Factors Associated with Adherence to Routine Screening Mammography in HIV-Infected Women

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Abstract

Background: Both HIV-infected women and minority women have historically lower rates of screening mammography. The objective of this study was to identify factors related to adherence to routine screening mammography in a diverse inner-city cohort of HIV-infected women, to inform future work on targeted interventions to address disparities.

Materials and Methods: This retrospective cohort study reviewed the electronic medical record of HIV-infected women aged 40 and older engaged in care between October 1, 2003 and March 31, 2008 at a large urban safety-net HIV clinic. Analyses included chi square testing and multivariate logistic regression to assess for patient-specific factors associated with adherence to breast cancer screening, defined as obtaining a screening mammogram within 2 years of engaging in care.

Results: The 292 women were a racially diverse group, with 70% black, 11% Hispanic, and 42% foreign born. There was suboptimal HIV control, with only 33% having an undetectable viral load (VL). One hundred forty-six (50%) were adherent to screening mammography. In multivariate analysis, women who were foreign born (OR 2.65 [CI 1.52–4.64]) had not completed high school (OR 1.77 [CI 1.06–2.95]) or had an undetectable VL (OR 2.51 [CI 1.44–4.40]) had increased odds of obtaining a mammogram.

Conclusions: Among a racially diverse urban population of HIV-infected women engaged in care, only half had a mammogram. Foreign-born women had higher odds of undergoing mammography, suggesting that nativity status and social determinants of health are under-recognized drivers of adherence in this population. Future programs targeting screening must be mindful of the multiple predictors of adherence.

Introduction

WITH ADVANCES in antiretroviral treatment over the past two decades, life expectancy has increased significantly for HIV-infected individuals. As a result there is a growing emphasis on ensuring that the aging HIV-infected population is obtaining routine cancer screening for non-AIDS-defining malignancies.¹ Screening mammography is especially critical, as breast cancer is the most common malignancy diagnosed in U.S. women, with one in eight women diagnosed with breast cancer in their lifetime.²

In multiple case series, as well as the Women's Interagency HIV Study (WIHS) and the HIV Epidemiology Research Study, breast cancer has been found to have a similar incidence in the HIV-infected population as the general

population.^{3–5} However, there is some evidence that HIV-infected women may have higher rates than the general population of advanced stage breast cancer at initial diagnosis,^{6,7} and be at increased risk of breast cancer-related mortality.⁸ In addition HIV status influences tolerance of chemotherapy for breast cancer. HIV infection is associated with higher levels of myelosuppression during chemotherapy, which results in early termination of treatment, impacting survival outcomes.^{9,10} Thus, early diagnosis with screening mammography may be an important strategy for the at-risk aging HIV-infected population.

Historically, the mammography screening rate for HIV-infected women has been lower than the national average, with some studies demonstrating that HIV-infected women who meet national guideline criteria are half as likely to get

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mammograms compared to similar cohorts of noninfected women.^{5,11–13} In this earlier work, some postulate that lower rates may be attributable to physician assessment of lack of utility of mammography in the setting of decreased life expectancy based on historically poor virological control, whereas alternative explanations include traditional barriers to preventive care observed in vulnerable populations.

Patients with HIV are at risk for lower rates of cancer screening not only because of their HIV status but also because of other social determinants of health. Many vulnerable subpopulations of women in the United States (*e.g.*, black, Hispanic, of low socioeconomic status, with low-educational attainment or who live in rural locations) have also had historically low rates of mammography.^{11,14–16} In response to these low rates in the general population, there have been multiple studies to create targeted interventions to increase mammogram rates.^{17–19} These interventions have been successful in increasing mammogram rates in some populations, most notably black women,²⁰ who now have the same mammogram rates as white women by the latest Center for Disease Control statistics.²¹

However, few studies have explored the combined impact of HIV status with other risk factors such as race and education among the most vulnerable populations. Existing studies are limited by small sample size,²² are performed only at the beginning of the use of antiretrovirals,²³ or are descriptive in nature.¹³ Given this limitation in current knowledge, we conducted this study to identify factors associated with screening mammography in a diverse cohort of HIV-infected women seeking care at a large urban safety-net HIV clinic.

Materials and Methods

We conducted a retrospective review of the electronic medical record (EMR) of HIV-infected women engaged in HIV care at a large urban safety-net medical center from 2003 to 2008 to identify factors associated with adherence to screening mammography. The Boston University Medical Center Institutional Review Board approved this study.

Study setting

Boston Medical Center (BMC) is the largest safety-net medical center in New England, which predominantly treats poor and underserved patients. Seventy-three percent of patients at BMC rely on government payors such as Medicaid, the Health Safety Net, and Medicare for their coverage.²⁴ This study involved patients in BMC's Center for Infectious Diseases HIV clinic, which serves as a primary care site for patients with HIV. Preventive services such as influenza vaccines and Papanicolaou (Pap) testing are performed on-site within the clinic, whereas mammograms are performed by the radiology department in a separate building on the same clinical campus. During the study time period, no formal clinical programs were in place to ensure adherence to preventive services. A referral for a screening mammogram could come directly from the provider, or the patient could initiate the screening by calling or arriving at radiology in person. Standard of care at BMC allows age-appropriate women to undergo screening mammography as long as they have evidence of a responsible BMC primary care physician; no order form is required.

Study population

All HIV-infected women aged 40 and older who were established in care at BMC's Center for Infectious Diseases HIV clinic between October 1, 2003 and March 31, 2008 were eligible for inclusion in this study. For the purposes of this study, being "established in care" was defined as having at least two visits over at least 6 months during the study time period.

Data sources and collection

All data were obtained from the EMR. Data were primarily collected by automated reporting of discrete data points using the hospital's Clinical Data Warehouse, which compiles all registration and clinical data, including sociodemographics, clinical visits, patient diagnoses, laboratory results, and radiology reports. For any missing sociodemographic data, the EMR was manually reviewed by a physician (ASB) using methods previously described.²⁵

Demographic information collected included nativity status (meaning U.S. born vs. foreign born), race/ethnicity, language, employment status, marital status, and education level. Medical variables collected included baseline (defined as initial value during the study period) CD4 T-cell count, baseline HIV viral load (VL), mental health diagnoses documented in the problem list of the medical record, cigarette smoking, illicit substance use, and prescription of antiretroviral therapy (ART) as ordered in the medical record.

For subjects with missing nativity status after manual abstraction, they were by default categorized as U.S. born because foreign-born status is generally documented, as it is potentially a risk factor for HIV acquisition.²⁶ Race/ethnicity was inferred based on non-U.S. country of birth if not otherwise documented.^{25,27,28}

To assess for receipt of a mammogram, radiology reports were automatically abstracted from each patient's EMR. If a mammogram report was found within 2 years of the patient establishing care, the patient was classified as receiving a mammogram. For all patients without a mammogram result, an additional manual chart review was performed by a physician (ASB) to find documentation within the patient's medical chart that her mammogram was completed elsewhere. There were no additional mammography reports detected in this manner. We did not collect the ordering of a mammogram, because an order was not required to obtain a screening mammogram in this health system, and thus it would not accurately reflect provider behavior.

Outcomes

The main outcome of interest was "adherence to screening mammography" that we defined as completion of a screening mammogram within 2 years of the patient's first visit to the HIV clinic during the study period. This standard was consistent with the U.S. Preventative Services Task Force recommendations during the study period²⁹ and guidelines for HIV-infected populations.⁵

Statistical analysis

Descriptive statistics were performed on patient demographics and clinical characteristics using percentages for categorical factors, and mean (standard deviation) or median

(interquartile range) for continuous factors. Comparisons of the groups of participants adherent and nonadherent to screening mammography were conducted using chi square tests and *t*-tests for significance.

First, we evaluated the unadjusted odd ratios of clinical and demographic variables of interest. Multivariate analysis was performed and included variables that were statistically significant in unadjusted analysis. Some pairs of variables were so highly related (colinear) that they caused an unstable model when analyzed together and so only one of the pairs was used in the model. Multivariate logistic regression was used to investigate the association between adherence to mammography (the outcome of interest) with the predictors race, nativity status, education, and VL status.

Odds ratios were used to measure the strength of the relationship between characteristics associated with adherence to mammography. A *p* value of <0.05 was considered statistically significant, and 95% confidence intervals were used. SAS version 9.1 (Cary, NC) was used for all analyses.

Results

Overall, 292 women were eligible for inclusion. Table 1 displays the sociodemographic and clinical characteristics of the study population by their mammography adherence status. Overall, 73% of the women were between 40 and 50 years of age, 70% were black, 11% Hispanic, with 42% being foreign born and 23% non-English speaking. The majority were unemployed and single. As for the sample's HIV care, the overall virological control was suboptimal, with only 33% of patients having an undetectable VL and only 72% of

patients having a CD4 T-cell count over 200 cells/mm³ at baseline.

Table 1 also shows that 50% of women in this study were adherent to screening mammography. Women adherent to screening mammography were more likely to be black, foreign born, non-English speaking, employed, not having completed high school, having an undetectable VL, and a CD4 T-cell count >200 cells/mm³ (*p* < 0.05 for all variables).

Table 2 shows the unadjusted and adjusted OR for mammography adherence. In unadjusted analysis, patients who were black (vs. white) (OR 2.76 [CI 1.44–5.29]), foreign born (OR 2.33 [CI 1.47–3.85]), non-English speaking (OR 1.96 [CI 1.11–3.45]), employed (OR 2.03 [CI 1.10–3.77]), completed less than high school education (OR 1.64 [CI 1.02–2.63]), had an undetectable VL (OR 2.21 [CI 1.34–3.67]), and a CD4 count >200 cells/mm³ (OR 2.08 [CI 1.23–3.57]) were more likely to be adherent to screening mammography (Table 2).

Two hundred seventy-six patients had complete data and thus were included in multivariate analysis. Among the 16 who were not included, there was an equal distribution between those who were and were not adherent to mammography.

In multivariate analysis, women who were foreign born (OR 2.65 [CI 1.52–4.56]) had not completed high school (OR 1.77 [CI 1.06–2.95]) or with an HIV VL <75 copies/mL (OR 2.51 [CI 1.44–4.40]) had increased odds of obtaining a mammogram (Table 2). The variables of age, language, employment status, and baseline CD4 count were assessed but not included in the final multivariate model. These variables were excluded either because they were no longer statistically

TABLE 1. CHARACTERISTICS OF FEMALE PATIENTS AT AN URBAN HIV CLINIC THAT ARE ASSOCIATED WITH ADHERENCE TO MAMMOGRAM SCREENING

Characteristic (n=292 unless otherwise noted ^a)	Total, n=292 (%)	Mammogram completed	
		Yes, n=146 (%)	No, n=146 (%)
Age			
40–50	212 (73)	105 (72)	107 (73)
≥50	80 (27)	41 (28)	39 (27)
Race ethnicity ^b			
Black	205 (70)	113 (77)	92 (63)
Hispanic	31 (11)	15 (11)	16 (11)
White	52 (18)	16 (11)	36 (25)
Other	4 (1)	2 (1)	2 (1)
Social demographics			
Foreign born ^b	124 (42)	77 (53)	47 (32)
Non-English speaking ^b	67 (23)	42 (29)	25 (17)
Employed or in school ^{a,b}	53 (18)	34 (25)	19 (14)
Less than high school education ^b	144 (51)	82 (57)	62 (44)
Single	244 (84)	127 (87)	117 (80)
Medical demographics			
HIV VL <75 copies/mL ^{a,b}	95 (33)	60 (41)	35 (24)
CD4 count >200 cells/mm ^{3a,b}	210 (72)	116 (79)	94 (65)
Not prescribed ART	47 (16)	23 (16)	24 (16)
Never drug user	193 (66)	99 (68)	94 (64)
Smoker (current or former)	101 (35)	51 (35)	50 (34)
Mental health diagnosis	75 (26)	38 (26)	37 (25)

^aN < 292 (employment, N=288; education, N=285; HIV VL, N=290; CD4 count, N=291).

^bStatistically significantly different at *p* < 0.05 level.

ART, antiretroviral therapy; CD4, baseline CD4 helper suppressor T cells; HIV VL, baseline HIV viral load.

TABLE 2. UNIVARIATE AND MULTIVARIATE ANALYSES OF CHARACTERISTICS ASSOCIATED WITH ADHERENCE TO MAMMOGRAM SCREENING

Characteristic	Unadjusted OR (95% CI)	Adjusted OR ^a (95% CI)
Age		
40–50	Reference	
>50	0.93 (0.56–1.56)	
Race ethnicity		
Black	2.76 (1.44–5.29) ^b	1.65 (0.79–3.45)
Hispanic	2.11 (0.84–5.29)	1.09 (0.40–2.99)
White	Reference	Reference
Social demographics		
Foreign born	2.33 (1.47–3.85) ^b	2.65 (1.52–4.64) ^b
Non-English speaking	1.96 (1.11–3.45) ^b	
Employed or in school	2.03 (1.10–3.77) ^b	
Less than high school education	1.64 (1.02–2.63) ^b	1.77 (1.06–2.95) ^b
Single	1.67 (0.88–3.13)	
Medical demographics		
Baseline HIV VL <75 copies/mL	2.21 (1.34–3.67) ^b	2.51 (1.44–4.40) ^b
Baseline CD4 count >200 cells/mm ³	2.08 (1.23–3.57) ^b	
Not prescribed ART	1.05 (0.56–1.96)	
Never drug user	1.16 (0.72–1.89)	
Smoker	1.03 (0.64–1.67)	
Mental health diagnosis	1.04 (0.61–1.75)	

^aN=276 model included: race, nativity status, education and VL.

^bStatistically significantly different at $p < 0.05$ level. CI, confidence interval; OR, odds ratio.

significant once other variables were controlled for (age and employment) or because of colinearity (language and CD4 count), as some pairs of variables were so highly related, they caused an unstable model when analyzed together. For example, CD4 count and HIV VL were highly associated; therefore, we chose only to include HIV VL in the final model as it is a more sensitive marker of current adherence to ART. Similarly, language was highly correlated with nativity status, as the majority of U.S.-born patients are English speaking. As we could only include one of these variables, we chose nativity status as it was a stronger predictor of the outcome of interest and had an important relationship with other variables such as race/ethnicity. In addition, language was no longer statistically significant after controlling for nativity status.

Given the significance of nativity status (being U.S. born vs. foreign born) in the multivariate model, we explored the association of nativity status with other clinical characteristics. The relationship between race/ethnicity and mammogram status appeared to be confounded by nativity, with confounding defined as leading to a 10% or greater change in the Beta estimate. Thus an additional stratified bivariate analysis of demographic and clinical variables stratified by nativity status was performed. Differences in U.S.-born and foreign-born patients were observed across multiple sociodemographic and HIV characteristics, independent of mammography screening status. Foreign-born patients in general were more likely to

TABLE 3. CHARACTERISTICS OF STUDY POPULATION BY NATIVITY STATUS

Variables	U.S. born, N=168 (%)	Foreign born, N=124 (%)	p
Mammogram			0.0003 ^a
Yes mammogram	69 (41)	77 (62)	
No mammogram	99 (59)	47 (38)	
Age			0.42
40–50	125 (74)	87 (70)	
>50	43 (26)	37 (30)	
Race/ethnicity			<0.0001 ^a
Black	96 (57)	109 (88)	
Hispanic	22 (13)	9 (7)	
White	49 (29)	3 (2)	
Other	1 (1)	3 (2)	
Social demographics			
Non-English speaking	8 (5)	72 (58)	<0.0001 ^a
Employed or in school	10 (6)	47 (38)	<0.0001 ^a
Less than high school	91 (54)	60 (48)	<0.0001 ^a
Married	21 (13)	27 (22)	0.03 ^a
Medical demographics			
HIV VL <75 copies/mL	52 (31)	45 (36)	0.35
CD4 count >200 cells/mm ³	117 (70)	93 (75)	0.35
Not prescribed ARTs	26 (15)	21 (17)	0.15
Never drug user	71 (42)	122 (98)	<0.0001
Nonsmoker	78 (46)	113 (91)	<0.0001
No mental health diagnosis	107 (64)	110 (89)	<0.0001

^aStatistically significantly different at $p < 0.05$ level.

obtain a mammogram (62% vs. 41%), to be of black race (88% vs. 57%), be non-English speaking (58% vs. 5%), employed (38% vs. 6%), never drug user (98% vs. 41%), nonsmoker (91% vs. 46%), married (22% vs. 13%), and without a history of mental illness (89% vs. 64%) than the U.S.-born patients. However, notably these patients did not differ in their CD4 count, VL, or prescription of ART (Table 3).

Given the significance of virological control in the model, and the possibility that providers may prioritize screening for patients with good virological control, additional analyses of virological control were performed. Those with an undetectable VL (<75 copies/mL) had a higher adherence rate at 63% than the sample rate overall of 50%. As virological control worsened, mammogram adherence declined. The proportion of patients adherent to screening mammograms was 63% for those with a VL <75 copies/mL, 46% for patients with a VL between 75 and 10,000 copies/mL, and 41% for those with a VL >10,000 copies/mL (data not shown).

We also explored length of time in care, as patients who were established in the clinic for a longer period of time had more potential opportunities to receive a mammogram. The median time in care for the overall sample was 3.01 years. As the outcome of interest was receipt of mammogram within 2 years of initiating care, we focused our subanalysis on those patients who had been established in care for at least 2 years. One hundred ninety-five patients (66.8%) in our sample were in the clinic for 2 or more years. Of those patients, 59% had

one mammogram, compared to 31% who were in the clinic for <2 years. However, when the multivariate model was run again, including only patients in the clinic for 2 years, there were no changes in our findings. The three significant predictors remained significant (foreign born OR 2.65 [CI 1.18–5.94], undetectable VL OR 2.48 [CI 1.25–4.98], and less than high school education OR 2.23 [CI 1.15–4.31]) with similar strength and direction as in the original model, but wider confidence intervals because of decreased sample size.

Discussion

This study identifies predictors of screening mammography in a multiracial population of HIV-infected women engaged in care in a large urban safety-net clinic. We found that screening practices were low for this population, with only 50% of the women receiving a mammogram, compared with the national biennial mammogram rate of 67% in 2008²¹ and our health system rate of 78% in 2008.¹⁸

To our knowledge, this is the first study to evaluate the effect of nativity status on mammography adherence within the HIV-infected population. We were surprised to find that women born in the United States were most at risk for non-adherence to screening mammography. The reason for higher rates of nonadherence among our U.S.-born cohort is likely explained by certain social determinants of health, as opposed to poor virological control. Specifically, the U.S.-born patients compared with the foreign-born patients were less likely to be married (13% vs. 22%) and employed (4% vs. 38%), and more likely to have a history of drug use (59% vs. 2%), but with similar HIV-specific factors (Table 3). We believe that these characteristics represent social and economic instability that may negatively impact mammogram adherence.

Some previous studies in HIV-uninfected populations have shown lower rates of routine cancer screening among foreign-born women living in the United States than among ethnically similar U.S.-born minority women.^{30–32} However, other studies have not shown an effect of nativity status after controlling for covariates.^{33,34} Notably the previously proposed causes of lower screening rates in studies of foreign-born HIV-uninfected women may not apply to this cohort. Specifically, reasons such as lack of access to a primary care provider,³⁵ poor health literacy,³⁶ and lack of insurance,³⁷ which have been cited in prior studies, may not be applicable to the women in this cohort who have access to care and insurance, in part, through their diagnosis of HIV. This study highlights the unique interplay of race and nativity status among HIV-infected women. Although this is a novel finding in the mammography literature for the HIV-infected population, a study of Pap test rates in this same cohort found a similar strong impact of foreign-born status on adherence to Pap testing.²⁵

Notably, we did not find racial or ethnic differences in mammography rates in our vulnerable population after controlling for confounders. Although race/ethnicity was associated with adherence to mammography in unadjusted analysis, nativity status, which was highly related to race/ethnicity, was the largest determinant of adherence to screening. This is in contrast to a large body of literature showing significant racial disparities in screening and treatment for breast cancer in the general population^{15,16,38} as well as the HIV-infected population,²² although, notably, these studies generally did not address nativity status.

Consistent with previous literature, we found that suboptimal HIV control, as represented by detectable VL, is correlated with lack of adherence to mammography screening. This relationship has been primarily established in the Pap testing literature^{22,39} but has not been well documented in relation to mammography. In addition, as virological control worsened, mammogram screening adherence declined. This may reflect both differences in patient and provider behaviors when HIV is poorly controlled. For example, in terms of patient behavior, HIV-infected women who are less adherent to HIV treatment may also be less adherent to primary care screening recommendations. In addition, patients with poorly controlled HIV may be too ill to participate in preventive care in general, including mammography. Alternatively, providers may be less likely to refer patients to mammography if they are currently focusing on improving ART adherence or if they judge that the general screening guidelines are not applicable given the patient's overall shortened life expectancy. As there are no breast cancer screening guidelines specifically for HIV-infected women,⁵ and the United States Preventative Services Task Force (USPSTF) guidelines are generally intended for women with average life expectancy,^{29,40} providers were left to make individual decisions about the appropriateness of screening the women in our study. It is possible that providers may be prioritizing screening for patients who are healthier and overall more adherent as represented by undetectable VL.

We also found an association with low educational attainment and increased adherence. The WIHS cohort found a similar relationship between lower education level and adherence to mammography.²³ As in that cohort, this association may be because of unassessed confounders.

Limitations

This study does have multiple limitations. As this is a retrospective chart study, we were limited by the variables recorded in the chart for the purposes of clinical care. We did not account for differences in calendar year of each participants' entrance into the study, and although rates of mammogram are known to vary across years, the guidelines for screening were consistent across all years of the study.⁵ This work was carried out before the most recent controversial 2009 USPSTF guidelines, and future work should explore the impact of the current guidelines.

Overall, this study represents a relatively young population; however, this is consistent with the typical age of women within an HIV clinical practice. In addition, we were able to compare the mammogram rates in this cohort to age-stratified national rates from the same calendar years, and still demonstrate significantly lower rate of mammography in this cohort than the national rate.²¹

We were unable to delineate whether the receipt of mammograms reflected patient or provider behavior, as we were only able to record the completion and not ordering of mammograms. It is possible some of the results may in fact represent appropriate differential provider behavior in terms of ordering mammograms, and not patient behavior, although most likely the results reflect a combination of patient and provider behavior.

Despite these limitations, this represents a large study of an urban safety-net HIV clinic.

Conclusions

As the aging HIV-infected population grows, it is critical to focus on routine cancer screening within this group. This study demonstrates persistence of an inadequate rate of mammography adherence within this vulnerable group. In the modern healthcare system, there is growing emphasis on population health management, including increased adherence to routine cancer screening.⁴¹ Many evidenced-based interventions, such as patient navigation, exist to promote adherence in resource-limited settings serving the most at-risk patients.^{17,18} This study supports that among a vulnerable HIV-infected population, U.S.-born status may be a proxy for other social determinants of health, such as lack of employment, low social support, and drug use, which may have strong implications for adherence to screening. When planning interventions to increase adherence for eligible HIV-infected women, factors such as nativity status and social determinants of health likely deserve attention.

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Author Disclosure Statement

No competing financial interests exist.

References

- Center for Disease Control. CDC—HIV/AIDS—Living with HIV. Available at: www.cdc.gov/hiv/living/ Accessed October 9, 2014.
- Latif N, Rana F, Guthrie T. Breast cancer and HIV in the era of highly active antiretroviral therapy: Two case reports and review of the literature. *Breast J* 2011;17:87–92.
- Goedert JJ, et al. Risk of breast, ovary, and uterine corpus cancers among 85 268 women with AIDS. *Br J Cancer* 2006;95:642–648.
- Shiels MS, Pfeiffer RM, Engels EA. Age at cancer diagnosis among persons with AIDS in the United States. *Ann Intern Med* 2010;153:452–460.
- Sigel K, et al. Cancer screening in patients infected with HIV. *Curr HIV/AIDS Rep* 2011;8:142–152.
- El-Rayes BF, Berenji K, Schuman P, Philip PA, Barenji K. Breast cancer in women with human immunodeficiency virus infection: Implications for diagnosis and therapy. *Breast Cancer Res Treat* 2002;76:111–116.
- Shiels MS, et al. Cancer stage at diagnosis in patients infected with the human immunodeficiency virus and transplant recipients. *Cancer* 2015;121:2063–2071.
- Coghill AE, Shiels MS, Suneja G, Engels EA. Elevated cancer-specific mortality among HIV-infected patients in the United States. *J Clin Oncol* 2015;33:2376–2383.
- Parameswaran L, Taur Y, Shah MK, Traina TA, Seo SK. Tolerability of chemotherapy in HIV-infected women with breast cancer: Are there prognostic implications? *AIDS Patient Care STDs* 2014;28:358–364.
- Gomez A, Montero AJ, Hurley J. Clinical outcomes in breast cancer patients with HIV/AIDS: A retrospective study. *Breast Cancer Res Treat* 2015;149:781–788.
- Center for Disease Control. Products—Health United States—Women's health. Health, United States, 2014: Women's Health. Available at: www.cdc.gov/nchs/hus/women.htm#access Accessed October 1, 2014.
- Solomon L, et al. Health services use by urban women with or at risk for HIV-1 infection: The HIV Epidemiology Research Study (HERS). *J Acquir Immune Defic Syndr Hum Retrovirol* 1998;17:253–261.
- Sheth AN, Moore RD, Gebo KA. Provision of general and HIV-specific health maintenance in middle aged and older patients in an urban HIV clinic. *AIDS Patient Care STDs* 2006;20:318–325.
- Hoffman-Goetz L, Breen NL, Meissner H. The impact of social class on the use of cancer screening within three racial/ethnic groups in the United States. *Ethn Dis* 1998;8:43–51.
- Hershman D, et al. Racial disparities in treatment and survival among women with early-stage breast cancer. *J Clin Oncol* 2005;23:6639–6646.
- Smith-Bindman R, et al. Does utilization of screening mammography explain racial and ethnic differences in breast cancer? *Ann Intern Med* 2006;144:541–553.
- Battaglia TA, et al. Boston patient navigation research program: The impact of navigation on time to diagnostic resolution after abnormal cancer screening. *Cancer Epidemiol Biomarkers Prev* 2012;21:1645–1654.
- Phillips CE, et al. Patient navigation to increase mammography screening among inner city women. *J Gen Intern Med* 2011;26:123–129.
- Clark CR, et al. Addressing social determinants of health to improve access to early breast cancer detection: Results of the Boston REACH 2010 Breast and Cervical Cancer Coalition Women's Health Demonstration Project. *J Womens Health* 2009;18:677–690.
- Legler J, et al. The effectiveness of interventions to promote mammography among women with historically lower rates of screening. *Cancer Epidemiol Biomarkers Prev* 2002;11:59–71.
- Center for Disease Control. CDC—Breast cancer rates by race and ethnicity. Available at: www.cdc.gov/cancer/breast/statistics/race.htm Accessed October 9, 2014.
- Rahangdale L, Sarnquist C, Yavari A, Blumenthal P, Israelski D. Frequency of cervical cancer and breast cancer screening in HIV-Infected women in a county-based HIV clinic in the western United States. *J Womens Health* 2010;19:709–712.
- Preston-Martin S, et al. Use of mammographic screening by HIV-infected women in the Women's Interagency HIV Study (WIHS). *Prev Med* 2002;34:386–392.
- Commitment to Our Community—Health Needs Assessment. Boston Medical Center. Available at: www.bmc.org/about/commitment-to-community.htm Accessed October 10, 2014.
- Baranoski AS, Horsburgh CR, Cupples LA, Aschengrau A, Stier EA. Risk factors for nonadherence with Pap testing in HIV-infected women. *J Womens Health* 2011;20:1635–1643.
- Committee on Review Data Systems for Monitoring HIV Care & Institute of Medicine. Monitoring HIV care in the United States: Indicators and data systems. National Academies Press (US), 2012. Available at: www.ncbi.nlm.nih.gov/books/NBK201371/ Accessed May 29, 2015.
- Baranoski AS, Stier EA. Factors associated with time to colposcopy after abnormal Pap testing in HIV-infected women. *J Womens Health* 2012;21:418–424.
- Fiscella K, Fremont AM. Use of geocoding and surname analysis to estimate race and ethnicity. *Health Serv Res* 2006;41:1482–1500.
- US Preventive Services Task Force. Recommendation summary—Breast cancer screening. Breast cancer: Screening

- (2009). Available at: www.uspreventiveservicestaskforce.org/Page/Topic/recommendation-summary/breast-cancer-screening Accessed October 10, 2014.
30. Dallo FJ, Kindratt TB. Disparities in vaccinations and cancer screening among U.S.- and foreign-born Arab and European American non-Hispanic white women. *Womens Health Issues* 2015;25:56–62.
 31. Froment M-A, Gomez SL, Roux A, DeRouen MC, Kidd EA. Impact of socioeconomic status and ethnic enclave on cervical cancer incidence among Hispanics and Asians in California. *Gynecol Oncol* 2014;133:409–415.
 32. Keegan THM, et al. Breast cancer incidence patterns among California Hispanic women: Differences by nativity and residence in an enclave. *Cancer Epidemiol Biomarkers Prev* 2010;19:1208–1218.
 33. Billmeier TM, Dallo FJ. Nativity status and mammography use: Results from the 2005 National Health Interview Survey. *J Immigr Minor Health* 2011;13:883–890.
 34. Blackwell DL, Martinez ME, Gentleman JF. Women's compliance with public health guidelines for mammograms and Pap tests in Canada and the United States: An analysis of data from the Joint Canada/United States Survey of Health. *Womens Health Issues* 2008;18:85–99.
 35. Lofters AK, Moineddin R, Hwang SW, Glazier RH. Predictors of low cervical cancer screening among immigrant women in Ontario, Canada. *BMC Womens Health* 2011; 11:20.
 36. Fernandez ME, Tortolero-Luna G, Gold RS. Mammography and Pap test screening among low-income foreign-born Hispanic women in the USA. *Cad Saúde Pública* 1998;14:S133–S147.
 37. Kim KE, Chandrasekar E, Lam HY. Socio-demographic factors and cancer screening among foreign-born Chinese, Cambodian and Vietnamese women. *Race Soc Probl* 2014; 6:4–14.
 38. Kagawa-Singer M, Dadia AV, Yu MC, Surbone A. Cancer, culture, and health disparities: Time to chart a new course? *CA Cancer J Clin* 2010;60:12–39.
 39. Oster AM, Sullivan PS, Blair JM. Prevalence of cervical cancer screening of HIV-infected women in the United States. *J Acquir Immune Defic Syndr* 2009;51:430–436.
 40. Tyerman Z, Aboulaia DM. Review of screening guidelines for non-AIDS-defining malignancies: Evolving issues in the era of highly active antiretroviral therapy. *AIDS Rev* 2012;14:3–16.
 41. McPheeters ML, et al. Closing the quality gap: Revisiting the state of the science (vol. 3: quality improvement interventions to address health disparities). *Evid Rep Technol Assess* 2012;208:1–475.

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