Association Between Race, Depression, and Antiretroviral Therapy Adherence in a Low-Income Population with HIV Infection

Meg C. Kong, PhD¹, Milap C. Nahata, MS, PharmD¹, Veronique A. Lacombe, PhD¹, Eric E. Seiber, PhD², and Rajesh Balkrishnan, PhD³

¹College of Pharmacy, Ohio State University, Columbus, OH, USA; ²College of Public Health, Ohio State University, Columbus, OH, USA;

³College of Pharmacy and School of Public Health, University of Michigan, Ann Arbor, MI, USA.

BACKGROUND: Racial disparities exist in many aspects of HIV/AIDS. Comorbid depression adds to the complexity of disease management. However, prior research does not clearly show an association between race and antiretroviral therapy (ART) adherence, or depression and adherence. It is also not known whether the co-existence of depression modifies any racial differences that may exist.

OBJECTIVE: To examine racial differences in ART adherence and whether the presence of comorbid depression moderates these differences among Medicaid-enrolled HIV-infected patients.

DESIGN: Retrospective cohort study.

SETTING: Multi-state Medicaid database (Thomson Reuters MarketScan®).

PARTICIPANTS: Data for 7,034 HIV-infected patients with at least two months of antiretroviral drug claims between 2003 and 2007 were assessed.

MAIN MEASURES: Antiretroviral therapy adherence (90 % days covered) were measured for a 12-month period. The main independent variables of interest were race and depression. Other covariates included patient variables, clinical variables (comorbidity and disease severity), and therapy-related variables.

KEY RESULTS: In this study sample, over 66 % of patients were of black race, and almost 50 % experienced depression during the study period. A significantly higher portion of non-black patients were able to achieve optimal adherence (≥ 90 %) compared to black patients (38.6 % vs. 28.7 %, $p < 0.001$). In fact, black patients had nearly 30 % decreased odds of being optimally adherent to antiretroviral drugs compared to non-black patients (OR=0.70, 95 % CI: 0.63–0.78), and was unchanged regardless of whether the patient had depression. Antidepressant treatment nearly doubled the odds of optimal ART adherence among patients with depression (OR=1.92, 95 % CI: 1.12–3.29).

CONCLUSIONS: Black race was significantly associated with worse ART adherence, which was not modified by the presence of depression. Under-diagnosis and under-treatment of depression may hinder ART adherence among HIV-infected patients of all races.

KEY WORDS: HIV; adherence; depression; race; Medicaid.

J Gen Intern Med 27(9):1159–64

DOI: 10.1007/s11606-012-2043-3

© Society of General Internal Medicine 2012

INTRODUCTION

A significant racial divide exists in many aspects of HIV infection.¹ African Americans have the highest rates of new HIV infection and AIDS cases, seven and nine times higher (respectively) when compared to whites.² They also have poorer access to care,^{3,4} lower rates of antiretroviral treatment receipt,^{5,6} and lower survival rates.^{7,8}

Less clear is whether a link exists between race and ART adherence in HIV-infected patients. In a 2001 study by Kleeberger et al.,⁹ male HIV-infected patients were surveyed about their short-term (previous four-day) adherence to treatment, and it was found that a lower self-reported adherence rate (< 100 % adherence) was associated with African-American race, lower income, and having no outpatient visits. Other studies have reported mixed results regarding the role of race/ethnicity and adherence to ART.^{9–16} Thus, the association between race and adherence has not been investigated consistently in a large, representative population of HIV-infected individuals.

Of further concern is the common co-existence of depression among HIV-infected patients. Whereas depression is approximately found in 17 % of the general population, some studies have found it to be 30 % and upwards of 57 % in HIV-infected individuals.^{17–19} The presence of depression and other mental illnesses is considered a risk factor for poor quality of life and non-adherence²⁰ in several disease states.²¹ Within the context of HIV/AIDS, depressive symptoms have been linked to poor overall viral suppression^{22,23} and decreases in CD4+ count.^{24,25} Though some studies suggest that depression may negatively impact ART adherence,^{26–30} it is plausible that antidepressant treatment could improve ART adherence since it is generally well-tolerated and effective among HIV-infected patients.^{31,32}

Finally, we note that the combined effects of race and depression on ART adherence have not been studied. The complexity of ART adherence represents a convergence of

Received July 26, 2011

Revised January 23, 2012

Accepted March 12, 2012

Published online April 17, 2012

equally complex interactions. To inform and improve on treatment outcomes, we must try to disentangle these intricate adherence patterns. Thus, the purpose of this study was to examine the association between race and ART adherence, and whether any racial differences in adherence are further enhanced by the presence of depression. Subsequently, we also investigated the effect of antidepressant treatment receipt on ART adherence.

METHODS

Data Source

This study was carried out using the MarketScan® Multi-State Medicaid Database from Thomson Reuters. This unique database is comprised of data from eight unidentified, geographically-dispersed states and represents approximately 8.1 million lives. Extracted data used in this study were from January 1, 2003 to December 31, 2007.

Study Population

Patients who were at least 18 years old and had antiretroviral medication claims between January 1, 2003 to December 31, 2007 were included. Only patients who were continuously enrolled for 6 months before (pre-index period) and 12 months after (post-index period) the index date were included, where the index date was defined as the date of earliest antiretroviral drug claim following 6 months of continuous enrollment. Patients who were dually eligible for Medicare were excluded since their claims would not be fully captured. To establish accurate measurements of adherence, only patients who had two or more months of medication claims data were included. Additionally, women with a delivery diagnosis during the study period were also excluded because pregnancy may require short-term changes to ART regimen.³³

STUDY VARIABLES

The MarketScan® Multi-State Medicaid Database codes their race/ethnicity field as “White”, “Black”, “Hispanic” or “Other”. Race was then dichotomized as either “black” or “non-black” to examine the study objectives. Since the data source did not contain information on biological markers such as CD4+ count and viral load, disease severity was measured during the 6-month pre-index period based on the presence of at least one AIDS-defining clinical condition, as defined by the Centers for Disease Control and Prevention.³⁴ Comorbidity severity was estimated during the 6-month pre-index period using the Charlson-Deyo comorbidity index.³⁵ Patients with substance abuse during the 6-

month pre-index period were identified when at least one of the following criteria was met: (1) *International Classification of Diseases, Ninth Revision* (ICD-9) codes 292.xx, 304.xx, 305.2x, 305.99, 760.72, 760.73, 760.75, 779.5x, (2) *National Drug Code* (NDC) numbers matching methadone-related prescription fills in pharmaceutical claims, or (3) substance abuse/detoxification indicators (MarketScan® codes for 100: psychiatric/substance abuse, 102: substance abuse, and 103: detoxification). Patients were categorized as having prior experience with ART if they had at least one pharmacy claim during the 6-month pre-index period. Patients were also classified as fixed-dose users (reduced complexity of regimen) if they had at least one pharmacy claim for a fixed-dose combination antiretroviral drug (Combivir®, Epzicom®, Trizivir®, Truvada®, Atripla®, or Kaletra®) during the study period. As a proxy for access to care, the number of HIV-related outpatient visits during the 6-month pre-index period was summed and dichotomized (≥ 1 visit). A patient was identified as having depression if he/she had any diagnosis for depression or depression-related condition (ICD-9 codes 296.2x, 296.3x, 311, 301.12, 300.4, and 309.1) or a prescription claim for an antidepressant medication (including selective serotonin reuptake inhibitors, tricyclic and tetracyclic antidepressants, monoamine oxidase inhibitors, and serotonin-norepinephrine reuptake inhibitors).

Medication Adherence

ART adherence was examined over a 12-month observation period starting at the index date. All prescription fill events for antiretroviral medication were identified by matching against the list of NDC numbers for antiretroviral drugs. Medication adherence was measured by a method adapted from a number of studies by Turner et al.^{36,37} Essentially, the final medication adherence was measured by dividing number of adherent days by the post-index observation period (365 days) subtracted by the number of days hospitalized during that period.

Adherence of ≥ 90 –95 % is generally considered necessary to achieve optimal virologic suppression.^{38–41} After adherence was calculated, only patients who had a ≥ 90 % adherence over the study period were considered to be optimally adherent.

Statistical Analysis. Differences in baseline characteristics between non-black and black races were determined using the p-values of t-tests and chi-square tests. Unadjusted and adjusted logistic regression was used to examine the association between ART adherence, race, and depression. Adjusted models included a number of possible confounders (age, gender, disease and comorbidity severity, evidence of substance abuse, complexity of regimen, access to care). To investigate whether any association between race and adherence differed given the presence of depression, the

interaction term between the two variables was adjusted for in a separate model. We also performed an additional multiple logistic regression to predict odds of achieving ≥ 90 % adherence among patients with HIV-infection and comorbid depression based on receipt of antidepressant treatment. All statistical analyses were performed using Stata 9.2 (StataCorp LP, College Station, TX) with a priori significance level set at 0.05.

RESULTS

Data for 43,213 HIV-infected patients who were enrolled in Medicaid from 2003 to 2007 were assessed from the multi-state administrative claims database. Out of these, 15,077 patients were excluded because they did not have any claims for antiretroviral drugs during the study time period. Another 15,895 were excluded because they were not able to meet the continuous enrollment criteria. We also excluded an additional 4,830 patients because they were dually eligible for Medicare. After excluding 377 women who had evidence of childbirth during the study period, the final study population comprised of 7,034 patients.

Of the 7,034 HIV-infected patients, over 66 % were black. The “non-black” race group consisted of 1318 whites, 75 Hispanic, and 994 patients in the “other” category.

Table 1 provides the summary statistics for baseline variables by race. Patients in the black race group were

slightly younger (41.1 vs. 41.7, $p=0.0055$), had a higher proportion of females (54.8 % vs. 43.4 %, $p<0.001$), more severe disease (16.1 % vs. 12.3 %, $p<0.001$), and were less experienced with antiretroviral use (60.1 % vs. 66.4 %, $p<0.001$). The mean comorbidity severity for blacks was 0.82 vs. 1.06 for non-blacks ($p<0.0001$). A higher proportion of non-blacks showed evidence of depression compared to blacks (56.5 % vs. 41.7 %, $p<0.001$). A significantly lower proportion of black patients were able to achieve ≥ 90 % ART adherence (28.7 % vs. 38.6 %, $p<0.001$). This difference was also seen when medication adherence was considered as a continuous variable (62 % vs. 68 %, $p<0.001$).

Logistic regression was used to assess the association between race and ART adherence. The unadjusted and adjusted results from the logistic models are shown in Table 2. In our sample of low-income HIV-infected patients, blacks were approximately 36 % less likely to be adherent to their antiretroviral medication compared to non-blacks. After adjusting for the effects of age, gender, disease severity, comorbidity severity, prior antiretroviral use, regimen complexity, substance abuse, and access to care, and evidence of depression, black race was still associated with 30 % less odds of achieving optimal adherence compared to non-black race (OR=0.70, 95 % CI:0.63–0.78).

Before adjusting for confounders, patients who showed evidence of depression were 15 % more likely to achieve optimal adherence compared to non-depressed patients. However, this increase in odds lessened and became only

Table 1. Summary Statistics by Race

	All patients N=7034	Black N=4647	Non-black N=2387	P
Age in years, mean (SD)	41.3 (9.3)	41.1 (9.5)	41.7 (8.9)	0.0055
Gender				
Female, N (%)	3585 (51.0)	2548 (54.8)	1037 (43.4)	<0.001
Male, N (%)	3449 (49.0)	2099 (45.2)	1350 (56.6)	
Disease Severity (AIDS-defining condition)*				
no, N (%)	2094 (85.2)	3898 (83.9)	2094 (87.7)	<0.001
yes, N (%)	293 (14.8)	749 (16.1)	293 (12.3)	
Comorbidity Severity ^a , mean (SD)	0.90 (1.79)	0.82 (1.71)	1.06 (1.94)	<0.0001
Prior antiretroviral use				
no, N (%)	2655 (37.8)	1854 (39.9)	801 (33.6)	<0.001
yes, N (%)	4379 (62.2)	2793 (60.1)	1586 (66.4)	
Complex Regimen				
no fixed-dose use, N (%)	2144 (30.48)	1320 (28.41)	824 (34.52)	<0.001
fixed-dose use, N (%)	4890 (69.52)	3327 (71.59)	1563 (65.48)	
Substance abuse				
no, N (%)	6583 (93.6)	4318 (92.9)	2265 (94.9)	0.0014
yes, N (%)	451 (6.4)	329 (7.1)	122 (5.1)	
Access to care*				
no	1363 (19.4)	822 (17.7)	541 (22.7)	<0.001
yes	5671 (80.6)	3825 (82.3)	1846 (77.3)	
Evidence of Depression				
no	3748 (53.3)	2709 (58.3)	1039 (43.5)	<0.001
yes	3286 (46.7)	1938 (41.7)	1348 (56.5)	
Adherence				
<90 % adherent, N (%)	4779 (67.9)	3314 (71.3)	1465 (61.4)	<0.001
≥ 90 % adherent, N (%)	2255 (32.1)	1333 (28.7)	922 (38.6)	
Mean (SD)	0.64 (0.31)	0.62 (0.31)	0.68 (0.31)	<0.001

*Measured in the 6-month pre-study period

Table 2. Association Between Race, Depression, and Odds of Achieving Optimal ($\geq 90\%$) Adherence

	OR (95 % CI)	
	Unadjusted	Adjusted*
Race		
Non-black	1 [reference]	1 [reference]
Black	0.64 (0.58–0.71)	0.70 (0.63–0.78)
Depression		
No	1 [reference]	1 [reference]
Yes	1.15 (1.04–1.27)	1.11 (1.00–1.24)

*Adjusted for age, gender, disease severity, comorbidity severity, prior antiretroviral use, regimen complexity, substance abuse, and access to care

marginally significant after adjusting for confounders (OR=1.11, 95 % CI:1.00–1.24).

The association between race and adherence was not found to be moderated by the existence of depression, as the interaction term of race and depression was not statistically significant, and was thus not included in the final model.

The influence of antidepressant treatment and odds of ART adherence was specifically examined among the 3,286 patients that showed evidence of depression (Table 3). We found that HIV-infected patients on antidepressant treatment were nearly twice as likely to be adherent to their antiretroviral medication compared to those who did not (OR=1.92, 95 % CI: 1.12–3.29).

DISCUSSION

The results of this study indicate that a significant racial disparity exists in HIV medication adherence. In our study population of 7034 patients, black race was significantly associated with decreased odds of ART adherence. Although almost 40 % of non-black patients achieved optimal adherence over a one-year period, less than 30 % of black patients were able to do so. In fact, black patients were consistently 30 % less likely to achieve optimal adherence compared to non-black patients, even after adjusting for a number of covariates. While previous smaller studies presented inconsistent results,^{9–16} our study indicates that a true racial disparity in antiretroviral medication adherence

Table 3. Association between antidepressant treatment and odds of achieving optimal ($\geq 90\%$) adherence among patients with depression (N=3286)

	Total	N (%) Adherent	Adjusted* OR (95 % CI)
Antidepressant Treatment			
No	84	9 (10.7)	1 [reference]
Yes	3202	816 (25.5)	1.92 (1.12–3.29)

*Adjusted for race, age, gender, disease severity, comorbidity severity, prior antiretroviral use, regimen complexity, substance abuse, and access to care

is likely to be present in the HIV-infected population. In part, these racial disparities may be attributed to findings that show black patients are more likely to postpone medical care,⁶ have less access to care,³⁰ and less trust in healthcare providers than white patients.⁴²

Although this study found a high prevalence rate of depression among HIV-infected patients, our analysis did not find that comorbid depression moderated the association between race and adherence during the one-year study period. In other words, the presence of depression did not further enhance the already existing racial disparity between blacks and non-blacks with regards to ART adherence. However, this finding should be interpreted with caution since there is evidence that African Americans face a disparity in both diagnosis⁴³ and treatment of depression compared to whites.⁴⁴ Thus, while African Americans are generally reported to have lower rates of depression than whites,^{45,46} true prevalence may actually be higher.

We also saw that patients categorized as having depression were slightly more adherent to their HIV medication than those who were not. Initially, this may seem contradictory since the presence of comorbid depression generally worsens outcome measures. However, it seems that the improvement in adherence may be attributed to the receipt of antidepressant medication. This is consistent with two previous studies.^{19,27} It is understandable that this may be due to the improved emotional and mental function provided by antidepressant treatments. It may also represent a proxy for the quality of the physician–patient relationship, i.e., patients with a better relationship with their physician are more likely to have their depressive symptoms recognized and treated for.

In our analysis, depressed patients who did not receive antidepressant medication not only had worse adherence than their medicated counterparts, but also had lower adherence compared to the non-depressed patients. This implies that depression does have the expected negative impact on ART adherence if left untreated. Conversely, if depression symptoms are treated for, a patient's adherence to ART; thus, overall disease management, may in fact improve despite the initial negative connotation that comes with being diagnosed with depression. For this reason, we believe that future studies on ART adherence should include not only depression as a covariate, but also additional details on the treatment of depression, since this can significantly influence the interpretation and implication of study results. Furthermore, these findings underscore the importance of mental health evaluation in the successful management of HIV infection. Healthcare providers must increase their vigilance for symptoms of depression in HIV-infected patients and offer appropriate treatment as this may not only effectively treat those symptoms, but also improve their ART adherence.

This study was subject to several limitations. Given the inherent limits of all administrative claims data studies,

causality cannot be established. Additionally, medical conditions were identified using ICD-9 and NDC codes, which if recorded inaccurately, may lead to incorrect patient classification. Data such as laboratory values and clinical outcomes are unavailable in administrative claims data and could not be included in the analysis. Since prescription claims data were used to assess this adherence, it was not possible to verify whether a patient actually consumed the filled prescription. Thus, it was assumed that any prescription filled was also consumed. Administrative claims data is also prone to omitted variable bias since many personal, social, and physician factors (such as severity of depression, socioeconomic status, education level, stress, social support, and physician trust) could not be controlled for. In an attempt to address this bias, we used proxy variables in place of some covariates when possible. However, proxy variables are not true replacements and may be prone to covariate misidentification.

To identify evidence of depression, both ICD-9 codes for depression and NDC codes for antidepressants were used. This method may improve depression detection, since it is generally under-diagnosed,⁴⁷ but could also overestimate the true number of patients with depression. Nevertheless, we used this method because a study using multi-state Medicaid claims found that compared to using either diagnostic code or prescription medication claims, the combination of both yielded much better overall performance in correctly classifying depression and other chronic illnesses.⁴⁸ Furthermore, we only classified a patient as having evidence of depression if he/she did not also have a diagnosis for anxiety disorder or other disorders that would be treated with antidepressants. Finally, since we examined HIV-infected individuals from multi-state Medicaid claims, study results may not be generalizable to other HIV-infected populations.

Despite these limitations, this study's large sample size allowed for robust quantitative analysis of the association between race, depression, and antiretroviral medication adherence. Our results demonstrate that black patients are at a disadvantage compared to other races when it comes to ART adherence, and that these racial differences persist independent of whether depression is also present. Disease management programs within Medicaid could be especially beneficial to disadvantaged groups by providing customized disease education and self-management strategies with sensitivity to cultural and socioeconomic differences. With clear evidence that adherence is crucial in the successful management of HIV infection and prevention of disease progression, continued improvement in our understanding of the factors associated with any racial disparity is of utmost importance. Prospective studies using clinical and qualitative assessments may provide further insight into the causes of the racial disparities seen in ART adherence, and

shed light on possible solutions to successfully target vulnerable HIV-infected populations.

Acknowledgment/Funding support: This study was supported by the Dev Pathak Dissertation Fellowship.

Conflict of Interest: The authors declare that they do not have a conflict of interest.

Corresponding Author: Rajesh Balkrishnan, PhD; College of Pharmacy and School of Public Health, University of Michigan, 428 Church Street, Ann Arbor, MI 48109-1065, USA (e-mail: rbalkris@umich.edu).

REFERENCES

1. **Kraut-Becher J, Eisenberg M, Voytek C, Brown T, Metzger DS, Aral S.** Examining racial disparities in HIV. *J Acquir Immune Defic Syndr.* 2008;47(Suppl 1):S20-S27.
2. **Hall HI, Song R, Rhodes P, et al.** Estimation of HIV incidence in the United States. *JAMA.* 2008;300:520-529.
3. **Shapiro MF, Morton SC, McCaffrey DF, et al.** Variations in the care of HIV-infected adults in the United States. *JAMA.* 1999;281:2305-2315.
4. **Cunningham WE, Anderson RM, Katz MH, et al.** The impact of competing subsistence needs and barriers on access to medical care for persons with human immunodeficiency virus receiving care in the United States. *Med Care.* 1999;37:1270-1281.
5. **Gebo KA, Fleishman JA, Conviser R, et al.** Racial and gender disparities in receipt of highly active antiretroviral therapy persist in a multistate sample of HIV patients in 2001. *J Acquir Immune Defic Syndr.* 2005;38:96.
6. **Palacio H, Kahn JG, Richards TA, et al.** Effect of race and/or ethnicity in use of antiretrovirals and prophylaxis for opportunistic infection: a review of the literature. *Public Health Reports (Washington, DC: 1974),* June 2002. 117(3):233-251; discussion 231-232.
7. **CDC.** HIV/AIDS Surveillance Report, 2007. Vol. 19. Atlanta, GA: US Department of Health and Human Services, CDC; 2009. Available at <http://www.cdc.gov/hiv/surveillance/resources/reports/2007report/index.htm>. Accessed February 20, 2012.
8. **Heron M, Hoyert DL, Murphy SL, et al.** Deaths: final data for 2006. Hyattsville, MD: US Department of Health and Human Services, CDC, National Center for Health Statistics; 2009. National Vital Statistics Report, vol. 57, no. 14. Available at [http://www.cdc.gov/nchs/data/nvsr/nvsr57_14.pdf](http://www.cdc.gov/nchs/data/nvsr/nvsr57/nvsr57_14.pdf). Accessed February 20, 2012.
9. **Kleeberger CA, Phair JP, Strathdee SA, Detels R, Kingsley L, Jacobson LP.** Determinants of heterogeneous adherence to HIV-antiretroviral therapies in the multicenter AIDS cohort study. *J Acquir Immune Defic Syndr.* 2001;26:82-92.
10. **Kleeberger CA, Buechner J, Palella F, et al.** Changes in adherence to highly active antiretroviral therapy medications in the multicenter AIDS cohort study. *AIDS.* 2004;18:683-688.
11. **Li X, Margolick JB, Conover CS, et al.** Interruption and discontinuation of highly active antiretroviral therapy in the multicenter AIDS cohort study. *JIDS.* 2005;38:320-328.
12. **Oh DL, Sarafian F, Silvestre A, et al.** Evaluation of adherence and factors affecting adherence to combination antiretroviral therapy among white, Hispanic, and black men in the MACS cohort. *J Acquir Immune Defic Syndr.* 2009;52:290-293.
13. **Gifford AL, Bormann JE, Shively MJ, et al.** Predictors of self-reported adherence and plasma HIV concentrations in patients on multidrug antiretroviral regimens. *J Acquir Immune Defic Syndr.* 2000;23:386-395.
14. **Golin C, Liu H, Hays R, et al.** A prospective study of predictors of adherence to combination antiretroviral medication. *J Gen Intern Med.* 2002;17:756-765.
15. **Thrasher AD, Earp JAL, Golin CE, et al.** Discrimination, distrust, and racial/ethnic disparities in antiretroviral therapy adherence among a

- national sample of HIV-infected patients. *J Acquir Immune Defic Syndr*. 2008;49:84–93.
16. **Schackman BR, Ribaud HJ, Krambrink A, et al.** Racial differences in virologic failure associated with adherence and quality of life on Efavirenz-Containing regimens for initial HIV therapy. *J Acquir Immune Defic Syndr*. 2007;46:547–554.
  17. **Weiser SD, Riley ED, Ragland K, Hammer G, Clark R, Bangsberg DR.** Brief report: factors associated with depression among homeless and marginally housed HIV Infected men in San Francisco. *J Gen Intern Med*. 2006;21:61–64.
  18. **Asch S, Kilbourne A, Gifford A, et al.** Underdiagnosis of depression in HIV. *J Gen Intern Med*. 2003;18:450–460.
  19. **Yun LW, Maravi M, Kobayashi JS, et al.** Antidepressant treatment improves adherence to antiretroviral therapy among depressed HIV-infected patients. *J Acquir Immune Defic Syndr*. 2005;38:432–438.
  20. **Grenard JL, Munjas BA, Adams JL, et al.** Depression and medication adherence in the treatment of chronic diseases in the United States: a Meta-analysis. *J Gen Intern Med*. 2011;26:1175–1182.
  21. **DiMatteo MR, Lepper HS, Croghan TW.** Depression is a risk factor for noncompliance with medical treatment: Meta-analysis of the effects of anxiety and depression on patient adherence. *Arch Intern Med*. 2000;160:2101–2107.
  22. **Shacham E, Nurutdinova D, Satyanarayana V, et al.** Routine screening for depression: identifying a challenge for successful HIV care. *AIDS Patient Care STDS*. 2009;23:949–955.
  23. **Cook JA, Cohen MH, Burke J, et al.** Effects of depressive symptoms and mental health quality of life on use of highly active antiretroviral therapy among HIV-seropositive women. *J Acquir Immune Defic Syndr*. 2002;30:401–409.
  24. **Ickovics JR, Hamburger ME, Vlahov D, et al.** Mortality, CD4 cell count decline, and depressive symptoms among HIV-seropositive women: longitudinal analysis from the HIV epidemiology research study. *JAMA*. 2001;285:1466–1474.
  25. **Burack JH, Barrett DC, Stall RD, et al.** Depressive symptoms and CD4 lymphocyte decline among HIV-infected men. *JAMA*. 1993;270:2568–2573.
  26. **Leserman J, Petitto JM, Perkins DO, et al.** Severe stress, depressive symptoms, and changes in lymphocyte subsets in human immunodeficiency virus-infected men. a 2-year follow-up study. *Arch Gen Psychiatry*. 1997;54:279–285.
  27. **Horberg MA, Silverberg MJ, Hurley LB, et al.** Effects of depression and selective serotonin reuptake inhibitor use on adherence to highly active antiretroviral therapy and on clinical outcomes in HIV-infected patients. *J Acquir Immune Defic Syndr*. 2008;47:384–90.
  28. **Ammassari A, Antinori A, Aloisi MS, et al.** Depressive symptoms, neurocognitive impairment, and adherence to highly active antiretroviral therapy among HIV-infected persons. *Psychosomatics*. 2004;45:394–402.
  29. **Gordillo V, del Amo J, Soriano V, et al.** Sociodemographic and psychological variables influencing adherence to antiretroviral therapy. *AIDS*. 1999;13:1763–1769.
  30. **Mugavero M, Ostermann J, Whetten K, et al.** Barriers to antiretroviral adherence: the importance of depression, abuse, and other traumatic events. *AIDS Patient Care STDS*. 2006;20:418–428.
  31. **Robinson MJ, Gaqish RB.** Practical psychopharmacology in HIV-1 and acquired immunodeficiency syndrome. *Psychiatr Clin North Am*. 2002;25:149–175.
  32. **Rabkin JG, Wagner GJ, Rabkin R.** Fluoxetine treatment for depression in patients with HIV and AIDS: a randomized, placebo-controlled trial. *Am J Psychiatry*. 1999;156:101–107.
  33. **Perinatal HIV Guidelines Working Group.** Public Health Service Task Force Recommendations for use of antiretroviral drugs in pregnant HIV-infected women for maternal health and interventions to reduce perinatal HIV-1 transmission in the United States. Jul 8, 2008. pp. 1–98. Available at <http://aidsinfo.nih.gov/ContentFiles/PerinatalGL.pdf>. Accessed February 20, 2012.
  34. **CDC.** 1993 revised classification system for HIV infection and expanded surveillance case definition for AIDS among adolescents and adults. Available at: <http://www.cdc.gov/mmwr/preview/mmwrhtml/00018871.htm>. Accessed February 20, 2012.
  35. **Deyo RA, Cherkin DC, Ciol MA.** Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. *J Clin Epidemiol*. 1992;45:613–619.
  36. **Turner BJ, Newschaffer CJ, Zhang D, et al.** Antiretroviral use and pharmacy-based measurement of adherence in postpartum HIV-infected women. *Med Care*. 2000;38:911–925.
  37. **Laine C, Newschaffer CJ, Zhang D, Cosler L, Hauck WW, Turner BJ.** Adherence to antiretroviral therapy by pregnant women infected with human immunodeficiency virus: a pharmacy claims-based analysis. *Obstet Gynecol*. 2000;95:167–73.
  38. **Paterson DL, Swindells S, Mohr J, et al.** Adherence to protease inhibitor therapy and outcomes in patients with HIV infection. *Ann Intern Med*. 2000;133:21–30.
  39. **Martin M, Del CE, Codina C, et al.** Relationship between adherence level, type of the antiretroviral regimen, and plasma HIV type 1 RNA viral load: a prospective cohort study. *AIDS Res Hum Retroviruses*. 2008;24:1263–1268.
  40. **Kyser M, Buchacz K, Bush TJ, et al.** Factors associated with non-adherence to antiretroviral therapy in the SUN study. *AIDS Care*. 2011;23(5):601–611.
  41. **Lima VD, Harrigan R, Murry M, et al.** Differential impact of adherence on long-term treatment response among naive HIV-infected individuals. *AIDS*. 2008;22:2371–2380.
  42. **Boulware LE, Cooper LA, Ratner LE, et al.** Race and trust in the health care system. *Public Health Rep*. 2003;118:358–65.
  43. **Das AK, Olfson M, McCurtis HL, et al.** Depression in African Americans: breaking barriers to detection and treatment. *J Fam Pract*. 2006;55:30–39.
  44. **Melfi CA, Croghan TW, Hanna MP, et al.** Racial variation in antidepressant treatment in a Medicaid population. *J Clin Psychiatry*. 2000;16:16–21.
  45. **Dunlop DD, Song J, Lyons JS, Mannheim LM, Chang RW.** Racial/ethnic differences in rates of depression among pre-retirement adults. *Am J Public Health*. 2003;93:1945–1952.
  46. **Kessler RC, Berglund P, Demler O, et al.** National comorbidity survey replication. The epidemiology of major depressive disorder: results from the National Comorbidity Survey Replication (NCS-R). *JAMA*. 2003;289:3095–3105.
  47. **Walkup JT, Boyer CA, Kellermann SL.** Reliability of Medicaid claims files for use in psychiatric diagnoses and service delivery. *Adm Policy Ment Health*. 2000;27:129–139.
  48. **Gilmer T, Kronick R, Fishman P, et al.** The Medicaid Rx model: pharmacy-based risk adjustment for public programs. *Med Care*. 2001;39:1188–1202.