Risk Factors for Nonadherence with Pap Testing in HIV-Infected Women

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Abstract

Background: HIV-infected women are at increased risk for cervical cancer; thus, adherence with Papanicolaou (Pap) testing is of particular importance. The objective of this study was to identify risk factors for inadequate Pap testing in a diverse cohort of HIV-infected women at a large urban safety net HIV clinic.

Methods: This retrospective cohort study assessed HIV-infected women aged 18–60 years in care between October 1, 2003, and March 31, 2008, for risk factors for inadequate Pap testing. Unadjusted odds ratios (OR) with confidence intervals (CI) and multivariate analyses with generalized estimating equations for correlated data were calculated.

Results: Of 549 women, 293 (53.4%) had a Pap test during each follow-up period. Women who were older, white or Hispanic race/ethnicity, U.S. born, unemployed, drug users, and those with advanced HIV had increased odds of no Pap testing in unadjusted analyses. In multivariate analyses, U.S.-born women who were white or unemployed or had a baseline CD4 count <200 cells/mm³ had increased odds of no Pap testing (OR 2.0, 95% CI 1.3–3.1; OR 2.3, CI 1.0–5.0; OR 1.7, CI 1.0–2.9, respectively). For non-U.S.-born women, age ≥50 years (OR 3.9, CI 1.7–9.0), non-English-speaking status (OR 1.6, CI 1.0–2.4), and drug use (OR 5.8, CI 2.5–13.9) were associated with no Pap testing.

Conclusions: U.S.-born status and low CD4 count were associated with increased odds of inadequate Pap testing. Further study is needed to identify interventions to improve Pap testing adherence in this high-risk group.

Introduction

THE INTRODUCTION OF CERVICAL CANCER SCREENING with regularly scheduled Papanicolaou (Pap) testing has dramatically decreased morbidity and mortality associated with cervical cancer and has shown that cervical cancer is largely preventable.^{1,2} As HIV-infected women are at increased risk for cervical cancer and dysplasia,^{3–8} routine Pap testing to diagnose precancerous changes is especially important for this group.^{4,5,9} Multiple HIV guidelines recommend cervical Pap testing every 6 months in the first year after HIV diagnosis and annually thereafter.^{10–12} Despite those guidelines, studies have shown that 19%–23% of HIV-positive women did not have a Pap test in the past year.^{13,14}

Risk factors associated with inadequate Pap testing in the general population include older age,^{15–21} white vs. Hispanic or black race/ethnicity,^{15,16,19,21} obesity,^{17,22} lower

income,^{15,19,20,23} lower education level,^{15,17,19–21,23,24} unemployment,²⁴ unmarried status,^{15,16,18,21} lack of health insurance,^{15,18,19,21,23} and no usual source of medical care.^{15,16,23} The data on the relationship between cigarette smoking and Pap screening are mixed.^{15–17,19,23}

Risk factors for inadequate Pap testing in HIV-infected women are less clear. Receiving gynecologic care at the same location as HIV care,^{13,14} recent pregnancy,¹³ and history of abnormal Pap testing^{13,25} have been associated with increased odds of recent Pap testing. Lower education,^{25–27} younger²⁵ or older^{13,26,27} age, obesity or low body weight,²⁶ intravenous drug use,^{26,28} cigarette smoking,²⁶ depression,²⁷ and receiving primary care from a private infectious disease physician²⁶ have all been associated with less frequent gynecologic care. Data on the association between race/ethnicity and adequate gynecologic care in HIV-infected women are mixed.^{14,26,28} CD4 count <200 cells/mm³ has been associated with

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decreased odds of Pap testing in multiple studies,^{13,25,29} although the relationship between HIV viral load and Pap testing is unclear.^{26,27,30}

This retrospective cohort study assessed factors associated with inadequate Pap testing in women engaged in HIV care. Because most prior studies of HIV-infected women have assessed Pap testing by self-report and studies focused on Pap testing in women engaged in HIV care are limited, we sought to define the proportion of women who did not have regular Pap tests and the factors associated with inadequate Pap testing in this population.

Materials and Methods

HIV-infected women aged 18–60 years receiving care at Boston Medical Center's HIV clinic with at least three visits during 18 months of follow-up were eligible. Boston Medical Center is a 639-bed hospital and is both the largest safety net hospital and largest HIV/AIDS program in New England. The hospital draws from the surrounding community and is affiliated with 15 community health centers. Because this is a retrospective chart review-based study, we chose to focus on women who had multiple HIV visits in order to increase the likelihood that subjects were not receiving care at another institution and, therefore, misclassified as nonadherent with Pap testing. The three 18-month periods were October 1, 2003–March 31, 2005; April 1, 2005–September 30, 2006; and October 1, 2006–March 31, 2008. As the guidelines suggest that a Pap test every 12 months is appropriate in women with an established HIV diagnosis and insurance companies will often not pay for a routine Pap test until at least 1 year has passed, the 18-month follow-up period was selected to give an additional grace period for appropriate screening.^{26,29} The outcome of whether a Pap test was performed was primarily based on the date of cervical cytology results in the electronic medical record. All Pap tests performed at our institution and multiple affiliated community health centers are captured in the electronic record. The record was reviewed for all subjects with periods during which no Pap test cytology results were provided to look for provider documentation of Pap testing at an outside institution. Documentation of a Pap test performed at an outside institution was also accepted for the outcome. A sensitivity analysis comparing results with and without subjects with Pap testing reported at an outside institution was performed.

A dedicated nurse practitioner was available at Center for Infectious Diseases (CID) for routine gynecologic care, and patients were generally referred by their HIV providers to her for Pap tests, which were not required to occur on the same day as an HIV provider visit. Patients could also self-refer to the nurse practitioner. The primary exposure of interest was a clinic systems issue: the proportion of CID visits that occurred on Mondays, Tuesdays, and Fridays—the days when the gynecologic nurse practitioner was available for Pap test appointments. This variable was based on the percentage of visits that occurred on these days: >75%, >50% but ≤75%, >25% but ≤50%, and ≤25%. After preliminary review of the data, these categories were dichotomized to >50% vs. ≤50% of visits on days when the nurse practitioner was available. We hypothesized that women who had the majority of HIV clinic visit on days when the gynecologic nurse practitioner was available would be more likely to be adherent with Pap

testing compared to women who were seen predominantly on days when she was not available.

Covariates of interest were divided into demographic and medical patient variables and provider-related variables. Demographic information collected included age, race/ethnicity, language, country of birth, employment status, marital status, education level, cigarette smoking, and any type of illicit substance abuse. Cigarette smoking and illicit substance abuse were collected from documentation in the medical record and dichotomized to active/former vs. never use. The electronic medical record was reviewed for subjects with missing race/ethnicity, country of birth, employment status, and education level. Race/ethnicity was inferred based on country of birth. Because information about immigrant status as an HIV risk factor is routinely collected, women with no documentation of immigration status and missing country of birth information were assumed to be U.S. born. ZIP code was used to approximate distance from home to clinic. Medical variables included baseline and final CD4 count and HIV viral load defined as first value during the study period, mental health diagnoses documented on the problem list of the medical record (including mood, psychotic, and cognitive disorders), prescription of antiretrovirals (ARVs) as ordered in the medical record, documentation of cervical dysplasia or cervical cancer and documentation of opportunistic infection (OI). The result of each Pap test during the study period was recorded.

Because subjects contributed up to 4½ years of follow-up, many women saw multiple providers, and, therefore, we were unable to analyze at an individual provider level for association with affected Pap testing adherence. Instead, provider gender and training were assessed. These variables were calculated as attending most visits (≥75%) with a provider of one gender or training method (general internist vs. infectious diseases trained) compared to a more mixed provider visit pattern. Participation in the Healthcare for the Homeless Program (HCH) was also recorded. Because clinic patients could potentially be homeless, at least transiently, and not enrolled in the program, this was defined as a system issue and not a demographic characteristic. The Boston University Medical Center Institutional Review Board approved the study protocol.

Statistical analysis

Because subjects could have multiple Pap tests over time, generalized estimating equations (GEE) for correlated data were conducted on the study data. GEE models are used to analyze correlated data from longitudinal studies when multiple observations occur in the same subject.³¹ This method uses logistic regression to assess the likelihood of a subject's not having a Pap test during 18 months of follow-up, adjusted for the subject's Pap testing history during other follow-up periods. CD4 count and viral load were analyzed according to initial values during the study period as well as rates of change. Because these variables were not normally distributed, rates were calculated as change in the log of CD4 count and viral load per person-year of follow-up. As CD4 count and viral load are closely related markers of HIV status, CD4 counts were used in the multivariate models because CD4 count was more strongly related to adherence with Pap testing compared to viral load in unadjusted models. The exchangeable and autoregressive correlation types of GEE

models were assessed using the quasi-likelihood information criterion (QIC) model fit statistic in SAS version 9.2 (SAS Institute, Cary, NC). Comparison of the QIC model fit statistic showed that the exchangeable correlation model provided a better fit, and so all GEE analyses used this model.

The primary exposure of interest, covariates, and outcomes were summarized and presented as means, medians, and proportions. Odds ratios (ORs) were used to measure the strength of the relationship between characteristics associated with nonadherence to cervical Pap testing, and *p* values and 95% confidence intervals (CIs) were used to assess the statistical stability of these relationships. SAS version 9.1 was used for all analyses.

Variables that appeared to be associated with adherence to Pap testing in the unadjusted analysis and potential confounders were assessed using both backward and forward selection modeling techniques, with a *p* value ≤ 0.10 for inclusion in the final model. Confounding was defined as a covariate associated with the exposure and outcome but not on the causal pathway between them. A confounding variable was included in the multivariate model if it led to a $\geq 10\%$ change in the beta estimate of an associated exposure.³² Interaction terms were included in the model if they were statistically significant at $p \leq 0.05$.

Results

Of 730 women who were seen in the HIV clinic during the study period, 549 (75.2%) were eligible to participate (Fig. 1). Of the 181 women not included in the analysis, 163 (20.2% of total) were followed for <6 months, and 8 (1.1%) had two visits over >6 months. Only 10 women (1.4% of total) who had at least three clinic visits were excluded because they did not contribute at least three visits to one study period. Women

not engaged in care, and thus excluded, were more likely to be younger, unemployed, and U.S. born and less likely to be of black race or married (results not shown).

The mean age of included subjects was 39.3 years (Table 1). Fewer than half of the subjects were born in the United States, and 71% were black. Eighty-four women (15.3%) had no Pap test documented, and 293 (53.4%) had a Pap test during every 18 months of follow-up; 397 women (72.3%) were followed for at least 36 months. There were 31 women with Pap testing documented at an outside institution. The overall model results did not change when a sensitivity analysis was performed; therefore, these women are included in all results presented. Of 464 women (38.6%) who had at least one Pap test during the study, 179 had an abnormal Pap test result, a rate of 19.2 abnormal Pap tests per 100 person-years of follow-up.

Subjects had no Pap testing documented in 27.8% of 18-month follow-up periods. The proportion of women with Pap testing performed remained relatively constant over time, with 27.1% of subjects with no Pap testing between October 1, 2003, and March 31, 2005; 28.1% with no Pap testing between April 1, 2005, and September 30, 2006; and 28.2% with no Pap testing between October 1, 2006, and March 31, 2008. In univariate analyses, older age, Hispanic ethnicity, white race (vs. black race), U.S.-born status, unemployment, current/former drug use or cigarette smoking, and baseline HIV viral load $>10,000$ copies/mL and CD4 count <200 cells/mm³ were associated with increased odds of no Pap testing during 18 months of follow-up (Table 2). Documentation of cervical dysplasia was associated with decreased odds of no Pap test during 18 months of follow-up (OR 0.5, 95% CI 0.4-0.8). History of OI was not associated with likelihood of Pap testing, even when stratified by CD4 count.

Because of the concern for possible effect measure modification by abnormal Pap test result during the study, the

FIG. 1. Distribution of study subjects.

TABLE 1. DEMOGRAPHIC CHARACTERISTICS
OF 549 WOMEN RECEIVING CARE
AT BOSTON MEDICAL CENTER HIV CLINIC, 2003–2008

Characteristic	n (%)
Demographic characteristics	
Age, years	
18–29	78 (14.2)
30–39	203 (37.0)
40–49	206 (37.5)
50–60	62 (11.3)
Race/ethnicity	
Black	389 (70.9)
Hispanic	74 (13.5)
White	81 (14.8)
Other	5 (0.9)
U.S. born	259 (47.2)
English speaking	447 (81.4)
Unemployed or disabled (<i>n</i> =545)	398 (73.0)
Did not complete high school (<i>n</i> =534)	266 (49.8)
Married	98 (17.9)
Cigarette smoking	156 (28.4)
Drug use	161 (29.3)
Home distance from hospital, miles, mean±SD	9.5±12.0
Home distance from hospital, range	0.4–91.6
Medical characteristics	
Mental health diagnosis in problem list	141 (25.7)
Baseline HIV viral load <75 copies/mL	177 (32.2)
Baseline CD4 count <200 cells/mm ³	128 (23.3)
Prescribed ARV	477 (86.9)
History of opportunistic infection	182 (33.2)
History of cervical dysplasia	75 (13.7)
Pap documentation outside of hospital	31 (5.7)
Length of follow-up, years, mean±SD	2.9±1.3
Length of follow-up, range	0.5–4.5
System characteristics	
Healthcare for the Homeless program	24 (4.4)

Results are reported as number (%) unless noted.

ARV, antiretroviral therapy; CD4, CD4 helper suppressor T cells; SD, standard deviation.

unadjusted results were stratified by whether an abnormal Pap test result was documented (results not shown). The two strata were generally similar; therefore, the nonstratified multivariate model is presented. There were 540 subjects (98%) contributing 1181 18-month follow-up periods included in the multivariate models. Older age, white race, U.S.-born status, drug use, and baseline CD4 count <200 cells/mm³ remained significantly associated with increased odds of no Pap testing in the multivariate model (Table 2). History of cervical dysplasia was associated with decreased odds of no Pap testing, and participation in the HCH Program trended toward decreased odds of no Pap testing. Fifty percent or fewer clinic visits on days when the gynecologic nurse practitioner was available was not associated with no Pap testing in all analyses. U.S.-born status and drug use showed evidence of confounding and interaction, and an analysis stratified by U.S.-born status was performed. The change in log rate of CD4 count was substituted for baseline CD4 count and was not statistically significant; therefore, baseline CD4 count was used in the final model.

The U.S.-born women had no Pap test performed in 36.1% of 18-month follow-up periods compared to 21.0% of 18-month

follow-up periods for the non-U.S.-born women ($p<0.001$). In the U.S.-born group, white race, unemployment, cigarette smoking, drug use, living ≥ 5 miles from the clinic, baseline CD4 count <200 cells/mm³, and viral load >10,000 copies/mL were associated with increased odds of no Pap testing during 18 months of follow-up (Table 3). Farther distance from home to clinic, majority of clinic visits with a male provider, and baseline CD4 count between 200 and 499 cells/mm³ trended toward an association with no Pap testing. In the foreign-born group, aged ≥ 50 years, Hispanic ethnicity, drug use, CD4 count <200 cells/mm³, and viral load >10,000 copies/mL were associated with increased odds of no Pap testing. Foreign-born women with documentation of cervical dysplasia had 60% decreased odds of no Pap testing in 18 months of follow-up. In the foreign-born group, aged 40–49 years old, no prescription of ARV, non-English language, and mental health diagnosis trended toward increased odds of no Pap testing.

In multivariate models adjusted for age, for the 256 U.S.-born women included in the multivariate model, white women (vs. black) had 2 times the odds of no Pap test during 18 months of follow-up (OR 2.0, 95% CI 1.3–3.1, $p=0.002$). Women with a baseline CD4 count <200 cells/mm³ had 1.7 times the odds of no Pap testing (95% CI 1.0–2.9, $p<0.05$). Although drug use initially appeared to be associated with no Pap testing, it was removed when unemployment was entered in the model for U.S.-born women (OR 2.3, 95% CI 1.0–5.0, $p=0.04$). For the 284 foreign-born women included in the multivariate model, age ≥ 50 years (OR 3.9, 95% CI 1.7–9.0, $p=0.002$), non-English-speaking status (OR 1.6, 95% CI 1.0–2.4, $p=0.03$), and drug use (OR 5.8, 95% CI 2.5–13.9, $p<0.0001$) were associated with increased odds of no Pap testing (Table 4). History of cervical dysplasia was associated with decreased odds of no Pap testing (OR 0.5, 95% CI 0.3–1.0, $p=0.04$). CD4 count <200 cells/mm³ trended toward increased odds of no Pap testing (OR 1.7, 95% CI 1.0–3.0, $p=0.07$). In both stratified models, $\leq 50\%$ of clinic visits on days when the gynecologic nurse practitioner was available was not associated with likelihood of Pap testing. Substituting change in log rate of CD4 count for the baseline values was not statistically significant in either U.S.-born or foreign-born stratified modeling.

Discussion

We found that only 53% of women engaged in HIV care had a Pap test during every 18 months of follow-up. This is substantially less than the 73%–81% reported previously for studies that looked at Pap test adherence at one time point.^{13,14} Moreover, those surveys looked at completion in a 12-month interval, so our results using an 18-month time period are likely even poorer than they appear. The longitudinal design of our study suggests that most HIV-infected women are getting Pap tests occasionally but not always as frequently as recommended. Eighty-four percent of the subjects in this study had at least one Pap test performed during up to 4½ years of follow-up, which is more in line with prior research. Our study also differs from multiple surveys^{13,14,25,26} because we documented Pap testing through the medical record rather than through self-report. This may be a more accurate method, as self-report relies on subjects remembering exactly when their last Pap test was performed. A recent meta-analysis showed that women overreport Pap testing,³³ which may be in part because they may have a

TABLE 2. ODDS RATIO OF NO PAP TESTING IN 18 MONTHS OF FOLLOW-UP

Variable	No Pap test done (n = 333)	Unadjusted OR (95% CI)	Multivariate OR (95% CI)
≤ 50% of visits on days when the gynecologic NP is available	191 (57.5)	0.9 (0.7-1.2)	^a
Demographic characteristics			
Age, years			
18–29	30 (9.1)	Reference	Reference
30–39	112 (33.6)	1.3 (0.8-2.0)	1.3 (0.8-2.1)
40–49	141 (42.3)	1.9 (1.2-2.9)	1.4 (0.9-2.3)
50–60	50 (15.0)	2.3 (1.4-3.9)	2.5 (1.4-4.6)
Race/ethnicity			
Black	203 (61.0)	Reference	Reference
Hispanic	52 (15.6)	1.5 (1.1-2.2)	1.2 (0.8-1.9)
White	76 (22.8)	2.8 (2.0-4.0)	2.0 (1.3-3.0)
Non-English speaker	56 (16.8)	0.8 (0.6-1.1)	
U.S. born	194 (58.3)	2.1 (1.6-2.8)	1.5 (1.0-2.3)
Unemployed or disabled	254 (77.4)	1.7 (1.3-2.3)	^a
Less than high school education level	160 (49.4)	0.9 (0.7-1.2)	
Married	55 (16.5)	0.9 (0.6-1.3)	
Cigarette smoking	126 (37.8)	1.9 (1.4-2.5)	^a
Drug use	150 (45.1)	2.7 (2.1-3.5)	4.6 (2.2-9.9)
Drug use–U.S. born interaction	–	–	0.3 (0.1-0.8)
Miles from hospital			
<2	80 (24.0)	Reference	
2 to <5	91 (27.3)	1.0 (0.7-1.4)	
5 to <10	60 (18.0)	1.1 (0.8-1.7)	
≥ 10	102 (30.6)	1.0 (0.7-1.4)	
Medical characteristics			
Mental health issue	94 (28.2)	1.3 (0.9-1.7)	^a
History of opportunistic infection	116 (34.8)	1.0 (0.7-1.2)	^a
History of cervical dysplasia	32 (9.6)	0.5 (0.4-0.8)	0.6 (0.4-1.0)
Prescribed ARV	294 (88.3)	0.8 (0.5-1.2)	
Baseline viral load, copies/mL			
≤ 75	91 (27.3)	Reference	
> 75–10,000	108 (32.4)	1.3 (1.0-1.9)	
> 10,000	134 (40.2)	1.9 (1.4-2.6)	
Viral load log rate of change (median, interquartile range)	–0.01 (–1.27-0)	1.02 (0.99-1.05)	
Baseline CD4 count, cells/mm ³			
≥ 500	90 (27.0)	Reference	Reference
200 to <500	149 (44.7)	1.3 (0.9-1.7)	1.3 (0.9-1.9)
< 200	94 (28.2)	1.9 (1.4-2.7)	1.8 (1.2-2.6)
CD4 count log rate of change (median, interquartile range)	0.04 (–0.09-0.18)	1.0 (0.9-1.2)	
Provider characteristics			
ID trained provider	239 (80.5)	1.1 (0.8-1.5)	
≥75% of visits with male provider	103 (30.9)	1.3 (1.0-1.7)	^a
System characteristics			
Healthcare for the Homeless program	10 (3.0)	0.8 (0.4-1.7)	0.5 (0.2-1.1)

Results are reported as number (%) unless noted.

^aDenotes variables assessed but not included in the final multivariate model.

CI, confidence interval; ID, infectious disease; NP, nurse practitioner; OR, odds ratio.

pelvic examination without Pap testing for many reasons. We reviewed the medical record manually for every period of time in which no laboratory documentation of Pap testing occurred. We noted when a provider mentioned need for a Pap test, as well as if a Pap test was reportedly performed at an outside institution. Only 31 women had documentation of a Pap test performed at another facility. Of 84 women who had no Pap test results, 34 subjects (40.5%) had documentation in the record that their physician had asked about Pap testing.

This study involved a diverse population of HIV-infected women: 71% of the subjects were black, 53% were not born in the United States, 29% were current or former drug users per the medical record, and the majority was followed for multiple years. At least one Pap test was performed during 72% of the 18-month follow-up periods, which suggests that most women in this population undergo Pap testing at least some of the time. Although the guidelines call for annual Pap tests, a longer period was used in this study to account for the fact

TABLE 3. UNADJUSTED ODDS RATIO OF NO PAP TESTING IN 18 MONTHS OF FOLLOW-UP STRATIFIED BY U.S.-BORN STATUS

Variable	U.S. Born		Non-U.S. Born	
	n (%)	OR (95% CI)	n (%)	OR (95% CI)
≤ 50% of visits on days when gynecologic NP is available	109 (56.2)	1.0 (0.7-1.4)	82 (59.0)	0.9 (0.6-1.3)
Demographic characteristics				
Age, years				
18-29	17 (8.8)	Reference	13 (9.4)	Reference
30-39	59 (30.4)	0.9 (0.5-1.7)	53 (38.1)	1.6 (0.9-3.2)
40-49	94 (48.5)	1.5 (0.8-2.8)	47 (33.8)	1.8 (0.9-3.5)
50-60	24 (12.4)	1.1 (0.5-2.5)	26 (18.7)	3.9 (1.8-8.2)
Race/ethnicity				
Black	105 (54.1)	Reference	98 (70.5)	Reference
Hispanic	14 (7.2)	1.1 (0.6-2.2)	38 (27.3)	2.0 (1.3-3.1)
White	74 (38.1)	2.1 (1.4-3.0)	2 (1.4)	1.2 (0.3-6.1)
Non-English speaker	0	—	56 (40.3)	1.4 (0.9-2.0)
Married	26 (13.4)	1.0 (0.6-1.7)	29 (20.9)	1.0 (0.6-1.5)
Unemployed or disabled	178 (92.7)	2.5 (1.4-4.7)	76 (55.6)	1.0 (0.7-1.4)
Less than high school education level	101 (53.4)	0.8 (0.6-1.2)	59 (43.7)	0.9 (0.6-1.2)
Cigarette smoking	110 (56.7)	1.4 (1.0-2.1)	16 (11.5)	1.3 (0.7-2.3)
Drug use	131 (67.5)	1.7 (1.2-2.5)	19 (13.7)	6.2 (3.0-12.9)
Miles from hospital				
< 2	58 (29.9)	Reference	22 (15.8)	Reference
2 to <5	53 (27.3)	1.0 (0.6-1.6)	38 (27.3)	1.2 (0.7-2.1)
5 to <10	33 (17.0)	2.0 (1.1-3.5)	27 (19.4)	1.1 (0.6-2.0)
≥10	50 (25.8)	1.4 (0.9-2.2)	52 (37.4)	1.1 (0.6-1.9)
Medical characteristics				
Mental health issue	65 (33.5)	0.8 (0.6-1.2)	29 (20.9)	1.5 (0.9-2.4)
History of cervical dysplasia	18 (9.3)	0.8 (0.5-1.5)	14 (10.1)	0.4 (0.2-0.8)
Prescribed ARV	176 (90.7)	1.0 (0.5-1.8)	118 (84.9)	0.6 (0.3-1.0)
Baseline viral load, copies/mL				
≤75	45 (23.2)	Reference	46 (33.1)	Reference
>75-10,000	60 (30.9)	1.2 (0.8-1.9)	48 (34.5)	1.3 (0.9-2.1)
>10,000	89 (45.9)	1.7 (1.1-2.7)	45 (32.4)	1.7 (1.0-2.6)
Baseline CD4 count, cells/mm ³				
≥500	51 (26.3)	Reference	39 (28.1)	Reference
200 to <500	85 (43.8)	1.4 (0.9-2.1)	64 (46.0)	1.2 (0.8-1.9)
<200	58 (29.9)	1.9 (1.2-3.0)	36 (25.9)	1.9 (1.1-3.1)
Provider characteristics				
≥75% of visits with male provider	70 (36.1)	1.4 (0.9-2.0)	33 (23.7)	1.1 (0.7-1.7)
System characteristics				
Healthcare for the Homeless program	10 (5.2)	0.6 (0.3-1.3)	0	—

Results are reported as number (%) unless noted.

that many women take somewhat longer than 1 year before returning for a repeat annual Pap test.

This study suggests an association between older age, white race, U.S.-born status, and drug use with no Pap testing in 18 months of follow-up. When the relationship between drug use and U.S. born status was assessed in greater detail, it appeared that the association between drug use and no Pap testing was present only for foreign-born women, although the same association was present in the U.S.-born population in the unadjusted analysis. Although drug use was included in the U.S.-born multivariate analysis, it appeared that the association between current or former drug use and no Pap testing was related to unemployment or disabled status. It is possible that the barriers of drug use and immigrating from another country work together against routine gynecologic care. As only 13 foreign-born women compared to 148 U.S.-born women had a drug use history, these results are difficult

to interpret. In general, however, foreign-born women were more likely to have a Pap test in 18 months of follow-up. This is in contrast to prior studies that have shown no relationship between U.S.-born status and cervical cancer screening^{15,16} or decreased likelihood of Pap testing in immigrants.^{34,35} It is unclear why white race predicted inadequate Pap screening in the U.S.-born group. It is possible, however, that unmeasured confounders partially explain this association. Some prior studies have also suggested that black women are more likely than white women to have a Pap test.^{15,16,19,21}

Baseline CD4 count <200 cells/mm³ was associated with increased odds of no Pap testing in both stratified and non-stratified analyses, with a trend toward significance in the non-U.S.-born multivariate model. This is a concern because lower CD4 count is associated with increased risk of cervical dysplasia,^{4,7,8,36} and, therefore, Pap testing is particularly important for this group. Other studies have also shown a

TABLE 4. MULTIVARIATE ODDS RATIO OF NO PAP TESTING DURING 18 MONTHS OF FOLLOW-UP STRATIFIED BY U.S.-BORN STATUS

Variable	U.S.-born multivariate OR (95% CI)	Non-U.S.-born multivariate OR (95% CI)
≤ 50% of visits on days when gynecologic NP is available	^a	^a
Demographic characteristics		
Age, years		
18–29	Reference	Reference
30–39	0.9 (0.4–2.0)	1.8 (0.9–3.6)
40–49	1.3 (0.6–2.6)	1.5 (0.7–3.0)
50–60	1.3 (0.5–3.2)	3.9 (1.7–9.0)
Race/ethnicity		
Black	Reference	Reference
Hispanic	1.2 (0.5–2.7)	1.1 (0.6–1.9)
White	2.0 (1.3–3.1)	1.1 (0.3–4.6)
Non-English speaker		1.6 (1.0–2.4)
Unemployed or disabled	2.3 (1.0–5.0)	
Cigarette smoking	^a	
Drug use	^a	5.8 (2.5–13.9)
Medical characteristics		
Documentation of cervical dysplasia		0.5 (0.3–1.0)
Prescribed ARV		^a
Initial CD4 count, cells/mm ³		
≥ 500	Reference	Reference
200 to < 500	1.4 (0.8–2.2)	1.3 (0.8–2.1)
< 200	1.7 (1.0–2.9)	1.7 (1.0–3.0)
Provider characteristics		
≥ 75% of visits with male provider	^a	
System characteristics		
Healthcare for the Homeless program	^a	

^aDenotes variables assessed but not included in the final multivariate model.

relationship between low CD4 count and lack of gynecologic care in a diverse group of women.^{13,25,28,29} As we included women who were regularly coming for HIV care, it seems less likely that these women were simply too sick to have a Pap test, although this is one possible explanation. It seems more likely that women who had a low CD4 count at the start of the study may be less concerned with their overall health or may be different in other ways from women with higher baseline CD4 counts. In addition, we had access to only the first CD4 count documented after October 1, 2003, and not nadir CD4 count, so it is likely that some of the subjects with baseline CD4 counts >200 cells/mm³ had been in care before the study period and started with a much lower nadir CD4 count, which had improved over time. Although individuals who start ARVs at CD4 counts <200 cells/mm³ have worse outcomes than those starting at higher CD4 counts,³⁷ they can still have dramatic improvements in CD4 count over time when treated. Thus, cervical cancer screening is still an important issue for this high-risk group. Further studies on the relationship between CD4 count and adherence with Pap testing, including assessment of performance status and adherence to prescribed highly active antiretroviral therapy, as well as qualitative exploration of the reasons for nonadherence in this group, may provide better

understanding of this issue. In addition, even if adherence to Pap screening guidelines improves among HIV-infected women, cervical cancer risk may remain higher because HIV-infected women have lower rates of adherence with colposcopy referral after an abnormal Pap result.³⁸

We hypothesized that a systems issue, namely, the availability of the single nurse practitioner in the HIV clinic performing the majority of Pap tests, would affect which women underwent a Pap test. However, this factor, as well as other issues, such as provider training or gender, did not appear to play a role in the adequacy of Pap testing, although the single center study design limits the ability to assess systems issues in great detail. There may be differences based on individual provider practice; however many of the subjects were seen by multiple providers over time, and, therefore, we were unable to examine individual provider practice in detail.

This study had several limitations. As with any retrospective study, we could not account for patient refusal of Pap tests, provider referral patterns, and the effect of separate gynecology appointments on adherence with Pap testing. The retrospective design may also be limited by inaccuracies in data recording, which may lead to misclassification of both exposures and outcomes. It is possible that women who received gynecologic care at an outside institution were misclassified, although records were reviewed in detail to limit this possibility. It seems particularly likely that sensitive issues, such as drug abuse, are underreported in the medical record; however, any exposure misclassification would likely be nondifferential, which would bias the results toward the null, thus underestimating the true effects. Although our study population is representative of the changing face of the HIV epidemic in women, it is important to remember that this study was conducted in a safety net HIV clinic providing care to predominantly low-income and minority women, which may limit generalizability of our findings to other HIV care settings.

The major strengths of this study are use of an in-depth dataset in a diverse population of patients. Subjects were assessed for repeated follow-up with Pap testing over time, which is a major difference from most previously published studies, which assessed Pap test adherence at a single time point. In addition, the Pap test outcome was obtained from the medical record, which addresses the limitation in some prior studies that used patient self-report to determine if subjects underwent Pap testing. It is important to emphasize that our study population consisted of women actively engaged in HIV care; therefore, these results are likely better than what would be seen in the HIV-infected population as a whole. The HIV-infected women excluded from this study because they were not regularly engaged in HIV care had demographic differences. It should not be surprising, however, that women engaged regularly in HIV care are different in many ways from women not followed regularly. Although it is also important to understand the reasons for non-adherence with Pap testing in HIV-infected women regardless of how frequently they are engaged in care, this study included only women who attended multiple HIV visits over time, and we still found low rates of Pap testing in this group.

Conclusions

This study identified disparities in routine gynecologic care for HIV-infected women at an urban medical center.

Although foreign-born women were more likely to be adequately screened with Pap testing, it appeared that there were different risk factors based on U.S.-born status. Thus, different strategies to improve adherence to Pap testing may be necessary for these two groups. Women with low CD4 counts may be at increased at risk for inadequate Pap testing regardless of history of OI, and this group warrants special focus for interventions to increase adherence with annual Pap testing.

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