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MAJOR ARTICLE

Impact of Pharmacy Type on HIV Viral Suppression: A Retrospective Cross-Sectional Cohort Study

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Background. People with HIV (PWH) use various pharmacy types beyond traditional local pharmacies. Some specialized pharmacies offer additive adherence services such as refill reminders, expedited delivery, and adherence packaging.

Methods. This single-center, retrospective cohort study evaluated the impact of pharmacy type on the gain or loss of HIV viral suppression (VS; HIV RNA ≤50 copies/mL). Patients (≥19 years) were categorized by VS and pharmacy type: HIV-specialized (additive adherence/delivery services) vs traditional (without adherence/delivery services). Fisher exact tests examined the effect of pharmacy type on differences in VS between years, and logistic regression models identified possible predictors of gaining or losing VS.

Results. During 2017–2018, no differences were observed for the gain or loss of VS across pharmacy types (VS gain vs continued viremia, $P = .393$; VS loss vs continued VS, $P = .064$). Predictors for the gain of VS included antiretroviral therapy adherence as percentage of days covered (PDC; adjusted odds ratio [aOR], 1.05; $P < .001$) and Federal Poverty Level 100%–138% (FPL; aOR, 0.17; $P = .032$). Predictors for the loss of VS included use of protease inhibitor (aOR, 2.85; $P = .013$), ≥1 other illicit substance including tobacco (aOR, 2.96; $P = .024$), PDC (aOR, 0.95; $P < .001$), FPL 139%–200% (aOR, 0.09; $P = .031$), and CD4 >200 cells/ccm (aOR, 0.19; $P = .013$).

Conclusions. The gain or loss of VS among PWH in this retrospective cohort was not impacted by pharmacy transitions within the 2-year study period. However, PDC, FPL, illicit substance use, protease inhibitor use, and CD4 >200 cells/ccm were identified as factors associated with changes in VS.

Keywords. adherence services; HIV viral suppression; specialty pharmacy.

Viral suppression with antiretroviral therapy (ART) is the cornerstone of HIV treatment [1]. Sufficient adherence to prescribed ART ensures the maintenance of HIV viral suppression. People with HIV (PWH) often experience barriers to ART adherence and retention in care. Lack of consistent telephone/text access, housing instability, language barriers, mental illness, and ongoing illicit substance use, among others, have been reported as potential adherence barriers among PWH [2].

Efforts to enhance ART adherence are vast and have included telephone/text reminders, smartphone applications, electronic dose counters, and other interventions such as incorporating pill boxes, blister packages, or strip packages [3–7]. Antiretroviral therapies are sometimes considered specialty medications by insurance formularies due to their high cost. Specialty pharmacies were developed to provide high-cost, complex medications for patients with rare medical conditions. Specialty pharmacies have highly trained staff and provide adherence support through services such as monthly telephone/text reminders, expedited delivery processes, ongoing patient education, medication safety monitoring, and medication access through patient assistance programs, copay cards, or grants [8].

Two cohort studies found higher ART adherence rates among PWH using HIV-specialized pharmacies that offered medication therapy management and adherence services compared with traditional pharmacies [9, 10]. Similar results were observed among PWH using an integrated health system specialty pharmacy compared with traditional pharmacies, yet no significant differences in rates of viral suppression were found (HIV RNA <20 copies/mL; 93.5% vs 82.0%; $P = .12$) [11].

Despite considerable efforts to improve ART adherence by pharmacies, PWH often experience transitions in their pharmacy care services secondary to changes in prescription coverages through insurance or Ryan White HIV/AIDS (RWHAP) support. The Affordable Care Act allowed PWH greater access to insurance coverage through the insurance market place, often from RWHAP support and Medicaid expansion [12]. Changes in eligibility for various insurance coverages or grant support through RWHAP funding can occur frequently [13]. Further, mandated use of specific specialty pharmacies for medications designated by insurance formularies as specialty medications

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is a common practice [14]. Insurance mandates vary by plan structure and often restrict patients to solely using mail-order specialty pharmacies [15], limiting flexibility in pharmacy choice and access to pharmacy-provided adherence services.

The association between pharmacy type and sustained viral suppression among PWH is largely unknown. We conducted a retrospective analysis to determine the impact of pharmacy type on the gain or loss of HIV viral suppression among PWH receiving care at a Midwestern academic HIV clinic over a 2-year period.

METHODS

Study Design, Data Collection, and Inclusion Criteria

We conducted a single-center, retrospective cohort study of PWH receiving care at the University of Nebraska Medical Center's HIV clinic, the Specialty Care Center (SCC). The clinic provides comprehensive HIV, transgender, and psychiatric care with interprofessional collaboration between medical providers (physicians and advanced practice providers), nursing, on-site clinical pharmacy (separate medication assistance staff), social workers, and other case management/patient resource specialists. The SCC care team reviews each patient seen in the clinic or hospitalized on a weekly basis during SCC roundtables. Intercampus referrals for dental, eye, nutrition, substance use, and other specialized medical and surgical care are available to SCC patients. Additionally, SCC is a recipient of Ryan White Part C and Part D funding and operates the Nebraska AIDS Drug Assistance Program (ADAP) as a subgrantee.

Data were abstracted from the electronic health record for the period of January 1, 2017, to December 31, 2018. Patients with HIV aged 19 years or older, established in care at SCC, and prescribed ART for at least 6 months before the study period were included in the analysis. Patients were excluded if they were participating in an industry-sponsored clinical trial at SCC or had no HIV RNA collected in either of the 2017 or 2018 calendar years. All patients included in the study analysis were categorized by pharmacy type and viral suppression (HIV RNA ≤50 copies/mL) by the last HIV RNA for both 2017 and 2018. Viral suppression was defined as HIV RNA ≤50 copies/mL to reflect the SCC clinic standards. Pharmacy type was categorized as HIV-specialized or traditional. HIV-specialized was defined as a pharmacy providing enhanced pharmacy services, which included ≥1 of the following: expedited delivery (same-day couriered local delivery or next-day mailed delivery), adherence services (monthly refill reminders, adherence counseling, adherence packaging), and medication assistance (prior authorization assistance, medication assistance programs, copay assistance, or AIDS Drug Assistance Program [ADAP] linkage). All pharmacies specifically advertising any enhanced pharmacy service or classified as an accredited specialty pharmacy were designated as HIV-specialized pharmacies. Alternatively, traditional pharmacies either did not offer or did not advertise any of the enhanced services (Appendix 1). Local and mail-order pharmacies were classified as either HIV-specialized or traditional based on whether any of the aforementioned enhanced pharmacy services were provided.

Over the 2-year study period, patients were subcategorized by their change or maintenance of viral suppression status (maintained viral suppression, maintained viremia, gained viral suppression, or lost viral suppression) and pharmacy type (HIV-specialized both years, traditional both years, transition to HIV-specialized in 2018, or transition to traditional in 2018). This study design was chosen to account for changes in insurance and grant support. Often, these changes lead to subsequent changes in medical/prescription coverage and periods of transition or "churning" [13]. The primary outcome measure was the HIV RNA. Other variables collected included patient demographics (age, gender marker, race, ethnicity), marital status, income as a percentage of the Federal Poverty Level (FPL), housing status, insurance coverage, CD4 count, time on ART, ART regimen by class, ART pill burden and dosing frequency, ART adherence by percentage of days covered (PDC; calculated as number of ART refills over study period/total months in study period), substance use, mental health disorder, and clinical comorbidities.

Patient Consent Statement

This study was approved by the University of Nebraska Medical Center's Institutional Review Board (IRB# 786-18-EP).

Statistical Analysis

The primary aim was to determine the impact of pharmacy type on the gain or loss of HIV viral suppression within our study period. The proportions of patients who experienced a gain or loss of viral suppression from 2017 to 2018 were compared across the 4 pharmacy type status groups described above using the Fisher exact test.

Simple logistic regression models were used to evaluate associations between various potential predictor measures and the gain or loss of viral suppression. Models for losing viral suppression were limited to the subset of patients who were suppressed in 2017, whereas models for gaining viral suppression were limited to the subset of patients with HIV viremia in 2017. A multivariable logistic regression model for losing viral suppression included all variables with simple regression P values <.10, while a multivariable model for gaining viral suppression started with the variable having the smallest simple regression P value and included all variables with simple regression P values <.10 up to the point where the number of calculated parameters reached 10. This limitation was put in place because of the relatively small size of the subset used for these models. Adjusted odds ratios with respective P values were reported for each covariate.

Statistical analyses were performed using STATA (version 16.0; College Station, TX, USA). *P* values <.05 were considered statistically significant.

RESULTS

A total of 931 patients were included in the study analysis (Table 1). The mean age was 47 years, with the majority of patients identifying as cisgender men (74%). Twenty-nine percent were African American, and 14% were Hispanic. A little more than half of the patients were prescribed integrase strand transfer inhibitor–based regimens (59%), the median ART pill burden (range) was 1.8 (1–7) agents, and 57% were on single-tablet regimens. The median time on ART (range) was 8.2 (0.5–28.3) years. The majority of patients were virally suppressed for both study years (2017: 89%; 2018: 91%) and had a CD4 count >200 cells/ccm (94%). Fourteen percent (n = 131) switched ART regimens in 2018. Reasons for ART revision were most commonly attributable to improvements in the safety profile of the ART regimen (82%). However, 13% (n = 16/131) and 5% (n = 7/131) switched due to nonadherence and development of HIV drug resistance, respectively.

A description of pharmacy distribution for the study period is described in Figure 1 and a listing of each pharmacy utilized in the study period is described in Appendix 1.

Primary Outcome Measures

One hundred five patients (11.3%) were not virally suppressed in 2017. Fifty-nine (56.2%) of these patients gained viral suppression in 2018. No significant differences were observed among the 4 pharmacy type subcategorizations in those who gained viral suppression compared with patients remaining viremic (*P* = .393). Of the 826 patients with viral suppression in 2017, 41 patients (5.0%) lost their viral suppression status with HIV RNA values >50 copies/mL. Similarly, no significant differences were observed among the 4 pharmacy type subcategorizations in patients who lost viral suppression compared with patients remaining virally suppressed (*P* = .064). A summary of these results is presented in Table 2.

Regression Models for the Gain and Loss of Viral Suppression

In multivariable analyses adjusted for sociodemographic and clinical characteristics, ART adherence as measured by PDC (adjusted odds ratio [aOR], 1.05; *P* < .001) and FPL of 100%–138% compared with FPL <100% (aOR, 0.17; *P* = .032) were significantly associated with gain of viral suppression.

Variables associated with the loss of suppression included PDC (aOR, 0.95; *P* < .001), use of a protease inhibitor–based ART regimen compared with an integrase strand transfer inhibitor–based regimen (aOR, 2.85; *P* = .013), use of >1 illicit substance (aOR, 2.96; *P* = .024), CD4 count >200 cells/ccm

Table 1. Patient Characteristics (n = 931)

Characteristic	No. (%)[a]
Age, mean (SD), y	47.0 (11.4)
Gender	
Cisgender man	690 (74)
Cisgender woman	231 (25)
Transgender woman	10 (1)
Transgender man	0 (0)
Race	
White, non-Hispanic	488 (52)
Black, non-Hispanic	266 (29)
Hispanic	134 (14)
Other	43 (5)
Insurance coverage	
Commercial insurance	356 (38)
Medicare	181 (19)
Medicaid	104 (11)
Full ADAP	52 (6)
Commercial ADAP-HIP	238 (26)
PDC, mean (SD)	84.2 (22.3)
ADAP protocol	579 (62)
ART regimen type	
INI	546 (59)
PI	195 (21)
Other	188 (20)
ART pill burden, median (range)	1.8 (1–7)
ART single-tablet regimen	528 (57)
Viral suppression (≤50 copies/mL)	
2017	827 (89)
2018	845 (91)
Time on ART (range), y	8.2 (0.5–33.8)
Changed ART between 2017 and 2018	131 (14)
Comorbidity[b]	543 (58)
Mental health diagnoses	
Depression	364 (39)
Anxiety	197 (21)
>1 mental health diagnosis	184 (20)
Substance use	
Methamphetamine	84 (9)
Marijuana	176 (19)
Cocaine	47 (5)
Tobacco	156 (17)
Use of >1 illicit substance	92 (10)
Last CD4 >200	871 (94)
Federal Poverty Level	
<100%	334 (39)
100%–138%	132 (15)
139%–200%	128 (15)
201%–300%	190 (22)
>300%	80 (9)
Stable housing	887 (95)

Abbreviations: ADAP, AIDS Drug Assitance Program; ADAP-HIP, insurance coverage provided by ADAP; ART, antiretroviral therapy; Full ADAP, sole coverage through ADAP; INI, integrase strand transfer inhibitor; PDC, percentage of days covered; PI, protease inhibitor.

[a]All values expressed as No. (%) unless otherwise indicated.

[b]"Comorbidities" includes cardiovascular disease diagnosis, chronic kidney disease, hepatitic disease, or co-infections.

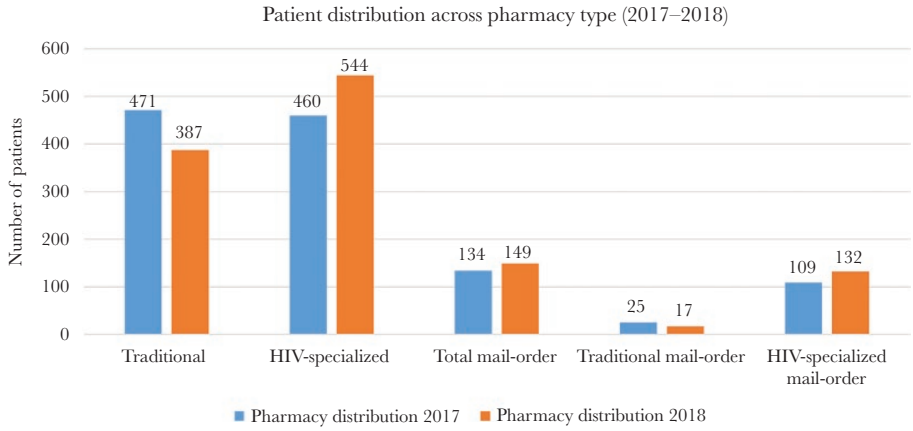

Figure 1. Patient distribution across pharmacy type (2017–2018). Overall traditional and HIV-specialized designations include mail-order subcategories. Definitions: Traditional: pharmacy without additive adherence services or expedited delivery; HIV-specialized: pharmacy with additive adherence and expedited delivery services.

(aOR, 0.19; $P = .013$), and FPL 139%–200% compared with an FPL <100% (aOR, 0.09; $P = .031$).

Results from logistic regression models assessing associations for the gain and loss of viral suppression can be found, respectively, in Tables 3 and 4.

DISCUSSION

In this study, we analyzed the impact of pharmacy transitions on viral suppression among PWH receiving HIV care at an academic HIV clinic in the Midwest longitudinally over a 2-year period. We did not find a significant association between pharmacy transitions and gain of viral suppression in patients with initially detectable viral loads, nor did we find a significant association between pharmacy transitions and loss of viral suppression in patients with initially undetectable viral loads. We had anticipated greater proportions of viral suppression among PWH using HIV-specialized pharmacies secondary to better access to adherence services. However, our findings suggest that the enhanced pharmacy services offered by some HIV-specialized pharmacies may not impact the gain or loss of viral suppression during periods of pharmacy transition.

Despite these findings, the importance of adherence services offered by any provider, pharmacy or otherwise, should not be undermined. We observed ART adherence, as measured by PDC, to be strongly associated with viral suppression in secondary analyses. This has also been observed in several other studies [16, 17]. Importantly, adherence services provided by many HIV-specialized pharmacies, regardless of location, have been associated with increased viral suppression and other positive treatment outcomes [6, 7, 9, 11, 18–21]. Adherence services, particularly with adherence packaging, may be helpful for PWH who are not eligible for single-tablet co-formulated ART regimens as well as those with a large number of concomitant medications. High rates of viral suppression were observed in 1 small observational cohort study of PWH receiving biweekly adherence packaging refills [3]. While pharmacies offering adherence packing services are often based locally within communities, CVS Health, PillPack, and others have started providing adherence packaging services by mail order [22].

Table 2. Differences in the Gain or Loss of Viral Suppression Based on Pharmacy Type Between 2017 and 2018

		Pharmacy Transition Between 2017 and 2018				
Viral Suppression Comparison	Total, No. (%)	Traditional, No. (%)	HIV-Specialized, No. (%)	Transition to Traditional, No. (%)	Transition to HIV-Specialized, No. (%)	*P* Value
No VS at beginning of 2017	105 (100)					.393
Gained VS	59 (56)	21 (50)	26 (67)	6 (46)	6 (55)	
Remained viremic	46 (44)	21 (50)	13 (33)	7 (54)	5 (45)	
VS at beginning of 2017	826 (100)					
Loss of VS	41 (5)	21 (7)	11 (3)	2 (6)	7 (6)	.064
Sustained VS	785 (95)	279 (93)	365 (97)	30 (94)	111 (94)	

Definitions: Traditional pharmacy: pharmacy without adherence services or expedited delivery; HIV-specialized pharmacy: pharmacy with adherence services and expedited delivery. Both pharmacy types are independent of mail-order designations.

Abbreviation: VS: viral suppression (≤50 copies/mL).

Table 3. Simple and Multivariate Logistic Regression Models for Gaining Viral Suppression[a]

	Simple Logistic Regressions		Multivariable Model	
	Odds Ratio	*P* Value	Odds Ratio	*P* Value
Pharmacy transition between 2017 and 2018[b]				
Traditional	Ref.	Ref.	-	-
HIV-specialized	2.00	.131	-	-
Transition to traditional	0.86	.809	-	-
Transition to HIV-specialized	1.20	.788	-	-
Age, y	1.03	.088	1.05	.092
Race				
White, non-Hispanic	Ref.	Ref.	-	-
Black, non-Hispanic	1.17	.708	-	-
Hispanic	1.58	.465	-	-
Other	0.88	.929	-	-
Insurance coverage				
Commercial	Ref.	Ref.	-	-
Medicare	0.48	.255	-	-
Medicaid	0.82	.741	-	-
Full ADAP	0.29	.035	-	-
Commercial ADAP-HIP	0.54	.309	-	-
PDC	1.05	<.001	1.05	<.001
ART regimen type				
INI	Ref.	Ref.	-	-
PI	0.54	.167	-	-
Other	0.48	.271	-	-
Changed ART during study period	0.29	.013	0.65	.539
Mental health disorder				
Depression	0.84	.666	-	-
Anxiety	2.69	.058	3.20	.108
Bipolar	0.63	.439	-	-
Schizophrenia/schizoaffective disorder[c]	-	-	-	-
>1 mental health condition	1.77	.242	-	-
Use of >1 illicit substance	0.74	.562	-	-
Last CD4 >200 cells/ccm	3.67	.004	3.17	.075
Federal Poverty Level				
<100%	Ref.	Ref.	Ref.	Ref.
100%–138%	0.41	.136	0.17	.032
139%–200%	0.71	.643	0.96	.971
201%–300%	12.50	.018	4.96	.162
>300%	3.13	.179	1.71	.608

Abbreviations: ADAP, AIDS Drug Assitance Program; ADAP-HIP, insurance coverage provided by ADAP; ART, antiretroviral therapy; INI, integrase strand transfer inhibitor; PDC, percentage of days covered; PI, protease inhibitor.

[a]Variables chosen for the multivariable model included those with simple model *P* values <.10 starting with the smallest *P* value and ending when the total number of calculated parameters reached 10 given our small sample size (n = 102 following listwise deletion for missing data elements). Variables analyzed by simple logistic regression but excluded from Table 3 include gender marker (transgender women and men were classified as "women" and "men," respectively, in the analysis), marital status, housing status, ART pill burden, ART dosing frequency, ADAP protocol status, presence of comorbidity (cardiovascular disease diagnosis, chronic kidney disease, hepatitic disease), co-infections, and housing status.

[b]*P* value for overall effect in the simple model was .408.

[c]Values missing because none of these disorders were observed among persons who remained viremic.

Several studies have specifically evaluated the use of mail-order pharmacies among PWH. In a prospective cohort study, Choe and colleagues found no difference in HIV viral suppression when comparing patients who used mail-order vs in-person pharmacies [23]. Yet delayed ART deliveries were noted in a small study of PWH receiving ART medications through a Veterans Affairs mail-order pharmacy where 47% of participants reported delivery delays leading to missed ART dosing [24]. Further, decreasing rates of viral suppression were observed among PWH as housing instability increased [25]. Thus, mail-order ART delivery may be challenged among PWH due to higher rates of housing instability (eg, homelessness or "couch surfing") and other social disparities [26–28]. Our study did not focus on the mail-order aspect of ART prescription access with regard to viral suppression, and we included mail-order pharmacies in both the HIV-specialized and

Table 4. Simple and Multiple Logistic Regression Models for Loss of Viral Suppression[a]

	Simple Logistic Regressions		Multivariable Model	
	Odds Ratio	*P* Value	Odds Ratio	*P* Value
Pharmacy transition between 2017 and 2018[b]				
Traditional	Ref.	Ref.	-	-
HIV-specialized	0.40	.016	-	-
Transition to traditional	0.89	.874	-	-
Transition to HIV-specialized	0.84	.695	-	-
Age, y	0.98	.142	-	-
Race				
White, non-Hispanic	Ref.	Ref.	Ref.	Ref.
Black, non-Hispanic	2.05	.036	1.95	.114
Hispanic	0.40	.221	0.38	.234
Other	1.86	.339	1.95	.377
Insurance coverage				
Commercial insurance	Ref.	Ref.	Ref.	Ref.
Medicare	2.56	.067	1.98	.297
Medicaid	6.00	<.001	2.70	.157
Full ADAP	4.82	.028	0.57	.542
Commercial ADAP-HIP	2.58	.050	1.62	.438
PDC	0.95	<.001	0.95	<.001
ART regimen type				
INI	Ref.	Ref.	Ref.	Ref.
PI	1.96	.049	2.85	.013
Other	0.22	.041	0.45	.308
Changed ART during study period				
Mental health disorder	1.97	.084	2.21	.101
Depression	1.59	.148	-	-
Anxiety	1.80	.091	1.61	.271
Bipolar	2.00	.165	-	-
Schizophrenia or schizoaffective disorder	0.70	.731	-	-
>1 mental health condition	1.78	.104	-	-
Use of >1 illicit substance	4.20	<.001	2.96	.024
Last CD4 >200 cells/ccm	0.22	.003	0.19	.013
Federal Poverty Level				
<100%	Ref.	Ref.	Ref.	Ref.
100%–138%	0.42	.086	0.71	.573
139%–200%	0.08	.014	0.09	.031
201%–300%	0.28	.010	0.42	.187
>300%	0.42	.159	0.96	.959

Abbreviations: ADAP, AIDS Drug Assitance Program; ADAP-HIP, insurance coverage provided by ADAP; ART, antiretroviral therapy; INI, integrase strand transfer inhibitor; PDC, percentage of days covered; PI, protease inhibitor.

[a]Variables chosen for the multivariable model included those with simple model *P* values <.10 (n = 760 following listwise deletion for missing data elements). Variables analyzed by simple logistic regression but excluded from Table 4 include gender marker (transgender women and men were classified as "women" and "men," respectively, in the analysis), marital status, housing status, ART pill burden, ART dosing frequency, ADAP protocol status, presence of comorbidity (cardiovascular disease diagnosis, chronic kidney disease, hepatitic disease), co-infections, and housing status.

[b]*P* value for overall effect in the simple model was .114.

traditional pharmacy groups. While we included housing status within univariable models, it was not included in multivariable analyses.

Changes in annual income (ie, FPL) can affect eligibility for insurance and grant support. Income changes, and subsequent changes in medical/prescription coverage, often lead to transition periods or "churning" [13]. Thus, we chose to design our study to detect changes in viral suppression as a result of pharmacy transitions over time. We found that an income level between 100% and 138% of the FPL was associated with a lower likelihood of gaining viral suppression and an income between 139% and 200% of the FPL was associated with a lower likelihood of losing viral suppression. Several reasons could exist for these findings. Often, PWH with an FPL of 100%–138% of the FPL transition out of that range for various reasons. A shift below 100% of the FPL could qualify that person for Medicaid eligibility (Nebraska is a nonexpansion state), and a shift above 138% of the FPL could be resultant of access to employer-based

insurance coverage. Thus, shifts in FPL may lead to ART nonadherence and lack of viral suppression secondary to insurance coverage gaps. Enrollment of PWH in RWHAP-sponsored ACA health plans and PWH living in states with Medicaid expansion has led to higher rates of ART prescription and HIV viral suppression [29–31]. In Nebraska, the ADAP program has provided PWH access to ACA insurance coverage through its RWHAP funding sources since 2015. We found that insurance coverage was not associated with the gain or loss of viral suppression in our study. Yet, the intersection of FPL transitions, pharmacy type, and viral suppression among PWH is an important consideration in light of the fact that this study was conducted in a state that did not expand Medicaid services.

Given the numerous sociodemographic barriers to medication adherence observed in PWH and the potential impact of adherence services on viral suppression, the choice of pharmacy type among PWH deserves further attention. The additive adherence and/or expedited delivery services provided by HIV-specialized pharmacies are important aspects for further evaluation. Future studies measuring the overall impact of enhanced pharmacy services offered by specialized pharmacies on maintenance of viral suppression among PWH over longer time periods would be beneficial. Additionally, some insurance plans have imposed mandates for antiretroviral refills through specialty pharmacies, which are sometimes owned by the pharmacy benefit managers for those plans [15]. Further research investigating the benefits of specialty pharmacy mandates for PWH is needed to provide transparency and support for their continued use [32].

We recognize that our study has limitations. Most notably, its retrospective design is prone to misclassification bias. Our results may not account for other potentially confounding variables such as clinic-derived services to enhance adherence and promote health care navigation and retention in care. Given the relatively small sample size (n = 931, unevenly split into various subgroups) and its single Midwestern cohort description, our study findings may not be generalizable to all areas of the United States or other countries. There were high baseline rates of viral suppression in our cohort, and over half of patients were prescribed a single-tablet regimen, which has been associated with higher rates of adherence than multitablet regimens [33]. We used a cutoff point of HIV RNA ≤50 copies/mL to define viral suppression as per our clinic standards. This cutoff could have impacted the results, as patients with viral blips (HIV RNA 51–200 copies/mL) were considered to have viremia. Additionally, neither the distance from the patient's residence to the pharmacy nor the impact of pharmacy location (local vs mail-order) was assessed in our analysis. Lastly, the patient has the ultimate choice to accept any of the enhanced pharmacy services offered by their respective pharmacy. Some patients may have received (ie, patient at a traditional pharmacy) or not received (ie, patient at an HIV-specialized pharmacy) any enhanced pharmacy services. It is possible that this phenomenon may not have been accounted for during the study period.

CONCLUSIONS

Despite the enhanced adherence and delivery services often provided by HIV-specialized pharmacies, our study did not find a significant association between pharmacy type and the gain or loss of viral suppression during the study period. Barriers to ART adherence and HIV care are likely to remain for PWH. The impact of pharmacy type, pharmacy location, and imposed insurance mandates on the long-term maintenance of viral suppression among PWH deserve further evaluation in future studies.

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APPENDIX

Appendix Table 1. Pharmacy Listing

Pharmacy	Pharmacy Model	Omaha Metro Area	Study Classification	Services Provided
Accredo	Mail-order	No	HIV-specialized	Expedited refills and adherence follow-up
Aetna	Mail-order	No	Traditional	-
AllianceRx	Mail-order	No	HIV-specialized	Expedited refills, adherence follow-up
Bakers Pharmacy	Local	Yes	Traditional	-
Briova Rx	Mail-order	No	HIV-specialized	Expedited refills, adherence follow-up, medication assistance
Catholic Health Initiatives	Local	Yes	HIV-specialized	Expedited refills, adherence follow-up, medication assistance
Cigna Home Delivery	Mail-order	No	Traditional	-
Costco	Local	Yes	Traditional	-
CVS	Local	Yes	Traditional	-
CVS Specialty	Mail-order	No	HIV-specialized	Expedited refills, some adherence follow-up, medication assistance
Ed Rexall	Local	Yes	Traditional	-
Elmwood Pharmacy	Local	Yes	HIV-specialized	Expedited refills, adherence follow-up, adherence packaging, medication assistance
Express Scripts	Mail-order	No	Traditional	-
Genoa Health	Local	Yes	HIV-specialized	Expedited refills, adherence packaging
Geri Med	Mail-order	No	Traditional	-
Humana	Mail-order	No	Traditional	-
HyVee Pharmacy	Local	Yes	Traditional	-
Hyrum Pharmacy	Local	No	Traditional	-
Integrated Pharmacy	Mail-order	Yes	Traditional	-
Kohlls Pharmacy[a]	Local	Yes	Traditional	-
LDI Specialty Pharmacy	Mail-order	No	HIV-specialized	Expedited refills, adherence follow-up, medication assistance
Magellan Specialty	Mail-order	No	HIV-specialized	Expedited refills, adherence follow-up
Maxor Rx	Mail-order	No	HIV-specialized	Expedited refills, adherence follow-up, medication assistnace
Nebraska Medical Center[a]	Local	Yes	Traditional	-
Nucara Pharmacy	Mail-order	No	HIV-specialized	Expedited refills, adherence follow-up, medication assistance
One World	Local	Yes	Traditional	-
OptumRx	Mail-order	No	Traditional	-
Penn Drug	Local	No	Traditional	-
Pharmerica	Mail-order	No	Traditional	-
Redler	Local	No	Traditional	-
RestoreRx	Mail-order	No	HIV-specialized	Expedited refills, adherence follow-up, medication assistance
Think Whole Person Healthcare	Local	Yes	Traditional	-
Union Pharmcy	Local	No	Traditional	-
US Specialty Care	Mail-order	No	HIV-specialized	Expedited refills, adherence follow-up, medication assistance
Walgreens	Local	Yes	Traditional	-
Walgreens Specialty	Local	Yes	HIV-specialized	Expedited refills, adherence follow-up, adherence packaging, medication assistance
Walmart	Local	Yes	Traditional	-

Definitions: expedited refills: same-day couriered local delivery or next-day mailed delivery; adherence follow-up: refill reminders or adherence counseling offerings; medication assistance: assistance with prior authorization process and/or linkage to medication assistance programs, copay assistance programs, or AIDS Drug Assistance Program services.

[a]Kohlls Pharmacy and Nebraska Medical Center Pharmacy have separate specialty pharmacy departments; however, no patients with HIV received medications from the specialty pharmacy operations during the study period.