

A Comparison Study of Methods for Measuring Retention in HIV Medical Care

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Abstract The purpose of this study was to compare multiple measures of retention in HIV medical care by determining their ability to predict viral suppression. Patients who sought care between 2003 and 2011 were eligible. Visit constancy, gaps-in-care, and HRSA measure were the measures compared. Multiple logistic regressions and area under the curve statistics were employed to determine which measure most accurately discerned between patients with or without viral suppression. There were 850 patients included in the study. The mean follow-up time among the cohort was 5.6 years and less than half were consistently retained in care. All three measures had similar area under the curves, but only visit constancy and gaps in care were significantly associated with viral suppression. Retention in care should be defined consistently across studies and interventions should be set in place to increase the number of optimal retainers.

Keywords HIV · Gaps in care · Visit constancy · Retention · HRSA performance measure

Introduction

Retention in medical care among individuals living with HIV has become a major priority among HIV medical

providers and public health researchers. Engagement in medical care is an important concept as it involves the process of linking newly diagnosed individuals into medical care and retaining those individuals in care throughout the course of their infection [1–3]. It is critical for individuals living with HIV, who are linked to care, to maintain optimal retention as this maximizes viral suppression, reduces the risk of AIDS progression, and reduces the risk of HIV transmission [1, 4–7]. According to the HIV Medicine Association guidelines, an enormous emphasis should be placed on retention to HIV medical care rather than just concentrating on adherence to HIV medications [8].

Similar to adherence to HIV medication studies, the central concern for researchers and clinicians eager to study retention is determining how to best define retention [1, 9, 10]. Measuring retention in HIV medical care can be complex as the process includes multiple clinic visits which occur longitudinally over time [1, 11, 12]. Although multiple methods have been used in defining retention in HIV medical care, there is currently no standard preferred method [1, 12]. Researchers have suggested up to five different methods (i.e. missed visits, visit adherence, visit constancy, HRSA performance measure, and gaps in care), each with their limitations and questions on how to best measure retention in care [1, 12]. A consistent definition of retention must be in place in order to compare results across studies.

In spite of multiple researchers studying retention in care, rigorous study comparing different retention measurement techniques in order to determine the best method remains rare [13]. This is in part because the measurement of long-term retention can be complex as it requires a longitudinal assessment. To date, most studies have only employed one measure of retention and have focused on short time periods (1–3 years) [5, 11, 14–17]. Yehia et al.

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[18] recently published a study comparing three different retention measures, but focused on how each measure was correlated with one another and did not evaluate which method was best. Understanding how each retention measure determines viral load (VL) suppression among people diagnosed with HIV/AIDS is essential as estimates show that approximately only 20 % of people living with HIV/AIDS (PLWHA) are virally suppressed and that this is largely due to poor retention [2, 3]. The current study adds to the research by comparing multiple measures of retention to HIV medical care and employing a longer follow-up time. The purpose of this study is to determine each measure's ability to determine VL suppression among PLWHA seeking care at a Ryan White (RW) clinic.

Methods

Study Design and Participants

To determine retention in HIV medical care among PLWHA, a retrospective cohort study employing a medical chart review was conducted at a RW funded clinic at the University of Kentucky (KY). Individuals who were diagnosed with HIV and had at least one clinic visit between 2003 and 2011 were considered eligible for this study. The individuals eligible for the study were followed to the end of the study period, death, or movement out of service region.

Patients seeking care at the RW clinic were included in the study if they were diagnosed with HIV before or during the study period, were 18 years of age or older, had at least two HIV medical care visits at any time during the study period, and had an initial VL measurement. A clinic visit was defined as an HIV medical outpatient care visit. Since laboratory tests were ordered by the HIV care physicians during every clinic visit, VL and/or CD4⁺ cell count measurements were used as surrogate clinic visits [15, 17].

Data Collection

Data were abstracted from an electronic database at the RW clinic for service dates, January 1st, 2003–December 31st, 2011. Patients' data were queried based on age and date of HIV diagnosis. The study was approved by the University of KY Institutional Review Board.

Retention in Care Measures

The current guidelines set by the U.S. Department of Health and Human Services for adolescents and adults with HIV, state that primary care visits should be made by newly diagnosed persons at least every 3–4 months until

initial patient evaluation is completed and stable clinical and immunological status is achieved for 2–3 years. Thereafter, at least one visit every 6 months is recommended for monitoring health outcomes [19]. The patients included in the study were all assigned 6-month intervals from their initial start date to the end of the follow-up period. Patients, whose initial start date came before the beginning of the study period, were followed from their first completed clinic visit in the time frame. During each 6-month interval, the number of visits and VL results were recorded.

Due to the data available for this study, only three measures of retention were observed during this study: (1) visit constancy; (2) gaps in care; and (3) the HRSA performance measure. The study clinic does not capture missed visits in their database, so missed visit and visit adherence could not be assessed for this study. Visit constancy was defined as having at least one HIV clinic visit every 6 months. Visit constancy was observed as the proportion (%) of 6-month intervals with at least one clinic visit during the study period that the patient was a member of the cohort. For the multivariate analysis, visit constancy was dichotomized into 100 % retention versus <100 %. Gaps in care were defined as the time (in months) between two consecutive clinic visits. Gaps in care was dichotomized into having an interval <12 months versus ≥ 12 months. The last retention measure involved a measurement described and used by HRSA and the National HIV/AIDS strategy (NHAS). The HRSA measurement was defined as having completed at least 2 clinic visits separated by 3 or more months within a 12-month period. To calculate this measure, each patient had their follow-up time broken into 12-month intervals. For each interval, the HRSA performance measurement was observed, and the proportion (%) of 12-month intervals where the HRSA performance measurement criteria was met was calculated [19]. For the multivariate analysis, HRSA performance measure was dichotomized into 100 versus <100 %.

Outcome Measure

At the end of the follow-up period, each individual's final VL was assessed. If an individual failed to acquire a VL at the last 6-month interval, the measurement closest to the end of the study period was chosen. VL is the standard measurement for HIV treatment success or failure, so the primary outcome was to understand how well retention discerns between those individuals who have a suppressed VL and those who do not. This method has been employed in medication adherence studies to determine how well adherence measures predict viral suppression [20]. VL suppression was defined as having a VL of ≤ 400 copies/ml [6, 13, 21].

Other Measures

Baseline and clinical characteristics were abstracted from the medical charts. Race was categorized into white and non-white. Mode of transmission was categorized as heterosexual contact, injection drug use (IDU), men who have sex with men (MSM) and other. Insurance status at baseline was categorized into no insurance, Medicaid, Medicare, and private. Because the VL at baseline was measured in copies/ml and was not normally distributed, the results were transformed into log copies/ml.

Statistical Analysis

Data were analyzed using the Statistical Analysis Software SAS version 9.3; SAS Institute; Cary North Carolina. Descriptive statistics were employed for the entire study sample. Means and standard deviations were calculated to describe the continuous variables and frequencies and percentages were used to describe the categorical variables. For the bivariate and multivariate analyses, the sample was restricted to those individuals who had a follow-up VL. Bivariate analyses observed differences between groups and VL suppression. To determine differences in means between those with and without VL suppression, independent two-sample *t* tests were used, and χ^2 tests of independence were used to determine significant differences between categorical variables and VL suppression.

The purpose of the study was to determine which measurement most accurately discriminated between those individuals who suppressed their VL and those individuals who did not. To determine the retention measure that most accurately predicted VL suppression, receiver operating characteristic curves (ROC) were produced. An ROC curve is a plot of sensitivity as a function of (1-specificity) [22, 23]. For each retention measure a logistic regression was employed to obtain the area under the ROC curves (AUC) (or *c* statistic), which is an estimate that quantifies the ability of each retention measure to accurately classify the outcome (VL suppression vs no suppression). A retention measure with an AUC of 0.5 would have no predictive capability, while an AUC of 1.0 would have perfect predictive capability. In order to conclude the predictive value of each continuous measure, each retention measure's AUC was compared to chance (AUC = 0.5), and χ^2 tests were used to determine whether the retention measure's AUC was significantly different from chance. An AUC that was significantly greater than chance was considered a useful measure in correctly discerning between the two groups. Each retention measure was then compared to each other to determine the best measure in predicting VL suppression.

Multiple logistic regression models were performed for each retention measure to determine the relationship between each retention measure and VL suppression while controlling for other confounders and risk factors. Variables with a *p* value ≤ 0.15 in the bivariate analysis were considered for inclusion into each regression model. Variables were included in the model as confounders based on previous literature. The Hosmer and Lemeshow goodness of fit tests were used to determine each models fit and Akaike information criteria (AIC) was used to determine which fitted model was best. Adjusted AUCs were also calculated for each retention measure.

The multiple logistic regression, modeling the probability of obtaining VL suppression, included race, insurance type, initial CD4⁺ cell counts and VLs, AIDS diagnosis, employment status, year of HIV diagnosis, and HAART.

Results

There were 1,358 individuals eligible for inclusion into the study. Of these, 850 (63 %) had a follow-up VL measurement. Of the 508 that did not have a follow-up VL, 61 % were not prescribed HAART. At the start of the study, the mean age was 39.5 ± 9.5 years. The majority of the sample were male (81.4 %), white (75.3 %), and MSM (57.9 %) (Table 1). Approximately 58 % of the sample lived below the federal poverty level and 36.6 % were uninsured at the start of the study. Twenty-five percent of the study sample entered the study with a CD4⁺ cell count < 200 cells/ μ L and 57.2 % had an AIDS diagnosis.

The mean follow-up time among the 850 patients included in the study was 5.6 ± 2.97 years (median = 6.16; 90th percentile = 9.18). At the end of the follow-up period, 84.0 % of the sample had a suppressed VL. Non-whites, individuals with income $< \$10,000$, those uninsured or on Medicaid, and those with CD4⁺ cell counts < 200 cells/ μ L were less likely to have a suppressed VL (Table 1).

For the HRSA measurement, the mean percentage of 12-month intervals where the criteria was met was 82.8 ± 24.5 % among the entire study sample. However, only 358 (48.7 %) patients met the HRSA criteria every 12-month period they were in the study. The longest time between consecutive visits was collected for each patient in the study. The mean time between two consecutive visits for the sample was 9.7 ± 10.2 months. Throughout the study period, 23.7 % of the patients had at least one interval greater than 12 months. Overall the mean percentage of 6-month intervals with at least one visit (visit constancy) was 80.9 ± 26.8 %, with 46.7 % of the patients

Table 1 Association of socio-demographic and clinical characteristics and viral suppression among the patients seeking HIV medical care: 2003–2011

	Total <i>n</i> (%)	Viral suppression		<i>p</i> value
		No <i>n</i> (%)	Yes <i>n</i> (%)	
Total	850	136 (16.0)	714 (84.0)	
Age: mean years (SD)	39.5 (9.5)	37.2 (9.5)	39.9 (9.5)	0.003
Sex: male	692 (81.4)	100 (73.5)	592 (82.9)	0.01
Race: non-white	210 (24.7)	44 (32.4)	166 (23.3)	0.02
Mode of transmission				0.18
Heterosexual	233 (27.4)	38 (27.9)	195 (27.3)	
IDU	83 (9.8)	20 (14.7)	63 (8.8)	
Other	42 (4.9)	6 (4.4)	36 (5.0)	
MSM	492 (57.9)	72 (52.9)	420 (58.8)	
Employment status				0.02
Employed	322 (44.1)	38 (36.5)	284 (45.4)	
Unemployed	262 (35.9)	50 (48.1)	212 (33.9)	
Other	146 (20.0)	16 (15.4)	130 (20.8)	
Income: <\$10,000	415 (57.6)	76 (73.1)	339 (54.9)	0.001
Tobacco use: yes	440 (51.8)	75 (55.2)	365 (51.1)	0.39
Illicit drug use: yes	206 (24.2)	38 (27.9)	168 (23.5)	0.27
Insurance type				<0.0001
No insurance	310 (36.6)	69 (50.7)	241 (33.9)	
Medicaid	148 (17.5)	30 (22.1)	118 (16.6)	
Medicare	158 (18.7)	13 (9.6)	145 (20.4)	
Private	230 (27.2)	24 (17.7)	206 (29.0)	
AIDS diagnosis: yes	486 (57.2)	70 (51.5)	416 (58.3)	0.14
HAART: yes	776 (91.3)	83 (61.0)	693 (97.1)	<0.0001
CD4 ⁺ cell count at baseline: <200 cells/μL	219 (25.8)	47 (34.6)	172 (24.1)	0.01
Viral load at baseline: median log copies (q1, q3)	4.9 (3.9, 9.3)	9.7 (7.6, 11.1)	3.9 (3.9, 8.1)	<0.0001

SD standard deviation

having at least one visit every 6 months over the 9-year study period (Table 2).

VL suppression was more likely among those individuals who met each retention criteria. For the HRSA retention measure, the mean percentage of intervals with at least two visits separated by 3 or more months was higher for those with a suppressed VL compared to those without a suppressed VL (86.4 vs 36.9 %, $p < 0.0001$). Approximately 88 % of the individuals who met the HRSA criteria 100 % percent of the time had a suppressed VL compared to just 79.8 % of those who did not meet the criteria (Table 2). Among the patients with gaps in care <12 months, 86.6 % had a suppressed VL compared to 75.6 % for those with a gap >12 months ($p = 0.0002$). On average, patients with a suppressed VL had more 6 month intervals with at least one visit compared to those who did not have a suppressed VL (84.9 vs 59.9 %, $p < 0.0001$). Patients with optimal retention were more likely to have a suppressed VL compared to those with non-optimal retention (90.9 vs 77.9 %, $p < 0.0001$).

Table 2 Retention in care measures among the patients seeking HIV medical care: 2003–2011

	Total <i>n</i> (%)	Viral suppression		<i>p</i> value
		No <i>n</i> (%)	Yes <i>n</i> (%)	
HRSA performance				
Mean % (std)	82.8 (24.5)	36.9 (35.1)	86.4 (20.1)	<0.0001
Yes	414 (48.7)	48 (11.6)	366 (88.4)	0.001
No	436 (51.3)	88 (20.2)	348 (79.8)	
Gaps in care				
Mean months (std)	9.7 (10.2)	11.5 (13.3)	9.3 (9.5)	0.07
<12 months	649 (76.4)	87 (13.4)	562 (86.6)	0.0002
>12 months	201 (23.7)	49 (24.4)	152 (75.6)	
Visit constancy				
Mean % (std)	80.9 (26.8)	59.9 (33.7)	84.9 (23.3)	<0.0001
Optimal	397 (46.7)	36 (9.1)	361 (90.9)	<0.0001
Non-optimal	453 (53.3)	100 (22.1)	353 (77.9)	

Table 3 presents the ROC statistics for predicting VL suppression at the end of the study. The AUCs were slightly higher for visit constancy (0.62) than for HRSA performance measure (0.58) and gaps in care (0.57). Compared to chance (AUC = 0.5), all three retention measures were significantly different (Table 3). Multiple logistic regressions were performed to determine the association of each retention measure with viral suppression while controlling for specific variables. While controlling for race, insurance status, AIDS diagnoses, initial VL and CD4⁺ cell counts, employment status, HAART, and HIV diagnosis year, gaps in care and visit constancy were significantly associated with viral suppression (Table 4). Patients with gaps <12 months had higher odds of viral suppression compared to those with gaps >12 months [odds ratio (OR) = 1.83; 95 % confidence interval (CI) 1.03–3.23]. Compared to non-optimal retainers, optimal retainers had higher odds of viral suppression (OR = 4.74; 95 % CI 2.56–8.80). When adjusting for the specific covariates, visit constancy had the higher AUC and AIC suggesting it to be the slightly better retention measure.

Discussion

An issue with retention in care studies is determining how to best define retention in HIV medical care among PLWHA. It has been suggested that there are at least five different ways to measure retention and currently no gold standard is in place, which makes comparison of studies complex [1, 12]. The purpose of this study was to compare three available measures of retention by determining their ability to predict VL suppression. We found that the three measures were similar, with visit constancy having the slightly higher AUC compared to gaps in care and the HRSA measure.

The means for HRSA measure and visit constancy were similar among the study sample, with approximately 83 % of all 12-month patient-care intervals having met the HRSA criteria and approximately 81 % of all 6-month patient-care intervals having at least one visit. For gaps in care, we were able to show that the longest average time

Table 4 Multiple logistic regression of viral suppression by retention in care categories

	No n (%)	Yes n (%)	AUC	aOR	95 % CI
HRSA HAB					
Yes	48 (35.3)	366 (51.3)	0.89	1.70	0.99–2.91
No	88 (64.7)	348 (48.7)		Ref.	
Gaps in care (months)					
<12	87 (64.0)	562 (78.7)	0.89	1.83	1.03–3.23
>12	49 (36.0)	152 (21.3)		Ref.	
Visit constancy					
Optimal	36 (26.5)	361 (50.6)	0.91	4.74	2.56–8.80
Non-optimal	100 (73.5)	353 (49.4)		Ref.	

Each regression model controlled for race, insurance type, employment status, aids diagnosis, initial VL and CD4 cell count, HAART, and year of HIV diagnosis

AUC adjusted for the confounding variables listed above, aOR adjusted odds ratio, CI confidence interval

* Bolded numbers signify *p* values <0.05

between two consecutive visits was approximately 9 months. Our study is among the few studies to employ a relatively long follow-up period to measure retention in care, with an average follow-up time of 6 years among the cohort. Yehia et al. [18] in 2012 conducted a similar study, comparing HRSA measure, visit constancy and gaps in care among a cohort of adults enrolled in and HIV Research Network (HIVRN). Using 3-month intervals to estimate visit constancy and an average follow-up time of 35.5 months, 73 % of all 3-month intervals had at least one visit and 75 % of all 12-month intervals met the HRSA measure. In our cohort, the mean percentages were slightly higher than the HIVRN cohort. Reasons for this could be the cohort chosen for the study (RW vs HIVRN), the sample size (850 vs 17,425), and the choice in intervals (6 vs 3-months).

In our study, 49 % of the cohort met the HRSA criteria 100 % of the time. The HRSA retention measure is a measure created and endorsed by HRSA and described in NHAS. The measure was created to be used as an indicator for providers receiving RW CARE Act funding and is typically restricted to just 12 months [1, 24]. We followed

Table 3 Receiver operating characteristic curves statistics for detecting viral suppression

Variable	Area under the curve (AUC)	Standard error	95 % CI		<i>p</i> value
			Lower bound	Upper bound	
HRSA	0.58	0.02	0.54	0.62	0.0004
Gaps in care	0.57	0.02	0.53	0.62	0.001
Visit constancy	0.62	0.02	0.58	0.66	<0.0001

Retention variables are dichotomized variables: visit constancy = optimal versus non-optimal; HRSA = 100 versus <100 %; gaps in care = <12 versus ≥12 months

individuals over a 9 year period to calculate the percentage of years where the criteria were met. Until recently, the HRSA measurement was not observed in most retention studies [16–18]. Hall et al. [17] conducted a study using HIV surveillance data from 13 areas and showed that 45 % of PLWHA had met the HRSA criteria. Our results were similar to theirs.

Observing visit constancy among the study sample, 47 % had optimal retention (100 % retention). The retention rate among our study sample is rather low and falls below the goal set by NHAS to increase the proportion of clients who are in continuous care from 73 to 80 %. In regards to gaps in care, only 24 % of the cohort had one or more gaps >12 months, which is lower than what most studies have reported [18, 25–27]. The data strongly suggests that significant energy needs to be put toward increasing the number of individuals optimally retained in care.

The measures of retention to medical care calculated in this study were compared to one another by employing methods described in adherence to HIV medication studies [9, 20]. Measures were compared based on their ability to predict VL suppression since VLs are normally used as measures for determining how well a patient is managing their disease. It was shown that visit constancy had a slightly higher AUC compared to the other two measures, suggesting a higher chance of discerning between VL suppression. Although, visit constancy had a slightly higher AUC compared to the other measures, all three measures were similar to each other and significantly different from chance. But, when adjusting for covariates, only gaps in care and visit constancy were significantly associated with viral suppression, with visit constancy having the higher AUC. In 2001, Liu et al. [20] conducted a similar study, but used ROC curves to determine the relationship between medication adherence and VL suppression. The average AUC calculated for the adherence measures was 77.5 %. The AUC calculated for visit constancy in the current study was 62.0 %.

At the end of the study follow-up period, each patient's final VL was recorded and 84 % of the cohort had a suppressed VL. The logistic regressions suggested that poor retention in care greatly hinders a patient from being virally suppressed. While controlling for the confounding variables, gaps in care and visit constancy were the only measures that were significantly associated with VL suppression. With visit constancy, the individuals with optimal retention had much higher odds of VL suppression compared to non-optimal retainers. This shows the importance of retaining in HIV medical care.

The study has a few limitations. The study at hand was an observational, retrospective cohort study. Because of the

study design that was chosen, associations could be identified, but we could not recognize causality as this study is subjected to potential uncontrolled confounders. A medical chart review was employed to capture the information needed for this study, which is a limitation of our study as not all patients had complete information. This was the case for selecting patients for inclusion into the study who had a VL and a follow-up measurement. Individuals were excluded from the analysis partly because they had missing information regarding their HIV labs. There were no significant differences between those that were excluded from the analysis, but this does pose the potential bias that could take place due to missing information. Although the clinic provides care for a large proportion of individuals diagnosed with HIV who reside in central and eastern KY, the results may not be generalizable to all Kentuckians living with HIV as well as all individuals living with HIV in the United States. A future research study conducted should involve a multi-center study across all RW funded clinics in KY. Also, the use of retention measures is a limitation. Due to the data available, two of the five measures could not be assessed. This is important as it cannot be stated definitively which measure is the best measure to employ. Mugavero et al. [13] conducted a similar study using all retention measures and was not able to present a preferred method. More studies are needed with all possible measures analyzed.

Finally, medication adherence was not observed or evaluated for this study. It may be concluded that medication adherence is the driving force behind viral suppression, but Giordano et al. [28] were able to show that poor retention in care and poor medication adherence were highly correlated. Also with this study, obtaining medication adherence was difficult as the patient population at the clinic obtain their medications from multiple pharmacies, which makes it difficult to track medication pick up once the prescription has been written.

In conclusion, there is currently no gold standard when it comes to defining retention in care. The resources available to the clinic or research site may dictate the type of retention measure that can be employed. This study was conducted to show how three of the five retention measures are operationalized and how they compare to each other. Although visit constancy slightly outperformed HRSA and gaps in care in regards to predicting VL suppression and was significantly associated with VL suppression, there appears to be no major differences among the measures. More studies need to be conducted to compare all possible retention measures to understand which measures may be more appropriate to employ. Interventions should be set in place to increase the number of optimal retainers and more studies should be conducted to understand retention in care.

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