Assessing the Overall Quality of Health Care in Persons Living with HIV in an Urban Environment

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Abstract

Ensuring high quality primary care for people living with HIV (PLWH) is important. We studied factors associated with meeting Health Resources and Services Administration-identified HIV performance measures, among a population-based sample of 376 PLWH in care at 24 Philadelphia clinics. Quality of care was assessed by a patient-level composite of 15 performance measures, focusing on HIV-specific care, vaccinations, and comorbid condition screening. Adjusted incidence rate ratios (IRR) demonstrated relationships between patient and clinic factors and the performance measures score. The mean number of measures met was 8.52. Older age groups met more measures than 18- to 29-year-olds (age 40–49: adjusted IRR: 1.19, 95% CI: 1.05–1.35; age ≥ 50: adjusted IRR: 1.19, 95% CI: 1.03–1.35). Higher CD4 counts were associated with meeting more measures compared to CD4 < 200 cells/ μ L (CD4 350–499 cells/ μ L: adjusted IRR: 1.14, 95% CI: 1.02–1.28; ≥ 500 cells/ μ L: adjusted IRR: 1.12, 95% CI: 1.01–1.26). PLWH attending clinics that provide adherence counseling or case management met more measures (adjusted IRR: 1.12, 95% CI: 1.04–1.21; adjusted IRR: 1.08, 95% CI: 1.02–1.14; respectively) than those attending clinics without these services. Limitations include potentially poor performance measure documentation and equal treatment of measures. Future work should focus on improving compliance with performance measures.

Introduction

AS PEOPLE LIVING WITH HIV (PLWH) survive longer, ensuring receipt of high quality care becomes increasingly important. Performance measures for HIV primary care have been established by the HIV Medicine Association,¹ the National Quality Forum,² and the Health Resources and Services Administration (HRSA).^{3–5} Guaranteeing high quality HIV care is particularly important to Ryan White Program (RWP)-funded clinics, which are required to monitor compliance with HRSA performance measures.⁶ However, little is known about patient and clinic factors that may contribute to success in meeting performance measures.

HRSA performance measures for HIV clinics include HIV-specific measures [retention in HIV care; CD4 count and HIV viral load monitoring; prescription of antiretroviral therapy (ART); virologic suppression; and prescription of *Pneumocystis jirovenii* prophylaxis], screenings for comorbid conditions (syphilis, gonorrhea, *Chlamydia*, hepatitis

B virus, hepatitis C virus, tuberculosis, hyperlipidemia, and cervical cancer among women), and vaccinations (influenza, hepatitis B virus, and pneumococcus).^{3–5} Prior research focusing on HIV-specific measures has shown that 51% of PLWH are retained in care,⁷ 89% of those in care are prescribed ART,⁷ and of those on ART, 77% achieve virologic suppression.^{7,8} However, less is known about how well HIV providers comply with vaccinations and screenings for comorbid conditions, or what clinic factors are associated with successfully meeting HIV measures. One study suggests that RWP-funded clinics meet more performance measures than non-RWP funded clinics.⁹ However, that analysis did not examine many of the measures currently in use.^{3–5,9}

To improve the care of PLWH, a better understanding of compliance with HRSA performance measures is needed. We used data from a representative sample of patients and clinics in Philadelphia to assess compliance with HRSA performance measures and to determine factors associated with meeting these measures.

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Methods

Study participants and data collection

Data were obtained from the Medical Monitoring Project (MMP), a surveillance project funded and coordinated by the Centers for Disease Control and Prevention (CDC). MMP uses a population-based sample of PLWH to monitor clinical outcomes, HIV medical care, and on-going risk factors for persons receiving HIV care. To select a representative sample of approximately 400 persons receiving primary HIV medical care in Philadelphia, MMP uses a three-stage sampling process with a probability proportion-to-size sampling design, as has been described elsewhere.^{10–13} Patients were interviewed between July 8, 2009 and May 28, 2010, and data were collected on all patients for the 365 days prior to the date of the interview or the date of abstraction for those not interviewed.

The Institutional Review Board of the University of Pennsylvania and of the City of Philadelphia Department of Public Health determined that the current analysis was exempt from review.

Patient and clinic variables

Demographic variables were defined according to CDC criteria.¹⁰ Sex was based on sex at birth. Race/ethnicity was categorized as white, black, Hispanic, or other. Age on January 1, 2009 was categorized as 18–29, 30–39, 40–49, and ≥ 50 years of age. United States (US) birth was coded as US birth (not including Puerto Rico) versus all other responses. Categories for HIV risk behavior included injection drug use (IDU), men having sex with men (MSM), heterosexual exposure, or other/unknown. Insurance status was categorized as private insurance, Medicaid, Medicare, Veterans Health Administration (VA) benefits, or uninsured. Those with both Medicare and Medicaid were coded as having Medicare. CD4 count was coded as the minimum value in the year, and categorized as < 200 , 200–349, 350–499, and ≥ 500 cells/ μ L.

Clinic variables included were adherence counseling, case management, and RWP-funding status. Adherence counseling (consultations or programs specifically designed to support or improve patient adherence to HIV treatment) and case management (coordination of health services) were defined according to MMP definitions.¹⁰ RWP-funding status was coded as presence or absence.

Patient-level performance measure variables

Table 1 describes the HRSA performance measures assessed.^{3–5} HIV-specific performance measures examined were: (1) retention in care (two clinic visits for HIV care in the study year, ≥ 90 days apart), (2) CD4 count monitoring (two CD4 T-lymphocyte levels sent in the study year, ≥ 90 days apart), (3) HIV viral load monitoring (two HIV-1 RNA levels sent in the study year, ≥ 90 days apart), (4) prescription of ART (receipt of a prescription for a preferred or alternative ART regimen during the study year, based on Department of Health and Human Services guidelines),^{14,15} and (5) virologic suppression (most recent HIV-1 RNA level in the study year < 200 copies/mL).³

Screening for co-morbid conditions were also examined. These included (1) hepatitis C virus screening (ever receiving a hepatitis C virus antibody test), (2) hepatitis B virus screening (ever receiving serologic testing for hepatitis B

surface antigen and hepatitis B core antibody, or any documentation of infection with a positive hepatitis B surface antigen, or immunity with a positive hepatitis B surface antibody), (3) lipid screening (any cholesterol, high-density lipoprotein, low-density lipoprotein, or triglyceride testing in the study year), (4) tuberculosis screening [ever receiving a quantiferon gold or purified protein derivative (PPD) test, or diagnosis of tuberculosis], (5) syphilis screening [receiving rapid plasma reagin (RPR), *Treponema pallidum* hemagglutination (TPHA), venereal disease research laboratory test (VDRL), dark field microscopy, or fluorescent Treponemal antibody (FTA) test in the study year], (6) *Chlamydia* screening [a sample from any site sent for *Chlamydia* polymerase chain reaction (PCR) in the study year], and (7) gonorrhea screening (a sample from any site sent for gonorrhea culture, Gram stain, or PCR in the study year).^{3–5}

Finally, we examined vaccination history. These included (1) hepatitis B virus vaccination (history of a positive hepatitis B virus surface antibody or at least one hepatitis B virus vaccination),⁴ (2) influenza vaccination (receipt of vaccination during the study year),⁵ and (3) pneumococcal vaccination (ever receiving a pneumococcal vaccination).⁵

Compliance with performance measures was assessed using an ordinal scale ranging from 0–15. Each HRSA performance measure chosen was given one point (Table 1).^{3–5} Performance measures that were missing for at least 50% of participants (e.g., oral exam, substance abuse screening) or applied to fewer than 50% of patients (e.g., cervical cancer screening, PCP prophylaxis) were excluded. A total of 15 of the 27 available HRSA performance measures were included in analyses. The summed performance measures score was further divided into HIV-specific measures, screening for comorbid conditions, and vaccinations for descriptive purposes.

Data analyses

Patient-level data was the focus of all analyses. We examined the proportion of patients meeting performance measures across patient and clinic variables. For multivariable analyses of number of performance measures met, we used negative binomial regression to estimate effects [incidence rate ratios (IRRs) with 95% confidence intervals (CI)]. When the variance is not equivalent to the mean of the distribution of count data, negative binomial regression is more robust than Poisson regression.¹⁶ In all models, clustering by clinic was accounted for by including an indicator variable for each clinic. As the original sampling mechanism oversampled larger clinics, clinic weights based on MMP data were added to the model.^{10–13} Patient and clinic variables *a priori* determined to be important (sex at birth, race/ethnicity, age, place of birth, HIV risk behavior, insurance status, CD4 count, adherence counseling, case management, and RWP funding status) were included in the multivariate models.

Because adherence counseling and case management may directly influence retention in care, virologic suppression, and receipt of ART measures, we removed these three measures from the summed performance measure score in secondary analyses (summed score = 12). Similarly, because retention in care may impact successfully meeting certain performance measures, we performed secondary analyses where retention in care was excluded from the summed performance measure score and instead included as a covariate (summed score = 14).

TABLE 1. HEALTH RESOURCES AND SERVICES ADMINISTRATION (HRSA) PERFORMANCE MEASURES USED IN THE STUDY^a

Performance measure	Eligible patients in denominator	Included in summed performance measure score?
Medical visits/retention in care (two visits in the year of the study with HIV care providers ≥ 90 days apart)	Visit in the prior year	Yes
CD-4 T-lymphocyte level (two values received that were ordered ≥ 90 days apart during the year of the study)	Meeting retention measure	Yes
HIV-1 RNA level (two values received that were ordered ≥ 90 days apart during the year of the study)	Meeting retention measure	Yes
Preferred or alternative ART regimen ^b	Meeting retention measure	Yes
Virologic suppression (HIV-1 RNA level < 200 copies/ml during the year of the study)	On ART	Yes
<i>Pneumocystis jirovecii</i> prophylaxis prescription in the prior year	CD-4 T-lymphocyte level < 200 cells/ μ L during year	No
Hepatitis C virus screening at any point	Visit in the past year	Yes
Hepatitis B screening at any point (serologic testing for hepatitis B surface antigen and hepatitis B core antibody, or any documentation of infection with a positive hepatitis B surface antigen, or immunity with a positive hepatitis B surface antibody)	Visit in the past year	Yes
Lipid screening in the prior year	On ART	Yes
Tuberculosis screening at any point	Visit in the past year	Yes
Syphilis screening in the prior year	Newly enrolled in care, sexually active, or STI in past year	Yes
<i>Chlamydia</i> screening in the prior year	Newly enrolled in care, sexually active, or STI in past year	Yes
Gonorrhea screening in the prior year	Newly enrolled in care, sexually active, or STI in past year	Yes
Cervical cancer screening	Women with intact cervixes	No
Hepatitis B virus vaccination (at least one) or evidence of positive Hepatitis B virus screening at any point	Visit in the past year	Yes
Pneumococcal vaccination at any point	Visit in the past year	Yes
Influenza vaccination in the prior year	Those who are not allergic to vaccine components	Yes
Pregnant women on ART	Pregnant Women	No
Adherence assessment and counseling	On ART	No
HIV risk counseling	Visit in the past year	No
Oral exam	Visit in the past year	No
<i>Mycobacterium avium</i> prophylaxis prescription in the prior year	CD4 level < 50 cells/ μ L in the past year	No
Mental health screening	New patients to clinic	No
Alcohol counseling	Coinfected with hepatitis B or hepatitis C	No
Substance use screening	New patients to clinic	No
Tobacco cessation counseling	Patients who use tobacco	No
<i>Toxoplasmosis gondii</i> screening	Visit in the past year	No

ART, antiretroviral therapy; HRSA, Health Resources and Services Administration; STI, sexually transmitted infection.

^aDenominator criteria for each performance measure included being seen by a clinic provider at least once during the year of the study unless otherwise indicated. HRSA criteria for performance measures have been described elsewhere.³⁻⁵ Performance measures excluded from the final summed performance measure score were not included if fewer than 50% of the patients in the study were eligible (e.g., pregnant women on ART, *Pneumocystis jirovecii* prophylaxis, cervical cancer screening, alcohol cessation counseling, *Mycobacterium avium* prophylaxis, mental health screening, substance use screening, and tobacco cessation counseling), or if the measures were not well documented across clinics (e.g., adherence assessment and counseling, HIV risk counseling, oral exam, alcohol cessation counseling, mental health screening, substance use screening, tobacco cessation counseling, and *Toxoplasmosis gondii* screening).

^bPreferred/alternative regimens defined based on HRSA criteria at the time of the study.^{3-5,24,40}

All data analyses were performed with SAS Ver. 9.2 (SAS Institute Inc., Cary, North Carolina).

Results

The study included 376 PLWH who received care in 24 HIV clinics in Philadelphia in 2009 (Table 2). Most were male

(64.2%) and black (67.3%). A majority used Medicaid (55.6%) for insurance. Table 3 describes the characteristics of the clinics sampled, as well as the numbers of PLWH attending these clinics. Most clinics (83.3%) were RWP-funded, with 87.8% of PLWH receiving care at these sites. A majority of clinics provided adherence counseling (83.3%) and case management (54.2%).

TABLE 2. SOCIODEMOGRAPHIC CHARACTERISTICS OF 376 HIV-POSITIVE PERSONS IN CARE IN PHILADELPHIA SAMPLED IN THE MEDICAL MONITORING PROJECT

<i>Characteristic</i>	<i>n (Percentage)</i>
<i>Sex at birth</i>	
Male	243 (64.6)
Female	133 (35.8)
Missing	4 (1.1)
<i>Race</i>	
White non-Hispanic	80 (21.3)
Black non-Hispanic	253 (67.3)
Hispanic	41 (10.9)
Other	2 (0.5)
<i>Age (years)</i>	
18–29	51 (13.6)
30–39	67 (17.8)
40–49	142 (37.8)
≥ 50	116 (30.9)
<i>Place of birth</i>	
United States	353 (93.9)
Puerto Rico or outside the United States	16 (4.3)
Missing	7 (1.9)
<i>HIV risk category</i>	
Heterosexual contact	140 (37.2)
Men who have sex with men	116 (30.9)
Injection drug use	111 (29.5)
Other/unknown	9 (2.4)
<i>Insurance status</i>	
Private	88 (23.6)
Medicaid	209 (55.6)
Medicare	46 (12.2)
VA	14 (3.7)
Uninsured	30 (8.0)
<i>Minimum CD4 count in year of study</i>	
< 200 cells/ μ L	80 (21.3)
200–349 cells/ μ L	84 (22.3)
350–499 cells/ μ L	64 (17.0)
≥ 500 cells/ μ L	124 (33.0)
Missing CD4 T-lymphocyte level	24 (6.4)

VA, Veterans Health Administration.

Percentages of patients meeting performance measures are reported (Table 4). Compliance with HIV-specific performance measures was high. Most patients (74.2%) were on a preferred or alternative ART regimen, 70.0% were virologically suppressed, and 77.7% were retained in care. Only a minority received *Chlamydia* (6.91%) or gonococcal (6.65%)

screening, but most received hepatitis B virus screening (81.1%) and hepatitis C virus screening (87.2%). Vaccination rates for hepatitis B virus (78.2%) and pneumococcus (80.1%) were high, but only half (51.9%) received an influenza vaccination in the past year. Overall, patients met a mean of 8.52 of the 15 performance measures assessed: 3.28 of 5 HIV-specific measures, 3.14 of 7 screening for co-morbid condition measures, and 2.10 of 3 vaccination-related measures.

Table 5 shows IRRs for the relationships between patient and clinic variables and the summed performance measure score. Older age groups, when compared with 18- to 29-year-olds, met more measures (age 40–49: adjusted IRR: 1.19, 95% CI: 1.05–1.35; age ≥ 50: adjusted IRR: 1.19, 95% CI: 1.03–1.35). Higher CD4 counts were associated with meeting more measures when compared with those with CD4 counts < 200 cells/ μ L (350–499 cells/ μ L: adjusted IRR: 1.14, 95% CI: 1.02–1.28; ≥ 500 cells/ μ L: adjusted IRR: 1.12, 95% CI: 1.01–1.26).

In addition, providing adherence counseling or case management was associated with a higher summed performance measure score (adjusted IRR: 1.12, 95% CI: 1.04–1.21; adjusted IRR: 1.08, 95% CI: 1.02–1.14, respectively). These relationships persisted when items considered specifically related to adherence (retention in care, virologic suppression, and receipt of ART) were excluded (adherence counseling: adjusted IRR: 1.28, 95% CI: 1.20–1.39; case management: adjusted IRR: 1.14, 95% CI: 1.04–1.25) (see supplementary Table S1 at www.liebertpub.com/apc). When retention in care was excluded from the summed performance measure score and included as a covariate, adherence counseling remained associated with a higher score, but case management was not (adjusted IRR: 1.10, 95% CI: 1.01–1.20; adjusted IRR: 1.02, 95% CI: 0.96–1.10, respectively) (supplementary Table S1). In this analysis, retention in care was also associated with a higher summed performance measures score (adjusted IRR: 1.17, 95% CI: 1.12–1.22).

Discussion

In our sample, patients only met 8.52 out of 15 performance measures (56.8%). PLWH were more likely to meet HIV-specific and vaccination-related measures [3.28 of 5 measures (65.6%) and 2.10 of 3 measures (70.0%), respectively] than screenings for co-morbid conditions screenings measures [3.14 of 7 measures (44.9%)]. To improve the quality of care delivery to PLWH, and in particular, co-morbid conditions screenings, an understanding of patient and clinic factors associated with meeting performance measures is necessary.

TABLE 3. CLINIC CHARACTERISTICS, OF 24 PHILADELPHIA HIV CLINICS AND 376 PATIENTS SAMPLED FOR THE MEDICAL MONITORING PROJECT^a

<i>Clinic characteristics</i>	<i>n = Clinics meeting Characteristic (percentage of clinics)</i>	<i>n = Patients attending clinic with characteristic (percentage of patients)</i>
Adherence counseling	20 (83.3)	336 (89.4)
Case management	13 (54.2)	225 (59.8)
Ryan White Program-funded	20 (83.3)	330 (87.8)

SD, standard deviation.

^a24 HIV medical care clinics were sampled from a list of all outpatient clinics providing HIV care in Philadelphia (defined as sites prescribing antiretroviral medications [ARV] or ordering CD4 T-lymphocyte or HIV viral load tests) in 2009. Participants were then sampled from each clinic (total N=376).

TABLE 4. PREVALENCE OF RECEIPT OF HEALTH RESOURCES AND SERVICES ADMINISTRATION (HRSA) PERFORMANCE MEASURES AMONG 376 PERSONS LIVING WITH HIV STUDIED IN THE MEDICAL MONITORING PROJECT

<i>Performance measure</i>	<i>n = Met performance measure</i>	<i>n = Eligible for performance measure</i>	<i>Percentage meeting performance measure</i>
<i>HIV-specific performance measures</i>			
Met clinic visit retention in care criteria	292	376	77.7
Met CD4 T-lymphocyte monitoring criteria in study year	352	376	93.6
Met HIV-1 RNA viral load monitoring criteria in study year	347	376	92.3
Prescribed a recommended or alternative antiretroviral regimen in study year	279	376	74.2
Virologic suppression achieved in study year	263	376	70.0
Summed HIV-specific performance measure score, of 5 (mean, SD)			3.28, 1.36
<i>Co-morbid condition performance measures</i>			
Hepatitis C virus screening at any point	337	376	87.2
Hepatitis B virus screening received at any point	305	376	81.1
Lipid screening in study year	64	376	17.0
Tuberculosis screening at any point	211	376	56.1
Syphilis screening in study year	212	376	56.4
Chlamydia screening in the past year	26	376	6.9
Gonorrheal screening in the past year	25	376	6.7
Summed co-morbid condition screening performance measure score, of 7 (mean, SD)			3.14, 1.30
<i>Vaccination performance measures</i>			
Hepatitis B vaccine at any point or positive screening	294	376	78.2
Influenza vaccination in the past year	195	376	51.9
Pneumococcal vaccination received at any point	301	376	80.1
Summed vaccination performance measure score, of 3 (mean, SD)			2.10, 0.87
Summed performance measures score of 15: mean, SD			8.52, 2.39

SD, standard deviation.

TABLE 5. ASSOCIATIONS BETWEEN PATIENT-LEVEL SOCIODEMOGRAPHIC OR CLINIC CHARACTERISTICS AND MEETING THE SUMMED PERFORMANCE MEASURE SCORE

<i>Clinic characteristic</i>	<i>IRR (95% CI)</i>	<i>Adjusted IRR (95% CI)</i>
<i>Sex at birth (male = referent)</i>		
Female	1.01 (0.97–1.04)	0.99 (0.89–1.09)
<i>Race/ethnicity (white = referent)</i>		
Black	1.02 (0.93–1.11)	1.04 (0.97–1.10)
Hispanic	0.98 (0.88–1.09)	1.04 (0.96–1.09)
<i>Age (18–29 = referent)</i>		
30–39	1.00 (0.86–1.16)	1.09 (0.96–1.25)
40–49	1.13 (0.77–1.30)	1.19 (1.05–1.35)
50 and up	1.12 (0.96–1.31)	1.17 (1.01–1.35)
<i>Place of birth (US = referent)</i>		
Non-U.S. birth	1.02 (0.73–1.45)	1.05 (0.73–1.50)
<i>HIV risk factor (heterosexual = referent)</i>		
Men having sex with men	1.02 (0.93–1.13)	1.05 (0.93–1.18)
Injection drug use	0.99 (0.90–1.10)	1.00 (0.93–1.07)
<i>Insurance (private = referent)</i>		
Medicaid	0.97 (0.93–1.02)	0.98 (0.92–1.06)
Medicare	0.93 (0.83–1.04)	0.97 (0.88–1.08)
VA	0.98 (0.96–1.01)	1.01 (0.87–1.18)
Uninsured	0.73 (0.64–0.82)	0.91 (0.81–1.03)
<i>Minimum CD4 count in year of study (<200 cells/μL = referent)]</i>		
200–349 cells/μL	1.08 (1.00–1.17)	1.08 (0.98–1.19)
350–499 cells/μL	1.07 (1.02–1.13)	1.14 (1.02–1.28)
≥500 cells/μL	1.04 (1.00–1.07)	1.12 (1.01–1.26)
Presence of adherence counseling	1.21 (1.13–1.28)	1.12 (1.04–1.21)
Presence of case management	1.14 (1.03–1.25)	1.08 (1.02–1.14)
Ryan White Program-funded	1.06 (0.96–1.17)	1.07 (0.92–1.25)

CI, confidence interval; FTE, full-time equivalent clinician; IRR, incidence rate ratio; US, United States; VA, Veterans Affairs.

These findings are consistent with earlier studies that noted high compliance with HIV-specific measures and low compliance with co-morbid conditions screenings.^{7,8,17–20} In the US, 89% of those in care are prescribed ART,⁷ and of those on ART, 77% achieve virologic suppression.^{7,8} In comparison, less than 40% of PLWH in a large health system received gonococcal or *Chlamydial* screening.¹⁷ Data on vaccination rates have varied, ranging from 33% to 88%.^{8,18–20} Providers should continue to emphasize HIV-specific performance measures, as these have been linked to improved clinical outcomes and survival. However, in an era where PLWH increasingly have morbidity and mortality from co-morbid conditions,¹ vaccinations and screening for co-morbid conditions should be a priority. New guidelines published by the HIV Medical Association focus attention on the importance of vaccination and screening for and treating co-morbid conditions, calling for all PLWH to be monitored for relevant age- and sex-specific health problems.¹ However, even when HIV providers are aware of guidelines calling for vaccination and screening for co-morbid conditions, compliance with these guidelines may be low.²¹

HIV providers and researchers should investigate ways to improve the outpatient quality of care. The Patient Centered Medical Home, a team-based model of care that emphasizes personalized, accessible, high-quality, and comprehensive care over time and across healthcare settings,²² has been shown to improve the delivery of preventative care services.²³ This may be a useful tool for increasing vaccinations and co-morbid condition screenings in HIV clinics.²⁴ Quality improvement programs may also increase compliance with performance measures. RWP-funded clinics in particular are mandated to have quality improvement plans.²⁵ Among 45 RWP-funded HIV clinics participating in HIVQUAL-US,²⁶ a federally-funded program designed to build quality management methodology capacity within HIV clinics, clinics improved on a combined quality indicator score over the 7-year study period, a trend that was even more pronounced among those clinics that had been in the lowest quartile at the start of the study.²⁷ These clinics receive technical assistance from experts in quality improvement, peer mentorship, an exchange of innovations with other HIVQUAL-US clinics, and databases of tools for continuous quality improvement.²⁶ In addition, PLWH peer mentors, who work in some settings to engage high-risk PLWH in care,²⁸ could potentially help PLWH in achieving performance measures. Similar techniques and programs may help HIV clinics improve compliance with performance measures.

Attending clinics that provide formal adherence counseling and case management services was associated with a higher score, even after excluding the prescription of ART, virologic suppression, and retention in care. Our study differs from prior studies because the effect of case management and adherence counseling was assessed at the clinic level, not the individual level. Prior research has noted increased provider productivity associated with case management in both inpatient²⁹ and outpatient³⁰ settings. By assisting PLWH with medication adherence or visit attendance, case managers and adherence counselors may allow providers additional time to focus on preventative care and screenings. In addition, adherence counselors and case managers may contribute as important parts of team-based approaches for improving compliance with performance measures, like those emphasized in HIVQUAL-US.^{26,27}

The relationship between case management and the summed performance measures score may be mediated by retention in care. When we removed retention in care from the summed performance measure score and included it as a covariate, case management was no longer significantly associated with the summed performance measure score. Clinics providing case management may retain more PLWH in care, giving providers greater opportunities to meet performance measures. This relationship has been shown in pediatric clinics serving children receiving Medicaid, where case management both increases the number of children seen and the quality of the screening exams provided.³¹ Recently, it has been shown that some PLWH can have clinic visits every 6 months without loss of virologic control.³² If retention in care is associated with meeting more performance measures, we should also confirm spacing clinic visits out further does not lead to decreased compliance with performance measures.

We found that older age groups (ages 40–49 and ≥ 50) met more performance measures than the youngest age group (ages 18–29). Providers may be more cognizant of the need for certain tests in adults ≥ 40 years of age (i.e., lipid screening). In addition, visits for routine medical care prior to HIV diagnosis are more common in older age groups and are associated with subsequent retention in care.³³ Meanwhile, those with higher CD4 counts were more likely to have a higher summed performance measure score. Providers may be waiting for higher CD4 counts to achieve certain performance measures (e.g., to improve the immune response to hepatitis B vaccination),³⁴ or may be focusing on more acute problems in a sicker population.

Surprisingly, insurance or RWP-funding status was not significantly associated with the summed performance measure score. It is possible that RWP-funded clinics actually negate the relationship between insurance status and the performance measure score. The RWP provides funding for the care of uninsured and underinsured PLWH and mandates improvements in the quality of care for PLWH.^{6,9,25} In previous studies, uninsured PLWH were less likely to meet HIV-specific measures (retention in care, use of ART, and virologic suppression),^{35–41} and nonprivate insurance was associated with more barriers to care.⁴² It would therefore be expected that uninsured PLWH may meet fewer performance measures. However, in our study, 96% of uninsured PLWH received care at RWP-funded clinics. Perhaps RWP-funded clinics aid the uninsured in meeting as many performance measures as the privately insured. While RWP-funding status was also not significantly associated with the summed performance measures score, as only four clinics in our study were not RWP-funded, we may have not had the power to detect this relationship.

Our study was subject to several limitations. First, we focused on adult patients in one city, which may limit the applicability of our findings to pediatric clinics or other regions of the country. Second, some patients may have received vaccinations and screenings for co-morbid conditions outside of their HIV primary care clinics. This may underestimate the numbers of performance measures met. Third, we elected to sum the performance measures, assigning one point to each, and did not include performance measures that applied to only a subset of patients or were not well documented. This methodology does not account for the fact that some

performance measures, such as virologic suppression, may be more important to patient survival⁷ than other measures. However, summed performance measure scores have been used in prior studies, and are useful tools for identifying gaps in care.^{8,27} In addition, using one performance measure as a proxy for other performance measures may not lead to valid conclusions, as a prior analysis of RWP-funded clinics showed poor correlation between individual HIV quality metrics.⁴³

Overall, PLWH only met 8.52 of 15 HRSA performance measures. Compliance was highest with HIV-specific measures and lowest with screening of co-morbid conditions. Older age, higher CD4 counts, and attending clinics that provide adherence counselors and case management were significantly associated with meeting more performance measures. Interventions focused on improving quality of care, such as rapid cycle change and continuous quality improvement methodologies,^{26,44} may assist HIV clinics in meeting performance measures. Future studies exploring how HIV clinics can improve the care of PLWH are needed.

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Author Disclosure Statement

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