

Health Literacy Is a Predictor of HIV/AIDS Knowledge

Giselle Hicks, MPH; Maribel Barragán, MPH; Carlos Franco-Paredes, MD, MPH;
Mark V. Williams, MD; Carlos del Rio, MD

Background and Objectives: *This study's objective was to evaluate the association between health literacy and human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) knowledge among patients seen at an inner-city, public hospital urgent care center (UCC). **Methods:** We used a prospective survey of patients offered an HIV test by their providers during a UCC visit. We measured patients' health literacy level using the Rapid Estimate of Adult Literacy in Medicine (REALM) scale and assessed their HIV/AIDS knowledge using a 22-item questionnaire. **Results:** A total of 372 patients were enrolled. Among participants in this relatively young sample (55% were under the age of 40), 92 (25%) had a REALM score at or below a sixth-grade level, and 122 (33%) did not have a high school diploma. Patients' mean HIV/AIDS knowledge scores differed significantly between patients with inadequate health literacy and those with marginal or adequate health literacy. In multivariate analyses, patients' REALM scores were positively associated with patients' HIV/AIDS knowledge even after adjusting for income, education, and risk perception. **Conclusions:** These findings demonstrate that HIV/AIDS knowledge is strongly associated with patients' health literacy in this inner-city population. These findings reiterate the need to target HIV prevention strategies toward populations with inadequate health literacy levels and to dispel misconceptions regarding HIV/AIDS that directly influence risk-taking behaviors and health care utilization.*

(Fam Med 2006;38(10):717-23.)

Approximately 250,000 people infected with human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) in the United States are not aware of their status.¹ To identify these individuals and offer them counseling and treatment, the Centers for Disease Control and Prevention (CDC) announced in 2003 a prevention initiative incorporating HIV testing in routine medical care and implementing new models of HIV testing outside medical care settings.^{1,2} Many educational interventions have sought to improve HIV treatment, testing rates, and knowledge about HIV transmission to enable individuals to assess their own HIV risk status and identify risk-taking behaviors.³⁻⁵ However, little is known about how patients' health literacy might modify the impact of such prevention interventions.

Health literacy is "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions."⁶⁻⁹ An estimated 40 million people in the United States have difficulty understanding and acting on health information, which may negatively influence their health outcomes.⁷⁻⁹ Patients' health literacy is associated with health knowledge, health status, and use of health services.¹⁰⁻²¹ Health literacy plays an important role in disease prevention through the understanding of risk and the identification of necessary behavioral changes.⁹ Given the importance of health literacy in understanding medical care, the Institute of Medicine (IOM) recently issued the report *Health Literacy: A Prescription to End Confusion*, which calls for multidisciplinary research on the consequences of limited health literacy.⁹

The HIV/AIDS epidemic among patients seeking medical care at public hospitals^{3,22} has many complexities associated with its prevention and treatment. The presence of limited literacy levels observed among patients at public hospitals,^{4,23} combined with the high

From the Department of Medicine (all), Division of Infectious Diseases (Drs Hicks, Barragan, Franco-Paredes, and del Rio), and Emory University Center for AIDS Research (Dr del Rio), Emory University.

prevalence of HIV/AIDS in populations served at public hospitals,^{13,22} requires interventions to consider patients' health literacy. Previous research evaluating links between patients' health literacy and HIV knowledge^{24,25} only studied patients already infected with HIV and included no sampling of uninfected at-risk patients.

In those studies of HIV-infected individuals, misconceptions about HIV/AIDS treatment and transmission were associated with lower health literacy.²⁵⁻²⁸ In addition, patients with lower levels of health literacy had lower levels of HIV knowledge, were less likely to understand the meaning and importance of HIV viral loads and CD4 cell counts, and less likely to have an undetectable HIV viral load.^{25,26} A study by Kalichman et al attempted to determine some of the reasons, including literacy, for nonadherence to Highly Active Antiretroviral Therapy (HAART).²⁶ While literacy was not a significant predictor of adherence when education was accounted for, lower-literacy patients gave different explanations for nonadherence than higher-literacy-level patients. More recently, health literacy was associated with willingness to comply with health care providers' recommendations to undergo HIV testing.²⁷

In the present study, we examined the association between health literacy level and HIV/AIDS knowledge score among patients who were unaware of their HIV serostatus and were offered an HIV test as part of their medical visit to a large, urban public hospital urgent care center (UCC). We hypothesized that the mean HIV/AIDS knowledge score among patients with an adequate literacy level was not statistically different from the mean HIV/AIDS knowledge score among patients with marginal or inadequate literacy levels. We also assessed the association of patients' health literacy on their attitudes toward HIV/AIDS.

Methods

Subjects

Between March and August 2000, we conducted a cross-sectional survey of 372 English-speaking patients ages 18–65 years who had been offered an HIV test by their health care provider during a visit to the UCC of Grady Memorial Hospital in Atlanta. An informational, low-literacy brochure on HIV testing was given to all patients upon registration into the UCC. The brochure was written at a level appropriate for patients with a reading level at or below the sixth grade, as assessed by the Flesch-Kincaid scale.²⁹

Patients were approached and screened for study participation by trained interviewers immediately after completion of their visit to the UCC. Demographic information was obtained during the participation eligibility screening. Patients both refusing and assenting to HIV testing were enrolled. Excluded from enrollment were patients who had received an HIV test during the previous 6 months and those in the UCC to receive

HIV test results. Thus, enrollment was restricted to patients who had been offered an HIV test by their health care provider during their visit to the UCC as a consequence of a concurrent study design.²⁷ Patients for whom English was a second language were eligible only if they possessed reading skills in English, enabling an assessment of their health literacy with the instrument used in this study.

A \$20 cash payment was provided to all participants. The study was approved by the Institutional Review Boards of Emory University and the CDC and by the Grady Memorial Hospital Research Oversight Committee.

Literacy Assessment

After obtaining informed consent, trained interviewers assessed each patient's health literacy level using the REALM, an instrument used to estimate health literacy by measuring reading ability through medical word recognition. In the REALM, the patient is given three lists, each containing 22 medical words arranged in order of difficulty and asked to read each word aloud. The REALM score is the total number of correctly pronounced words for the three lists, ranging from 0 to 66. REALM scores are objective and correlate highly ($r=0.88$ to 0.97) with standardized reading tests.²⁸ Examples of words listed on the REALM are "infection" and "diabetes." The range of REALM scores is categorized into three literacy levels: inadequate (at or below sixth grade), marginal (seventh to eighth grade) and adequate (at or above ninth grade).

HIV/AIDS Knowledge Assessment

Patients' knowledge of HIV/AIDS was assessed using an objective, multiple-choice format questionnaire to eliminate the introduction of bias by the interviewer. The HIV/AIDS knowledge composite score was comprised of 22 questions on the accuracy and timing of HIV tests, HIV/AIDS transmission routes, and available HIV/AIDS treatment.^{30,31} These 22 knowledge items were the same, regardless of whether patients accepted or refused HIV testing.

Additional information on three factors that could potentially affect patients' HIV/AIDS knowledge level was also obtained during the interview. The three factors included patients' personal HIV experience, their understanding of risk, and their attitudes and beliefs about HIV/AIDS. The questionnaire items used to measure risk perception were not previously validated.

Data Analysis

Bivariate analyses included an analysis of variance (ANOVA) for each independent variable to identify any differences between mean knowledge scores among its strata. Associations between patients' health literacy level and the other independent variables were assessed

using an ANOVA for continuous variables and a chi square test of proportions for categorical variables.

For multivariate analyses, the initial multiple linear regression model included only the potential confounding variables that had been associated with either patients' HIV/AIDS knowledge score or patients' health literacy level. Backward elimination was used to obtain the final regression model, and an analysis of covariance (ANACOVA) was performed among patients' adjusted mean HIV/AIDS knowledge scores to determine differences between patients' health literacy levels as measured by the REALM. We performed all analyses with SAS Software version 8.0 (SAS Institute, Cary, NC).

Results

The characteristics of the 372 patients enrolled in this study are presented in Table 1. The majority were African American (94%), single (66%), had an annual household income of less than \$10,000 (58%), and had no health insurance (68%). More than 30% of the enrolled patients did not have a high school diploma. Twenty-five percent of study participants had inadequate health literacy as defined by a REALM score equivalent to or below a sixth-grade reading level. Seventy percent of the enrolled patients had had a previous HIV test.

Bivariate analysis demonstrated that patients' HIV/AIDS knowledge score directly correlated with their REALM score ($P < .001$). The knowledge score was normally distributed with mean HIV/AIDS knowledge score significantly different between age categories ($P = .02$), income levels ($P = .005$), educational levels ($P = .001$), risk perception score tertile ($P < .001$), attitude score tertile ($P = .04$), and patients' health literacy level ($P < .001$). A Kruskal-Wallis test of the difference among the attitude score tertiles compared to knowledge score showed a nonsignificant trend ($P = .12$).

Older patients were more likely to have a knowledge score at or below the 25th percentile of the distribution ($\chi^2 = 8.88$, $P = .03$), as were patients with a lower literacy level ($\chi^2 = 11.1$, $P = .004$) and patients with low risk perception scores ($\chi^2 = 15.3$, $P < .001$). Patients with lower literacy levels were more likely to be African American ($\chi^2 = 6.62$, $P = .04$), have low annual household income ($\chi^2 = 8.67$, $P = .01$), and not have a high school diploma ($\chi^2 = 58.04$, $P < .001$).

Knowledge questions for which there was a significant difference in the proportion of correct answers among the three health literacy levels are shown in Table 2. There were also significant differences in risk perception items and attitudes and beliefs between patients with different levels of health literacy. Patients with higher literacy levels were more likely to have spoken to a friend about HIV/AIDS and more likely to trust printed materials about HIV/AIDS but less

likely to believe that the government is telling the truth about AIDS.

Multivariate analysis resulted in a final model of knowledge as a function of REALM score, income level, education level, and risk perception score. An ANOVA produced a P value of $< .001$ for the model, with an adjusted R^2 of 0.1354. REALM score was positively associated with knowledge (parameter coefficient [standard error] = 0.0352 [0.0093]), even when adjusted for income level, education level, and risk perception score. REALM score ($P < .001$) and risk perception score ($P < .001$) were the strongest predictors of HIV/AIDS knowledge in this model. The adjusted mean HIV/AIDS knowledge scores (95% confidence interval [CI]) were 14.42 [13.95, 14.90], 14.44 [13.93, 14.95], and 13.06 [12.43, 13.69] for patients with adequate, marginal, and inadequate health literacy levels, respectively. An ANACOVA showed a significantly different mean HIV/AIDS knowledge score among patients with inadequate health literacy levels (at or below the sixth-grade level) compared to those with marginal or adequate health literacy levels (multiple partial $F = 13.46$, $P < .001$), after adjustment for income level, education level, and risk perception score.

Discussion

Previous studies examining the relationship between HIV/AIDS knowledge and patients' health literacy have focused on the consequences of poor health literacy on HIV treatment adherence and subsequent disease outcomes among individuals already infected with HIV.^{24-26,32} Among persons who are not HIV-infected, there have been few studies that have examined health literacy's influence on HIV knowledge, risk, or HIV test-seeking behaviors. Recently, a study found that undergoing HIV testing is influenced by the level of health literacy,²⁷ and research involving patients with chronic diseases such as hypertension, diabetes, asthma, and congestive heart failure demonstrated a direct correlation between patients' health literacy and knowledge of their chronic disease.^{15,16,33} The results of our study are consistent with this previous research, showing that among patients from a population at high risk for HIV/AIDS, their knowledge of this infection is associated with their health literacy.

Misconceptions about HIV transmission were more common among patients with lower health literacy levels. For example, far fewer patients with an inadequate health literacy level, as compared to patients with a marginal or adequate health literacy level, knew that HIV is not transmitted through the use of public toilets. Although most patients, regardless of health literacy level, knew that HIV could be transmitted through vaginal sex without a condom, very few knew that the national blood supply is now screened and has been virtually free of HIV since the mid-1980s.³⁴⁻³⁶ This

Table 1
 Characteristics of Study Participants
 and Mean HIV/AIDS Knowledge Scores

Variable	n	%	Mean Knowledge Score (SD)*	P Value**
All Subjects	372	100	14.09 (±3.11)	—
Age (years)				
18–29	83	22	14.69 (±3.11)	.02***
30–39	123	33	14.41 (±2.84)	
40–49	108	29	13.75 (±3.04)	
50+	58	16	13.21 (±3.54)	
Race				
African American	350	94	14.04 (±3.05)	.20
Other	22	6	14.91 (±3.87)	
Gender				
Male	197	53	14.06 (±3.02)	.84
Female	175	47	14.13 (±3.21)	
Children				
Yes	258	69	14.05 (±2.89)	.68
No	114	31	14.19 (±3.56)	
Marital status				
Single	246	66	14.17 (±3.18)	.77
Married	51	14	13.78 (±3.07)	
Divorced	64	17	13.99 (±2.99)	
Widowed	11	3	14.64 (±2.38)	
Annual household income				
> \$10,000	157	42	14.62 (±2.91)	.005***
≤ \$10,000	215	58	13.70 (±3.20)	
Test Type				
Rapid	182	49	13.95 (±3.00)	.37
Standard	190	51	14.23 (±3.21)	
Accepted offered test				
Yes	200	54	14.21 (±3.06)	.43
No	172	46	13.95 (±3.16)	
Education				
≥ High school diploma	250	67	14.46 (±2.93)	.001***
< High school diploma	122	33	13.34 (±3.33)	
Insurance				
Private	46	12	14.22 (±2.50)	.49
Public	75	20	13.71 (±3.23)	
None	251	68	14.18 (±3.17)	
Previously tested for HIV				
Yes	260	70	14.27 (±3.04)	.10
No	112	30	13.69 (±3.24)	
Risk perception Tertile (range, median)				
1 (0–5, 4)	154	41	13.17 (±3.37)	<.001***
2 (6–7, 6)	111	30	14.74 (±2.80)	
3 (8–11, 8)	107	29	14.75 (±2.68)	
Attitudes and beliefs Tertile (range, median)				
1 (0–7, 6)	114	31	13.59 (±3.39)	.04***
2 (8–9, 9)	121	32	14.02 (±2.90)	
3 (10–13, 10)	137	37	14.58 (±2.98)	
Health literacy				
Inadequate (≤ 6th grade level)	92	25	12.71 (±3.11)	<.001***
Marginal (7th–8th grade level)	124	33	14.46 (±3.04)	
Adequate (≥ 9th grade level)	156	42	14.62 (±2.93)	

* Mean knowledge score is defined as the total number of HIV/AIDS test, transmission, and treatment questions answered correctly out of a total of 22 items. (Range: 2–22)

** P value is associated with an analysis of variance (ANOVA) comparing mean knowledge score among each variable's strata; *** denotes significance at $\alpha=0.05$.

represents a large gap in patients' HIV/AIDS knowledge that spans across all health literacy levels.

Attitudes and beliefs also differed among patients with inadequate, marginal, and adequate health literacy levels. Few patients, across all literacy levels, believed that the majority of those who are currently becoming infected in Atlanta are heterosexual; however, the percent that believed this to be true was only 4% among patients with an inadequate health literacy level versus 26% among patients with an adequate health literacy level. Although patients with an adequate literacy level were more likely to trust information received about HIV/AIDS from printed materials, they were much less likely to trust the government. This might be a function of patients with lower health literacy not having as much experience with printed materials and being less informed and hence having less reason to question authorities.⁹

The strong, positive association seen between patients' HIV/AIDS knowledge score and risk perception score should be explored further. Since the risk perception score is not a validated variable, however, no conclusions may be made about its association with HIV/AIDS knowledge. Future studies using methods such as factor analysis are warranted. The fact that 70% of the study participants reported having had a previous HIV test suggests that this population is perceived to be at increased risk for HIV infection by their health care providers. This study underscores the conclusion that populations such as this one with low health literacy should be offered literacy-appropriate interventions to increase HIV/AIDS knowledge, so that they may more readily identify risk-taking behaviors and make informed health decisions.^{9,27}

Limitations

The study has several limitations. The study participants were all

Table 2

HIV/AIDS Knowledge Items By Health Literacy Level (% Answering Correctly)

Questionnaire Item*	Literacy Level			χ^2	P Value**
	Inadequate	Marginal	Adequate		
HIV can be transmitted through vaginal sex without condoms.	97%	96%	100%	6.05	.05 ***
HIV cannot be transmitted through use of public toilets.	47%	73%	73%	21.18	<.001***
HIV cannot be transmitted through sweat.	55%	74%	65%	8.32	.02***
HIV cannot be transmitted through blood transfusions after 1985.	4%	10%	15%	6.53	.04***
Use of birth control pills cannot prevent people from getting the HIV/AIDS virus.	78%	92%	96%	21.75	<.001***
IUD use cannot prevent people from getting the HIV/AIDS virus.	41%	67%	77%	32.56	<.001***
Use of spermicidal gels cannot prevent people from getting the HIV/AIDS virus.	49%	67%	76%	19.45	<.001***
Not having sex can prevent people from getting the HIV/AIDS virus.	76%	82%	90%	8.34	.02***
There is no vaccine available that can keep people from getting AIDS.	49%	64%	71%	12.33	.002***

* The following HIV/AIDS Knowledge Questionnaire items did not significantly vary among health literacy levels:

HIV test knowledge

- How soon after contact with the AIDS virus can HIV tests tell that someone is infected with HIV?
- Is HIV testing always done when you are admitted to the hospital for surgery?
- Is HIV testing always done when a woman becomes pregnant?
- Is HIV testing always done when you go to the emergency room?
- Is HIV testing always done during your regular medical check-up?
- How often should people get an HIV test?

HIV transmission knowledge

- Can you get HIV from sharing needles?
- Can you get HIV from deep kissing?
- Can a pregnant woman who has the AIDS virus give it to her baby?
- Can a pregnant woman who has the AIDS virus do anything to keep the baby from catching it?
- Can condoms prevent people from getting the HIV/AIDS virus?

HIV treatment knowledge

- Are there medicines available that can keep people with HIV/AIDS from getting sick or dying?
- Is there a cure for HIV?

** P value is associated with a chi square test of proportions; *** denotes significance at $\alpha=0.05$.

HIV/AIDS—human immunodeficiency virus/acquired immunodeficiency syndrome

IUD—intrauterine device

volunteers who agreed to be interviewed after having been offered an HIV test at the UCC; this may have introduced participation bias if participants were more likely to enroll in the study because of a difference in HIV/AIDS knowledge level and health literacy level from nonparticipants. Many patients were not eligible for the study because they were not offered an HIV test by their providers during their visit to the UCC. Occasionally this was due to medical urgency or symptom severity, but mostly this was due to a provider only offering HIV tests based on risk. In the latter case, these patients may have been perceived by the provider as having a lower risk for HIV infection and may constitute a segment of the UCC patient population that was unintentionally excluded.

In summary, our results indicate that among the inner-city population of Atlanta that seeks care at a public hospital UCC, there is a relationship between level of HIV/AIDS knowledge and patients' health literacy level, even after adjusting for income level, education level, and risk perception. This finding is consistent with those found among HIV-infected patients, and reiterates the need to tailor HIV prevention strategies toward a population with a high prevalence of inadequate health literacy levels. Such a change could dispel misconceptions about HIV transmission and treatments that affect risk-taking behaviors and health care utilization.^{2,37} These strategies may ultimately contribute to lessening the effect of HIV/AIDS transmission in the United States.

Acknowledgment: This study was supported by cooperative agreement UR3/CCU416463 from the Centers for Disease Control and Prevention, Atlanta.

Corresponding Author: Address correspondence to Dr del Rio, Grady Memorial Hospital, Department of Medicine, Division of Infectious Diseases, Emory University, School of Medicine, Atlanta, GA 30303. 404-616-7025. Fax: 404-525-2957. cdelrio@emory.edu.

REFERENCES

1. Beckwith CG, Flanigan TP, del Rio C, et al. It is time to implement routine, not risk-based, HIV testing. *Clin Infect Dis* 2005;40(7):1037-40.
2. Centers for Disease Control and Prevention. Advancing HIV prevention: new strategies for a changing epidemic—United States, 2003. *MMWR* 2004;52(15):329-56.
3. Centers for Disease Control and Prevention. Revised guidelines for HIV counseling, testing, and referral. Draft. Atlanta: Centers for Disease Control and Prevention, October 17, 2000.
4. Nyamathi AM, Stein J, Swanson JM. Personal, cognitive, behavioral, and demographic predictors of HIV testing and sexually transmitted diseases in homeless women. *J Behav Med* 2000;23(2):123-47.
5. Solomon L, Landrigan J, Flynn C, Benjamin GC. Barriers to HIV testing and confidentiality: the concerns of HIV-positive and high-risk individuals. *AIDS Public Policy J* 1999;14(4):147-56.
6. Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, American Medical Association. Health literacy: report of the Council on Scientific Affairs. *JAMA* 1999;281:552-7.
7. Baker DW. Reading between the lines: deciphering the connections between literacy and health. *J Gen Intern Med* 1999;14(5):315-7.
8. Berkman ND, DeWalt DA, Pignone MP, et al. Literacy and health outcomes. Summary, evidence report/technology assessment no. 87 (Prepared by RTI International—University of North Carolina Evidence-based Practice Center). Publication no. 04-E007-1. Rockville, Md: Agency for Healthcare Research and Quality, January 2004.
9. Nielsen-Bohman L, Panzer AM, Kindig DA, eds. Health literacy: a prescription to end confusion. Institute of Medicine. Washington, DC: The National Academies Press, 2004.
10. Baker DW, Parker RM, Williams MV, Clark WS, Nurss J. The relationship of patient reading ability to self-reported health and the use of health services. *Am J Public Health* 1997;87(6):1027-30.
11. Davis TC, Crouch MA, Long SW, Jackson RH, Bates P, George RB. Rapid assessment of literacy levels of adult primary care patients. *Fam Med* 1991;23(6):433-5.
12. Davis T, Crouch M, Wills G, Miller S, Abdehou D. The gap between patient reading comprehension and the readability of patient education materials. *J Fam Pract* 1990;31:533-8.
13. Paasche-Orlow M, Parker RM, Gazmararian JA, et al. The prevalence of limited health literacy. *J Gen Intern Med* 2005;20:175-84.
14. Williams MV, Parker RM, Baker DW, et al. Inadequate functional health literacy among patients at two public hospitals. *JAMA* 1995;274(21):1677-82.
15. Williams MV, Baker DW, Honig EG, Lee TM, Nowlan A. Inadequate literacy is a barrier to asthma knowledge and self-care. *Chest* 1998;114(4):1008-15.
16. Williams MV, Baker DW, Parker RM, Nurss JR. Relationship of functional health literacy to patients' knowledge of their chronic disease: a study of patients with hypertension and diabetes. *Arch Intern Med* 1998;158(2):166-72.
17. Williams MV, Davis TC, Parker RM, Weiss BD. The role of health literacy in patient-physician communication. *Fam Med* 2002;34(5):383-9.
18. Bryant B, Malone R, Ayacue D, DeWalt DA, Pignone MP. The effect of literacy and anticoagulation knowledge on the adequacy of warfarin anticoagulation knowledge on the adequacy of warfarin anticoagulation for patients with atrial fibrillation. *J Gen Intern Med* 2003;18 (suppl 1):169.
19. Bennett CL, Ferreira MR, Davis TC, et al. Relation between literacy, race, and stage of presentation among low-income patients with prostate cancer. *J Clin Oncol* 1998;16:3101-4.
20. Schillinger D, Grumbach K, Piette J, et al. Association of health literacy with diabetes outcomes. *JAMA* 2002;288(4):475-82.
21. Baker DW, Parker RM, Williams MV, et al. Health literacy and the risk of hospital admission. *J Gen Intern Med* 1998;13(12):791-8.
22. Centers for Disease Control and Prevention. Routinely recommended HIV testing at an urgent-care clinic—Atlanta, Georgia, 2000. *MMWR* 2001;50(25):538-41.
23. Weiss BD, Hart G, et al. Health status of illiterate adults: relation between literacy and health status among persons with low literacy skills. *J Am Board Fam Pract* 1992;5(3):257-64.
24. Kalichman SC, Benotsch E, Suarez T, Catz S, Miller J, Rompa D. Health literacy and health-related knowledge among persons living with HIV/AIDS. *Am J Prev Med* 2000;18(4):325-31.
25. Kalichman SC, Rompa D. Functional health literacy is associated with health status and health-related knowledge in people living with HIV/AIDS. *J Acquir Immune Defic Syndr* 2000;25(4):337-44.
26. Kalichman SC, Ramachandran B, Catz S. Adherence to combination antiretroviral therapies in HIV patients of low health literacy. *J Gen Intern Med* 1999;14(5):267-73.
27. Barragan M, Hicks G, Williams MV, et al. Low health literacy is associated with HIV test acceptance. *J Gen Intern Med* 2005;20(5):422-5.
28. Davis TC, Long SW, Jackson RH, Mayeaux EJ, George RB, Murphy PW, Crouch MA. Rapid estimate of adult literacy in medicine: a shortened screening instrument. *Fam Med* 1993;25(6):391-5.
29. Kincaid J, Fishburn R Jr, Rogers R, Chissom B. Derivation of new readability formulas for Navy enlisted personnel. Millington, Tenn: Memphis Naval Air Station, 1975.
30. Hobfall SE, Jackson AP, Lavin J, et al. Reducing inner-city women's AIDS risk activities: a study of single, pregnant women. *Health Psychol* 1994;13(5):397-403.
31. Kaiser Family Foundation. National survey of African Americans on HIV/AIDS. Publication number 1372. Menlo Park, Calif: Kaiser Family Foundation, March 17, 1998.

32. Glynn JR, Carael M, Buve A, et al. Study Group on the Heterogeneity of HIV Epidemics in African Cities. Does increased general schooling protect against HIV infection? A study in four African cities. *Trop Med Int Health* 2004;9(1):4-14.
33. Gazmararian JA, Williams MV, Baker DW, Peel J. Health literacy and patient knowledge of chronic disease. *Patient Educ Couns* 2003;51:267-75.
34. van Servellen G, Carpio F, Lopez M, et al. Program to enhance health literacy and treatment adherence in low-income HIV-infected Latino men and women. *AIDS Patient Care STDS* 2003;17(11):581-4.
35. Richwald GA, Wansley MA, Coulson AH, et al. Are condom instructions readable? Results of a readability study. *Public Health Rep* 1988; 103:355-9.
36. Ebrahim SH, Anderson JE, Weidle P, Purcell DW. Race/ethnic disparities in HIV testing and knowledge about treatment for HIV/AIDS: United States, 2001. *AIDS Patient Care STDS* 2004;18(1):27-33.
37. Kellerman SE, Lehman JS, Lansky A, et al. HIV testing within at-risk populations in the United States and the reasons for seeking or avoiding HIV testing. *J Acquir Immune Defic Syndr* 2002;31(2):202-10.