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MAJOR ARTICLE

The Impact of Churn on HIV Outcomes in a Southern United States Clinical Cohort

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Background. Persons with human immunodeficiency virus (PWH) may experience a cycle of engaging and disengaging in care referred to as "churn." While human immunodeficiency virus (HIV) churn is predicted to be more prevalent in the southern United States (US), it has not been well characterized in this region.

Methods. We conducted a retrospective cohort study involving PWH newly establishing care at a large urban clinic in Atlanta, Georgia, from 2012 to 2017, with follow-up data collected through 2019. The primary exposure was churn, defined as a ≥12-month gap between routine clinic visits or viral load (VL) measurements. We compared HIV metrics before and after churn and assessed the risk of future churn or loss to follow-up.

Results. Of 1303 PWH newly establishing care, 81.7% were male and 84.9% were Black; 200 (15.3%) experienced churn in 3.3 years of median follow-up time. The transmissible viremia (TV) rate increased from 28.6% prechurn to 66.2% postchurn ($P <$ .0001). The 122 PWH having TV on reengagement had delayed time to subsequent viral suppression (adjusted hazard ratio, 0.59 [95% confidence interval {CI}, .48–.73]), and PWH returning to care contributed disproportionately to the community viral load (CVL) (proportion of CVL/proportion of patients, 1.96). Churn was not associated with an increased risk of subsequent churn (adjusted odds ratio [aOR], 1.53 [95% CI, .79–2.97]) or loss to follow-up (aOR, 1.04 [95% CI, .60–1.79]).

Conclusions. The rate of churn in a southern US clinic was high, and those who experienced churn had increased TV at reentry and disproportionately contributed to the CVL and likely contributing to ongoing HIV transmission.

Keywords. churn; community viral load; HIV care continuum; HIV in the South; HIV retention.

The primary objective of the United States (US) National HIV/AIDS Strategy for 2022–2025 is a 75% and 90% reduction of new human immunodeficiency virus (HIV) infections by 2025 and 2030, respectively [1]. In 2018, more than half of all new HIV infections occurred in the South; Georgia had the highest rate of new infections, and Atlanta had the second-highest rate of new infections for a metropolitan area in the US [2]. HIV transmission modeling estimated that persons with HIV (PWH) not retained in care generated 42.6% of new transmissions in 2016 [3]. Retention in care is also associated with improved clinical outcomes, including increased viral suppression (VS) and reduced AIDS-defining illnesses, hospitalizations, and mortality [4–7]. However in 2019, only 50.1% of PWH nationally [8] and 55% in Georgia [9] were retained in care. Retention is not a simple dichotomy; patients may leave and return to care in a cycle referred to as "churn" [10]. Sustained retention in care is key to attaining VS [11], and PWH who experience churn spend more time with unsuppressed viremia [12]. Churn is more often experienced by people who are of Black race, have a history of injection drug use [13], and possess lower monthly income and minimal health insurance [14]. While there is previous literature on churn, the dynamics of HIV transmission and disease progression vary by region and city. There is increased churn projected in the southern United States (US), but there have been no studies focused on the prevalence or effect of churn on a clinic population in this region [15, 16]. There are also limited data on HIV metrics of PWH at time of reengagement in care as well as their subsequent outcomes following reengagement. In this study, among a clinical cohort of mostly uninsured PWH in the southern US, we assess the impact of churn on HIV metrics and care continuum outcomes.

METHODS

Outcomes

The HIV metrics studied were measurements of viral load (VL) and CD4 count. The primary outcomes were time to VS and

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rates of transmissible viremia (TV) and reduced CD4 counts. We hypothesized that churn was associated with an increased rate of TV with longer time to subsequent VS and reduced CD4 counts. To further capture the population impact of churn, we calculated the community viral load (CVL) as a secondary outcome, hypothesizing that PWH returning to care will comprise a disproportionate proportion of the CVL. Using the CVL demonstrates the potential impact of a particular group of patients at a population level. It does not rely on isolated cross-sectional VL measurements, which can overestimate stable VS and does not accurately reflect the dynamic trajectory of each individual's VL, which often includes periods of suppressed as well as transmissible levels of HIV. For the primary care continuum outcome, we posited that PWH who experience churn have an increased odds of subsequent disengagement from care. Through these inquiries, we present a comprehensive appraisal of churn in an individual clinic.

Study Design and Participants

This was a retrospective cohort study involving PWH enrolled at the Grady Infectious Disease Program (IDP), an urban Ryan White HIV/AIDS Program–funded clinic in Atlanta, Georgia. The IDP provides care for >6000 PWH, accounting for approximately 16% of all PWH living in Atlanta during 2019 [17]. Through manual chart abstraction, we identified all individual patients aged >13 years who established care at IDP from 2011 (the year the clinic transitioned to an electronic medical record) to 2017. Follow-up data until the end of 2019 provided at least 2 years for each patient during which churn could be captured. The cohort included patients for whom IDP was the first outpatient clinic to manage their HIV and those who transferred to IDP within 6 months of diagnosis and were combination antiretroviral therapy (cART) naive. We also included patients with a more remote diagnosis of HIV if they had never previously received outpatient primary care for the condition and were cART naive. To capture PWH when they first entered the HIV care continuum and thus limit potential confounding from factors such as prior churn or other disruptions in care, we excluded patients who may have received outpatient HIV care elsewhere for ≥6 months or were already on cART at the time of enrollment. The study was approved by the Emory University Institutional Review Board (IRB00061530) and the Grady Health System research oversight committee.

Cohort Assignment

We assigned the eligible PWH to 1 of 4 care pattern categories: retained in care, transferred care, experienced churn, and became lost to follow-up. The care pattern category assignment was made per the first deviation from retention and did not change over the course of the study. Per the 2019 Krentz et al study [12], we defined retention in care as ≥1 clinic visit with a cART-prescribing provider and 1 VL measurement every 12 months since initial enrollment. We defined churn as a gap of ≥12 months prior to reengagement. We determined whether patients became lost to follow-up or transferred care by reviewing the circumstances of their last contact with the clinic. For 30 patients (Supplementary Figure 1), we could not conclude if they transferred care or became lost to follow-up; they were only included in the proportional hazards models.

Variables

The primary exposure variable was churn. We included the available sociodemographic covariates obtained at enrollment: age at the first visit, sex, race/ethnicity, insurance coverage, and drug/alcohol use. For the outcome measures, we supplemented local clinic data with Georgia Department of Public Health surveillance VL and CD4 cell count measurements to account for values obtained when patients received care elsewhere in the state. We defined VS as <200 copies/mL based on the National Institutes of Health cutoff for virologic failure being at least 200 copies/mL [18]. We defined TV as ≥1500 copies/mL, a cutoff at which transmission has been noted to occur [19, 20]. To calculate the time to VS, the first clinic visit served as time zero. As described in the literature [21], we calculated the total CVL per year for each group by adding the mean of the VL measurements for each patient in each group. While there was a right-skewed distribution with the VL measurements, as is usually the case, we used the mean instead of the median as suggested in prior studies due to the median often falling "below the level of viral suppression for any given time period" [21, 22]. The VL measurements noted in the registry as undetectable contributed the lower limit of detection value (either 40 or 75 copies/mL based on the assay) to the CVL. Conversely, VL measurements recorded as >5.70 log or >7.00 log contributed $10^{5.70}$ or 10^{7} copies/mL, respectively, to the CVL. When comparing metrics before and after churn, we used the last laboratory measurement obtained prior to disengagement and the first measurement obtained on reengagement for each PWH.

When evaluating the association between an episode of churn and subsequent churn or loss to follow-up, we created 2 groups involving patients enrolled between 2012 and 2015 to allow for at least 4 years of follow-up information as a subgroup analysis. The control group was 50 patients randomly selected from each enrollment year; the events of interest in this group were the first episode of churn or loss to follow-up. The comparator group comprised the patients who enrolled between 2012 and 2015 who experienced churn, excluding those randomly selected into the control group; the event of interest for this group was a second episode of churn or loss to follow-up.

Statistical Analyses

We conducted all data cleaning and statistical analyses with the R statistical package [23] and SAS software (version 9.4; SAS Institute, Cary, North Carolina). For the time-dependent analysis, we constructed Cox proportional hazards models to calculate the

hazard ratio, both unadjusted and adjusted for sociodemographic covariates. We assessed the proportional hazard assumptions by 3 methods: graphically, goodness-of-fit tests, and time-dependent models. We also performed a sensitivity analysis, stratifying churn by its onset (within or after 6 months of enrollment) and duration (gap of 1–2 years or ≥2 years out of care) when evaluating the VL and CD4 metrics before and after churn. When evaluating the association between churn and care continuum outcomes, we used simple logistic regression, adjusting for sociodemographic covariates.

RESULTS

General Characteristics

Among a population of 8113 patients, we identified 1303 patients newly establishing outpatient HIV care from 2012 to 2017, excluding 6810 patients who had received outpatient primary care prior to the enrollment date (Supplementary Figure 1). The cohort was primarily young (median age, 31 years), Black (84.9%), and male (81.7%), with 49% uninsured aside from Ryan White HIV/AIDS Program coverage. In 3.3 years of median follow-up time, 200 PWH (15.3% of the total cohort) experienced churn, 257 (19.7%) became lost to follow-up, and 127 (9.7%) transferred care elsewhere without returning to IDP. The retention rate increased annually from enrollment year 2013–2017 as the duration of follow-up data decreased. There was generally a concomitant decrease in the rate of churn over this period, aside from an increase in 2016. Among those continuously retained in care, there was a higher median age (34 years) at enrollment and a greater proportion of female PWH (22.1%) than the rest of the cohort. The group that experienced churn had a higher proportion of non-Hispanic Black PWH (92.0%) and PWH with history of both alcohol and drug use (Table 1). The median time to first episode of disengagement was 1.21 years from initial visit, and the median time to reengagement was 1.36 years following disengagement.

Outcomes

For PWH who experienced churn, HIV metrics significantly worsened on reengagement compared to predisengagement. Before the gap in care, 28.6% of PWH who experienced churn

Table 1. Demographic Characteristics of Patients by Category of Care Pattern

Characteristic	Care Pattern, No. (%)					
	Retention (n = 689 [52.9])	Transfer (n = 127 [9.7])	Churn (n = 200 [15.3])	Loss to Follow-up (n = 257 [19.7])	Unknown (n = 30 [2.3])	Total (N = 1303)
Age, y						
Median (IQR)	34 (24–46)	23 (20–33)	29 (22–40)	31 (23–40)	27 (21.2–37)	31 (23–44)
Sex						
Male	537 (77.9)[a]	115 (90.6)	171 (85.5)	218 (84.8)	24 (80.0)	1065 (81.7)
Female	152 (22.1)	12 (9.4)	29 (14.5)	39 (15.2)	6 (20.0)	238 (18.3)
Race/ethnicity						
Black, non-Hispanic	578 (83.9)	106 (83.5)	184 (92.0)	217 (84.4)	21 (70.0)	1106 (84.9)
Hispanic	60 (9.0)	6 (4.7)	7 (3.5)	12 (4.7)	2 (6.7)	87 (6.7)
White, non-Hispanic	37 (5.4)	9 (7.1)	6 (3.0)	23 (8.9)	3 (10.0)	78 (6.0)
Other/unknown	14 (2.1)	6 (4.7)	3 (1.5)	5 (1.9)	4 (13.3)	32 (2.5)
Substance use						
Alcohol	285 (41.4)	48 (37.8)	110 (55.0)	122 (47.5)	16 (53.3)	581 (44.6)
Drugs[b]	176 (25.5)	25 (19.7)	80 (40.0)	83 (32.3)	8 (26.7)	372 (28.5)
Insurance						
Private	105 (15.2)	35 (27.6)	26 (13.0)	43 (16.7)	8 (26.7)	217 (16.7)
Medicare	116 (16.8)	11 (8.7)	35 (17.5)	20 (7.8)	1 (3.3)	183 (14.0)
Medicaid	140 (20.3)	13 (10.2)	43 (21.5)	57 (22.2)	10 (33.3)	263 (20.2)
Ryan White only	328 (47.6)	67 (52.8)	96 (48.0)	137 (53.3)	11 (36.7)	639 (49.0)
Other	0 (0.0)	1 (0.8)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)
Enrollment year						
2011	15 (39.5)	3 (7.9)	10 (26.3)	10 (26.3)	0 (0.0)	38 (2.9)
2012	98 (52.1)	12 (6.4)	39 (20.7)	39 (20.7)	6 (3.2)	188 (14.4)
2013	94 (43.1)	21 (9.6)	50 (22.9)	53 (24.3)	3 (1.4)	218 (16.7)
2014	112 (50.7)	38 (17.2)	30 (13.6)	41 (18.6)	9 (4.1)	221 (17.0)
2015	117 (57.4)	20 (9.8)	24 (11.8)	43 (21.1)	4 (2.0)	204 (15.7)
2016	118 (57.0)	15 (7.2)	32 (15.5)	42 (20.3)	5 (2.4)	207 (15.9)
2017	135 (68.5)	18 (9.1)	15 (7.6)	29 (14.7)	3 (1.5)	197 (15.1)

Abbreviation: IQR, interquartile range.

[a]No. (column percentage) except for top row and the first 5 entries of each enrollment year row, which signify No. (row percentage).

[b]Including, but not limited to, injection drug use.

Table 2. Comparison of the Last Viral Load and CD4 Measurements Prior to Disengaging From Care and the First Measurements Upon Returning to Care

	Predisengagement			On Reengagement			
HIV Metric	no.	No.	(%)	no.	No.	(%)	*P* Value[a]
VL ≥1500 copies/mL							
All churn	57	199	(28.6)	131	198	(66.2)	<.00001
Disengagement <6 mo after enrollment	19	58	(32.8)	42	58	(72.4)	.00002
Disengagement ≥6 mo after enrollment	38	141	(27.0)	89	140	(63.6)	<.00001
Gap of 1–2 y out of care	45	158	(28.5)	104	158	(65.8)	<.00001
Gap of >2 y out of care	12	41	(29.3)	27	40	(67.5)	.0006
CD4 count <200 cells/μL							
All churn	69	200	(34.5)	87	190	(45.8)	.02
Disengagement <6 mo after enrollment	27	59	(45.8)	29	55	(52.7)	.46
Disengagement ≥6 mo after enrollment	42	141	(29.8)	58	135	(43.0)	.02
Gap of 1–2 y out of care	55	159	(34.6)	69	155	(44.5)	.07
Gap of >2 y out of care	14	41	(34.1)	18	35	(51.4)	.13

Abbreviations: HIV, human immunodeficiency virus; VL, viral load.

[a]Calculated per χ^2 testing.

had TV; on reengagement, 66.2% (Table 2); conversely, 62.3% of PWH had VS predisengagement, which decreased to 28.3% on reengagement (Supplementary Table 1). These differences persisted when stratifying churn by the onset of disengagement relative to enrollment and the duration of disengagement (Table 2, Supplementary Table 1). The CD4 count dynamics were similar, though the difference was not as statistically significant. Overall, 45.8% of PWH who experienced churn had a CD4 count <200 cells/μL on reengagement compared to 34.5% predisengagement (Table 2). The median CD4 count significantly decreased from 303 cells/μL prior to disengagement to 239.5 cells/μL (Supplementary Table 1). On stratification, only the PWH who disengaged from care ≥6 months after enrollment had a statistically significantly higher proportion of low CD4 counts on reengagement (43.0%) than predisengagement (29.8%) (Table 2).

Of 122 PWH who experienced churn and had TV on reenrollment, 101 (82.8%) subsequently attained VS, a significantly lower proportion than that of PWH on initial enrollment who did not experience churn (96.0%) ($P < .00001$). The churn group had a longer median time to VS (153.5 days) with a low hazard ratio of VS (0.59 [95% confidence interval [CI], .48–.73]), adjusted for sociodemographic covariates (Table 3). There is also a separation in the cumulative incidence curves for VS between the 2 groups (Supplementary Figure 2). The PWH reengaging in care after churn frequently accounted for a greater proportion of the CVL than of the cohort. Using 2017 as a representative year of this analysis, churn patients accounted for 7.3% of the CVL while comprising only 3.7% of the clinic population, resulting in a ratio of 1.96. Aside from the group of PWH newly enrolling in care, the patients returning to care were the only group with a ratio ≥1 in at least 3 of the 4 years. Conversely, PWH established in care had a ratio of <0.5 in every year of the analysis (Table 4, Supplementary Tables 2*A*–*C*).

Unlike with the HIV metrics, churn was not associated with worse care engagement related outcomes. PWH who experienced churn had higher rates of subsequent churn (17.4%) and loss to follow-up (24.0%) than those newly establishing care, but they were not statistically significant. PWH who experienced churn did not have significantly increased adjusted odds of churn (1.53 [95% CI, .79–2.97]) or loss to follow-up (1.04 [95% CI, .60–1.79]) compared to PWH newly establishing

Table 3. Rate of Viral Suppression (VS) and Time to VS Among Patients Who Experienced Churn and Had Transmissible Viremia on Reenrollment Compared to Those Retained in Care, Censoring for Transfer of Care and Loss to Follow-up

		VS			Time to VS, d[a]			
Care Pattern	Patients	No.	(%)	*P* Value[b]	Median	(IQR)	aHR[c]	(95% CI)
Churn	122	101	(82.8)	<.00001	153.5	(49–442)	0.59	(.48–.73)
No churn	1013	972	(96.0)		84	(47–156)	Ref	…

The no-churn group includes persons with human immunodeficiency virus (HIV) who attained VS prior to churn and never had subsequent transmissible viremia. People with HIV who had VS prior to or within 14 days of their first clinic visit are excluded.

Abbreviations: aHR, adjusted hazard ratio; CI, confidence interval; IQR, interquartile range; VS, viral suppression.

[a]Refers to the time from reenrollment to VS for the churn group and the time from initial enrollment to VS for the no-churn group.

[b]Calculated using χ^2 testing.

[c]Adjusted for age, sex, race/ethnicity, insurance status, alcohol use, and drug use.

Table 4. Distribution of Community Viral Load (CVL) by Care Pattern Category for 2017, Organized by Descending Ratio of Proportion of CVL to Proportion of Patient Population

2017 Category	Active Patients	Proportion of Patients	Proportion of CVL	Proportion of CVL/Proportion of Patients
New	156	15.3%	50.1%	3.28
Return from churn	38	3.7%	7.3%	1.96
Loss to follow-up	113	11.1%	15.9%	1.43
Transfer out	83	8.1%	8.8%	1.08
Enter churn	62	6.1%	4.0%	0.65
Unknown	11	1.1%	0.6%	0.55
Transfer in	6	0.6%	0.2%	0.28
In care	552	54.1%	13.2%	0.24

Abbreviation: CVL, community viral load.

Table 5. Risk of Future Churn or Loss to Follow-up After Having Previously Experienced Churn

Care Pattern	Patients, No.	No.	(%)	*P* Value[a]	aOR[b]	(95% CI)
Churn						
New	200	22	(11.0)	.11	Ref	…
Prior churn	121	21	(17.4)		1.53	(.79–2.97)
Loss to follow-up						
New	200	44	(22.0)	.68	Ref	…
Prior churn	121	29	(24.0)		1.04	(.60–1.79)

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval.

[a]Calculated using χ^2 testing.

[b]Adjusted for age, sex, race/ethnicity, insurance status, alcohol use, and drug use.

care (Table 5). Among those newly establishing care, the median time to disengagement was 2.04 years after the first visit. Among those who previously experienced churn, the median time to subsequent disengagement was 2.49 years following reengagement.

DISCUSSION

In this study of a large HIV clinic in the southern US, we found a high rate of churn (15.3%), with PWH who experienced churn having poorer HIV metrics on reengagement in care without immediate care continuum consequences. While we had limited data points for when PWH were out of care, the marked changes in rate of TV and CD4 count <200 cells/μL before and after the gap in care provide compelling evidence. As previously noted [12], although PWH who experience churn are in and out of care and may hypothetically have some measure of ongoing access to cART, they have TV rather than low-level viremia (Table 2). Their disproportionate contribution to the CVL on return to care (and thus likely also while out of care) (Table 4, Supplementary Tables 2*A*–*C*) is consistent with prior literature [21] and further highlights the potential impact of churn on HIV transmission and incidence. Moreover, following reengagement in care, despite many PWH having prior VS, they subsequently struggle to return to VS in a timely manner (Table 3), a finding not previously demonstrated in the literature. It is thus imperative to not only curtail the period out of care but also improve ease of cART access upon reentry to limit the window of TV. Rapid entry programs, where PWH start cART soon after enrollment, improve retention and VS [24–26], with their success largely attributed to associated system-wide changes such as enhanced patient navigator and social support services [24, 25].

As previously suggested in the literature [13, 14], younger Black PWH and PWH with a history of substance use and less insurance support comprise a higher proportion of the group that experienced churn than those retained in care (Table 1). These findings suggest that churn may be a manifestation of the structural violence comprising institutional racism, discrimination, and socioeconomic barriers that the most disenfranchised PWH face [13, 27]. With the National HIV/AIDS Strategy emphasizing the role of social determinants in amplifying health inequities [1], addressing churn could help reduce HIV-related disparities. Considering churn's association with social determinants of health, such a multidisciplinary approach should also be implemented to facilitate rapid reentry. The findings of this study add to the existing literature by more explicitly presenting outcomes of PWH who experience churn after they reengage in care, both in their HIV metrics on reengagement and in their subsequent experience with engagement in care. Within the follow-up period of this study, the absence of increased future deviations from the care continuum among PWH who previously experienced churn provides a note of optimism. Once PWH reengaged in care, they were just as likely to remain in care as those newly establishing care (Table 5). This underscores the value of investing in helping PWH return to care; once back, they could have a sustained period of retention.

There are a few limitations to acknowledge. First, the prevalence of churn may be underestimated in this study. Considering the churn rate was highest among those enrolled from 2011 to 2013, the overall rate would likely be higher if there were at least 5 years of follow-up data for every patient in the cohort. The resulting 200-patient cohort of PWH who experienced churn, while a similar size to prior studies [10, 12] and the follow-up period of this study, may not be enough to make comprehensive conclusions about an entire region. Second, we did not comprehensively account for the outcome measures while PWH were out of care. This most notably affected the CVL analysis with an underestimation of the contribution of those lost to follow-up and those who experienced churn while they were out of care. The dataset also had limited covariates. We could not treat covariates as dynamic variables. For example, we could not assess if churn coincided with specific stressors, such as relapse of a substance use disorder or loss of insurance. We did not have specific information regarding drug

use, such as injection drug use and types of drugs used, or details on other social determinants of health, such as access to phone and transportation. Our dataset also did not include details on medication regimens and adherence as this information was not consistently integrated into the electronic medical record until 2018; future analyses should aim to incorporation such data to evaluate the effect of churn on treatment adherence.

In conclusion, the results of this study suggest a notable public health cost with churn in the South. The rate of churn seen in this study was higher than rates described elsewhere [10, 28, 29], and the VL outcomes demonstrate its potential effect on incidence in our community. The pivotal next step is developing an understanding of what drives reengagement in care. This would likely require a mixed-methods approach that includes a qualitative evaluation of patients who have previously experienced churn to understand what prompted their return. One could leverage the factors associated with reengagement to implement interventions that prevent or minimize time out of care. Ultimately, the HIV epidemic reflects a series of regional microepidemics, and each area has unique drivers of HIV transmission. In the southern US, mitigating churn is necessary to reduce HIV incidence and move closer to ending the HIV epidemic.

Supplementary Data

Supplementary materials are available at *Open Forum Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

Notes

Patient consent. This work did not include factors necessitating patient consent.

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All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

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