participants, or approximately half of all individuals diagnosed, have enrolled in the NHS..(Weintrob et al., 2008) Study visits are conducted every six months. Routine laboratory measurements at each treatment facility include viral load, CD4 count and hepatitis B/C serologies; participants also undergo physician examination and meet with a research coordinator, at which time they are surveyed on domains including demographics, medical history medication use and adherence. All subjects have provided informed consent for participation, and the protocol has been reviewed and approved by the central IRB and at each participating site.

Since 2006, through a self-administered pen/paper questionnaire, annual data have been collected on self-reported alcohol use, including the typical and maximum number of drinks consumed on a single day and the number of drinking days per week over the prior twelve months. For this study, analysis was limited to those study participants who were initiated on HAART during or after January, 2006 through May, 2014 and who had at least one alcohol risk survey within a year of HAART initiation. Only one alcohol questionnaire was used per calendar year, with the latest date chosen if there were more than one. At-risk drinking was defined using criteria established by the National Institute for Alcohol Abuse and Alcoholism (Dawson, 2010) with greater than four drinks in a 24-hour period or 14 drinks/week for men, and greater than three drinks in a 24-hour period or 7 drinks/week for women. All analyses were performed using R version 2.13.2.

Multivariate Models

We constructed a time-updated, multivariate model using generalized estimating equation (GEE) logistic regression to determine the effect of at-risk drinking on virologic failure (VF) following HAART initiation. Our model was adjusted for age, race, gender, HIV viral load at HAART initiation, AIDS or ART use (e.g. monotherapy) before HAART initiation, less than perfect HAART adherence elicited by self-report, and time on HAART. VF was defined as the first of two consecutive viral load measurements greater than 200 copies/mL

beginning six months after HAART initiation, irrespective of prior suppression. The modeled outcome was a binary indicator of VF during each year of follow-up. In a second analysis, linear mixed effects regression was used to quantify the effect of alcohol use at HAART initiation on CD4 reconstitution beginning with the first year of HAART. The endpoint for this regression was all available CD4 counts; in this model, the rate of CD4 increase was assessed by using days elapsed from HAART initiation for each CD4 count after HAART initiation.

We found that a number of subjects missed at least one year of alcohol screening during follow-up, primarily at the beginning of the evaluation period and largely owing to staggered roll-out of the survey at clinical sites, as opposed to participant non-response. To identify the potential impact of missing data, we conducted exploratory analyses comparing participants with and without alcohol survey data, along with sensitivity analyses, including Bayesian and inverse probability weighting. We found that risk behaviors tended to not change frequently in this cohort (77% of years classified as “not at-risk” were followed by “not-at-risk” classified year and 72% of “at-risk” years are followed by “at-risk” classified years). Thus, where data was missing, we used the last available survey result in the multivariate model used to determine correlates of VF; multiple imputations and a last-value carried forward were also calculated to test the sensitivity of this approach.

Results

Of 801 subjects who initiated HAART on or after January 1, 2006, 752 had data on alcohol risk at HAART initiation and were included in the analysis (Figure 1). Baseline characteristics of the analyzed cohort are provided in Table 1; of all individuals, 45% (336/752) met criteria for at-risk drinking on at least one survey; the median number of years analyzed for each subject was 2.3 (IQR 1.1, 4.0). At-risk drinking significantly differed by race (p -value<0.001), with a higher prevalence among Caucasians than among individuals categorized as Hispanic, African-American or other. In addition, at-risk drinkers were more likely to be younger at the time of HIV diagnosis (median age 26 [IQR 23,32] vs 29 [IQR 24,36] and HAART initiation (median age 28 [IQR 24,35] vs 32 [IQR 26,40], p <0.001). At-risk drinkers tended to be diagnosed in the latter part of the decade and had a significantly shorter interval between diagnosis and HAART initiation (median 7.5 months [IQR 2.3,25] vs 12 months [IQR 2.3,40], p =0.008). The two groups did not significantly differ with respect to marital status, service affiliation or rank (officer vs enlisted).

Regarding immunologic status, at-risk drinkers did not differ from non-drinkers with respect to CD4 count nadir, CD4 at HAART initiation, or viral load at the time of HIV diagnosis or HAART initiation (Table 2). In addition, the two groups did not differ by hepatitis B or C status. At-risk drinkers had a higher red blood cell MCV (median 89 fL [IQR 86,92] vs 88 fL [IQR 86,91] p =0.025) than individuals without at-risk drinking, though there were no differences in liver transaminase levels. Medication adherence was also similar between the two groups, both in the first survey obtained after HAART initiation and in the time-updated analyses, where it averaged 97.5% in both groups.

Last, the rates of VF for at-risk drinkers and individuals without at-risk drinking were 4.30 per 100 person-years (95% CI [2.86,6.21]) and 2.45 per 100 person-years (95% CI [2.45 (1.57,3.65)]), respectively. In univariate analysis, at-risk drinking was not associated with a slower rate of CD4 reconstitution (CD4 increase 11.4; 95% CI [-19.8, 42.7]) $p=0.475$), while a marginally significant association was noted with VF ($p=0.087$). In multivariate analysis (Table 3), at-risk drinking was significantly associated with VF (OR 2.28 [95% CI 1.01,5.15]); in addition, ten-year decreases in age were protective against VF (OR 0.50, [95% CI 0.26,0.96]). Sensitivity analyses did not show significant impact of missing data on the analyses (Appendix 1).

Discussion

In our longitudinal survey of HIV-infected military personnel, we found that at-risk drinking was not directly associated with an increased risk of VF following HAART initiation, though interestingly, a statistically significant relationship was observed in our multivariate model. Thus, the relationship between at-risk drinking and VF suggests that alcohol consumption may remain an important factor in virologic outcomes, potentially mediated by other factors such as total length of exposure or medication adherence. Our study therefore adds to a complex body of evidence, demonstrating that alcohol consumption is one of many factors that can interact to compromise virologic outcomes, presumably at higher levels of drinking. Conen et al, analyzing data from the Swiss cohort, found no effect of alcohol consumption on VF or change in CD4 count among 2,460 individuals, where 4.7% and 2.2% were characterized as moderate and heavy drinkers, respectively. Nonetheless, severe drinkers were more likely to experience treatment interruption when compared with abstainer/light drinkers, and in a sensitivity analysis, where individuals were not censored at the time of ART interruption, severe drinkers were more likely to experience virologic failure (Conen et al., 2013).

Elsewhere, several small, cross-sectional studies have shown that alcohol may affect virologic outcomes at higher levels of consumption. In a study of 241 individuals on ART in Philadelphia, Wu et. al. found that daily drinkers had a four-fold higher risk for detectable viral load, independent of adherence, though this effect was not observed when regular drinkers were added to the analysis (Wu et al., 2011). Among 231 HIV+ individuals in Miami, Baum et al found that heavy alcohol use (two or more drinks daily) was associated with higher viral load, though the authors speculate that the association was likely driven by reduced adherence (Baum et al., 2010). Last, in a cohort of injection drug users in Baltimore, failure to achieve virologic suppression was associated with hazardous drinking, though it could not be determined if this effect was found independent of medication adherence (Chander et al., 2006). On the basis of these studies, a link between VF and alcohol consumption with severe drinking cannot be ruled out completely, though the effect of problem drinking on virologic outcomes in an era of simplified and forgiving ART regimens may mitigate such effects.

In line with other longitudinal studies, we found no effect of at-risk drinking on change in CD4 count among individuals on HAART (Conen et al., 2013, Kowalski et al., 2012, Samet et al., 2007). Here, several unique characteristics of our cohort deserve mention. Owing to

routine screening in the military, HIV-infected individuals are diagnosed and managed early in the course of infection, and therefore a higher degree of immunologic preservation may be present than in the studies mentioned above. In turn, this relative immunologic preservation may protect against the deleterious effects of alcohol to a significant extent. Interestingly, at-risk drinkers in our study had significantly shorter times between HIV diagnosis and HAART initiation, which may have resulted from the fact that at-risk drinkers in our survey were diagnosed with HIV one year later (2009), when trends toward earlier initiation of therapy were observed.

Beyond the direct effects of alcohol consumption on immunologic function, at-risk drinking compromises and complicates HIV treatment, which indirectly leads to poor outcomes. Medication adherence among problem drinkers has been shown to compromise HIV-related health outcomes,(Azar et al., 2010, and it has also been demonstrated that alcohol users are less likely to receive quality indicators, such as prophylaxis or routine laboratory evaluations (Korthuis et al., 2012). However, in our active-duty population, periodic physician visits are mandatory for HIV-infected individuals, and thus most at-risk drinkers receive levels of care that potentially overcome alcohol-related barriers. Indeed, active-duty military status may have influenced the trend we observed of improved outcomes among younger individuals, which has not been observed in other studies (Fong et al., 2013, Hassan et al., 2014, Riddler et al., 2008). In addition, we observed high rates of adherence, among both at-risk drinkers and non-drinkers, possibly resulting from a system of centralized and guaranteed health care provided by the military. It remains to be seen whether the effects of problem drinking would be minimal in settings distinct from our centralized health delivery system.

There is increasing recognition of the inflammatory effects of HIV, with resultant increases in malignancies, cardiovascular disease (CVD) and other organ compromise. In a study of HIV-infected individuals from the Veterans Aging Cohort Study (VACS), hypertension, obstructive lung disease, candidiasis and bacterial pneumonia were associated with past or current alcohol use (Justice et al., 2006). Hazardous drinking and alcohol abuse/dependence have also been associated with a high prevalence of CVD among HIV-infected and uninfected individuals, even after adjusting for traditional CVD risk factors (Freiberg et al., 2010). The slight, though statistically significant increase in red blood cell MCV which we observed among at-risk drinkers may suggest that biologic effects of alcohol consumption may be distinct from virologic consequences among patients on HAART. These studies provide further justification for greater attention to alcohol use disorders among HIV-infected individuals where these outcomes may occur at higher rates, and ongoing studies are underway to examine the relationship between at-risk drinking and non-HIV/AIDS endpoints such as CVD and malignancies in our cohort.

Several additional findings in our study warrant mention, including the high and concerning proportion of at-risk drinkers (45%) which we observed. At-risk drinkers in our cohort tended to be younger, which is unique in studies of HIV-related alcohol use, though consistent with typical patterns of military drinking. In large surveys of drinking behavior, active duty military personnel under age 35 were significantly more likely to have engaged in heavy drinking than their civilian counterparts (a trend which reverses among individuals aged 46-64.(Bray et al., 2009) Elsewhere, younger age has been associated with alcohol-

related problems among individuals recently deployed to Afghanistan or Iraq (Jacobson et al., 2008). Given the risk associated with alcohol-related problems among military personnel, including suicide (LeardMann et al., 2013), these studies demonstrate urgency in addressing the broader problem of alcohol use among service members.

Our paper has several limitations. The variable of exposure, at-risk drinking, does not describe conditions of severe drinking, which as noted above may have greater impact on virologic outcomes, often mediated by poor medication adherence. In light of missing alcohol survey data, we utilized a binary indicator of VF as opposed to a time-to-event model, though our multiple sensitivity analyses did not find differences in the groups with and without alcohol data. Measures of alcohol consumption and medication adherence were obtained by self-report, though our estimates of at-risk drinking are consistent with several large surveys of military alcohol use (Bray et al., 2013, Bray et al., 2009), and our cohort's virologic outcomes are consistent with studies of highly adherent populations. Moreover, an association was found between VF and non-adherence, suggesting sufficient discriminatory power of this variable in spite of its self-reported nature. Last, our analysis did not include information on substance abuse, though a significant effect on our results is unlikely, as the prevalence of drug abuse in the military HIV population is quite low (Institute of Medicine, 2012).

The strengths of our study included a large, diverse cohort with multiple measurements and regular follow-up. Our analysis was time-updated, which allowed us to assess changes in drinking patterns and medication adherence over time, and to examine surrogate markers of HIV infection within these dynamic contexts. While the quantification of problem drinking is a common methodological problem in all alcohol-related studies (Dawson, 2010), the use of a standardized (NIAAA) definition to define at-risk drinking, consistent with prior studies, (Baum et al., 2010, Conen et al., 2013, Kowalski et al., 2012) was an additional strength of our study. Future studies from our cohort will incorporate prospective data using the abbreviated Alcohol Use Disorders Identification Test (AUDIT-C), which will help us better distinguish levels of drinking severity and further define the dynamic extent and effects of alcohol use disorders on virologic outcomes in our cohort.

In sum, we found a high prevalence of at-risk drinking in our HIV-infected military population and a moderate association between at-risk drinking and VF. Initiation of antiretroviral therapy is now recommended for all individuals with HIV infection, though patient readiness and comorbid conditions remain important considerations for special populations, including problem drinkers. Thus, to achieve maximal benefit of antiretroviral therapy, our study demonstrates that interventions to reduce at-risk drinking among HIV-infected individuals should remain a priority. Targeted interventions are also necessary to reduce the persistence of at-risk drinking among military HIV-infected individuals, and further research to understand the relationship of severe drinking to HIV and non-HIV outcomes is warranted.

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Appendix 1

Sensitivity analysis of multivariate model using multiple imputations to identify predictors of virologic failure

Risk Factors	OR (95% CI)	p-value
At-Risk vs Not At-Risk Drinking	2.49 (1.09, 5.69)	0.031
HIV VL at HI (log10 copies/mL))	1.12 (0.75, 1.67)	0.572
Female vs Male	1.55 (0.18, 13.56)	0.690
Caucasian vs Other	1.01 (0.36, 2.83)	0.990
Current Age (per 10 years)	0.54 (0.28, 1.02)	0.059
AIDS before HI	2.44 (0.48, 12.36)	0.281
100% Adherence vs <100%	0.55 (0.26, 1.16)	0.117
ARVs before HI	2.99 (0.63, 14.23)	0.170
Time on HAART (years)	1.17 (0.89, 1.55)	0.270

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Figure 1. Flow Diagram of Study Analysis

Table 1
Baseline characteristics of individuals initiating HAART in or after 2006, by alcohol risk

	Total	Not At-Risk	At-Risk	p-value
Subjects	752	416	336	
Gender				0.654
Male	726 (97%)	400 (96%)	326 (97%)	
Female	26 (3%)	16 (4%)	10 (3%)	
Race				<0.001
Caucasian	274 (36%)	128 (31%)	146 (43%)	
African-American	292 (39%)	199 (48%)	93 (28%)	
Hispanic/Other	186 (25%)	89 (21%)	97 (29%)	
Duty Status				0.36
Active Duty	718 (95%)	393 (94%)	325 (97%)	
Dependent	10 (1%)	6 (1%)	4 (1%)	
Other	2 (0%)	1 (0%)	1 (0%)	
Retired	22 (3%)	16 (4%)	6 (2%)	
Rank				0.774
Enlisted	646 (89%)	355 (88%)	291 (89%)	
Officer/Warrant	82 (11%)	47 (12%)	35 (11%)	
Marital Status				0.087
Married	190 (27%)	116 (30%)	74 (24%)	
Single	507 (73%)	271 (70%)	236 (76%)	
Age at HIV Diagnosis				<0.001
Years	28 (24,34)	29 (24,36)	26 (23,32)	
Year of HIV Diagnosis				0.009
	2008 (2006,2010)	20082006,2010	2009 (2007,2011)	
Viral Load (log) at HIV Diagnosis				0.986
	4.4 (3.9,4.9)	4.4 (3.8,4.9)	4.5 (3.9,4.9)	
CD4 at HIV Diagnosis				0.796
(cells/mm3)	458 (339,593)	454 (326,597)	461 (351,590)	
Time between diagnosis and HAART initiation				0.008
(Months)	8.8 (2.3,34)	12 (2.3,40)	7.5 (2.3,25)	

Table 2
Demographic and immunologic characteristics of individuals at the time of HAART initiation (HI), by alcohol risk

	Total	Not-at-risk	At-risk	P-Value
Calendar Year	2010 (2008,2012)	2010 (2008,2012)	2010 (2008,2012)	0.624
Age				<0.001
(Years)	29 (25,38)	32 (26,40)	28 (24,35)	
Viral L (log) at				0.436
Copies/uL	4.5 (4,5)	4.5 (4,5)	4.5 (3.9,5)	
CD4				0.111
cells/mm3	363 (278,472)	350 (269,461)	376 (297,478)	
CD4 Nadir				0.125
cells/mm3	330 (255,413)	319 (246,408)	347 (266,418)	
AIDS \				0.997
No	724 (96%)	401 (96%)	323 (96%)	
Yes	28 (4%)	15 (4%)	13 (4%)	
MCV				0.025
fL	89 (86,91)	88 (86,91)	89 (86,92)	
ALT \				0.819
IU/L	30 (22,43)	30 (22,43)	30 (21,44)	
AST \				0.902
IU/L	31 (24,40)	31 (24,39)	31 (24,41)	
prior ART				0.886
No	730 (97%)	404 (97%)	326 (97%)	
Yes	22 (3%)	12 (3%)	10 (3%)	
Initial Regimen				0.599
3 NRTI	87 (12%)	48 (12%)	39 (12%)	
Boosted PI	117 (16%)	58 (14%)	59 (18%)	
NNRTI	516 (69%)	294 (71%)	222 (66%)	
PI+NNRTI+NRTI	4 (1%)	2 (0%)	2 (1%)	
Unboosted PI	28 (4%)	14 (3%)	14 (4%)	
HCV \				0.245
Negative	709 (97%)	385 (96%)	324 (98%)	
Positive	20 (3%)	14 (4%)	6 (2%)	
HBV				0.182
No	626 (83%)	339 (81%)	287 (85%)	
Yes	126 (17%)	77 (19%)	49 (15%)	
First HAART adherence				0.304
Not Perfect	201 (28%)	105 (27%)	96 (30%)	
Perfect	512 (72%)	291 (73%)	221 (70%)	
HI to Last Med Hx				0.917

	Total	Not-at-risk	At-risk	P-Value
Years	2.3 (1.1,4)	2.4 (1.1,4.1)	2.3 (1.1,4)	

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Table 3
Rates of Virologic Failure across various demographic and immunologic categories

	Events	Years of follow up	rate (95% CI)
Overall	61	1944.8	3.14 (2.4, 4.03)
Alcohol Risk			
Not At-Risk	24	978.11	2.45 (1.57, 3.65)
At-Risk	28	651.2	4.3 (2.86, 6.21)
Year			
2006-07	6	83.64	7.17 (2.63, 15.61)
2008-09	15	354.66	4.23 (2.37, 6.98)
2010-11	19	672.00	2.83 (1.7, 4.42)
2012-14	21	834.51	2.52 (1.56, 3.85)
Gender			
Male	58	1866.34	3.11 (2.36, 4.02)
Female	3	78.46	3.82 (0.79, 11.17)
Race			
White	17	734.16	2.32 (1.35, 3.71)
Black	25	748.07	3.34 (2.16, 4.93)
Hisp/Other	19	462.58	4.11 (2.47, 6.41)
Current Age			
<26	12	280.14	4.28 (2.21, 7.48)
26 – 35	20	723.86	2.76 (1.69, 4.27)
35+	22	853.96	2.58 (1.61, 3.9)
Time-updated CD4			
<200	7	48.79	14.35 (5.77, 29.56)
201-350	15	205.98	7.28 (4.08, 12.01)
351-500	17	474.3	3.58 (2.09, 5.74)
501+	22	1119.43	1.97 (1.23, 2.98)
Rank			
Enlisted	58	1656.92	3.5 (2.66, 4.53)
Officer/Warrant	1	208.53	0.48 (0.01, 2.67)
Years on ARVs			
0-1	24	818.44	2.93 (1.88, 4.36)
1 -2	15	419.33	3.58 (2, 5.9)
2+	22	707.02	3.11 (1.95, 4.71)
Duty Status at HIV Dx			
Active Duty	59	1846.2	3.2 (2.43, 4.12)
Dependent	1	33.99	2.94 (0.07, 16.39)
Retired	1	64.61	1.55 (0.04, 8.62)
Mode of HIV Transmission			
Blood Products	0	33.65	0 (0, 10.96)
Injection Drugs	2	16.64	12.02 (1.46, 43.41)

	Events	Years of follow up	rate (95% CI)
Opposite-Sex	12	279.53	4.29 (2.22, 7.5)
Other/Unknown	10	328.69	3.04 (1.46, 5.6)
Same-Sex	25	952.28	2.63 (1.7, 3.88)

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Table 4
Univariate and Multivariate Analyses Showing Predictors of Virologic Failure

Risk Factors	Unadjusted		Adjusted	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Demographic Characteristics				
Female vs Male	2.42 (0.63, 9.33)	0.198	1.29 (0.14, 11.47)	0.820
Caucasian vs. Other	0.60 (0.28, 1.30)	0.195	0.88 (0.33, 2.40)	0.809
Current Age (per 10 years)	0.88 (0.60, 1.28)	0.507	0.50 (0.26, 0.96)	0.038
Immunologic Characteristics				
HIV VL at HI (log10 copies/mL)	0.87 (0.56, 1.35)	0.538	1.12 (0.72, 1.76)	0.614
Treatment History				
AIDS before HI	2.38 (0.77, 7.37)	0.131	3.65 (0.74, 18.02)	0.113
100% Adherence vs <100%	0.41 (0.21, 0.77)	0.006	0.61 (0.28, 1.32)	0.209
ARVs before HI	2.11 (0.66, 6.74)	0.209	3.69 (0.81, 15.21)	0.071
Time on highly active antiretroviral therapy (years)	0.94 (0.71, 1.34)	0.708	1.19 (0.89, 1.57)	0.241
Alcohol consumption				
At-Risk vs Not At-Risk	1.73 (0.92, 3.25)	0.087	2.28 (1.01, 5.15)	0.047