Patterns and Correlates of Linkage to Appropriate HIV Care After HIV Diagnosis in the US Medicaid Population

Stephen S. Johnston, MA, Timothy Juday, PhD,† Daniel Seekins, MD,† Tony Hebden, PhD,† Nicole Fulcher, MA,* Amanda M. Farr, MPH,* Bong-Chul Chu, PhD,* and C. Daniel Mullins, PhD‡*

Background: Timely linkage to appropriate care after human immunodeficiency virus (HIV) diagnosis is critical to optimizing patient outcomes. Medicaid is the largest source of health care coverage for patients with HIV in the United States, yet no studies of linkage to appropriate HIV care have focused solely on the Medicaid population.

Methods: This is a retrospective study using Medicaid claims data from 15 states. Study sample comprised patients aged 18 to 64 years with 1 or more HIV tests between January 1, 2003, to May 1, 2010, followed or accompanied by HIV diagnosis. The "Test Index" corresponded to the HIV test that was temporally proximate to first HIV diagnosis. Study end point was linkage to appropriate HIV care, defined as receipt of CD4 and viral load tests as per US treatment guidelines. Time-to-event analyses characterized patterns and correlates of linkage to appropriate care.

Results: This study included 6684 patients, with a mean age of 35 years, 70% female, and 47% black race. Overall, 21.0% of patients linked to appropriate care within 1 year of the Test Index and 26.4% within 5 years. Compared with whites, blacks had a significantly shorter time to linkage to HIV appropriate care (hazard ratio, 2.034; $P < 0.001$).

Conclusions: These findings in Medicaid patients newly diagnosed with HIV contrast with prior research show disparities in access to HIV care favoring whites. Overall, the proportion of patients who linked to appropriate HIV care was very low given the availability of effective treatment, suggesting a need for more effective interventions promoting timely linkage to appropriate care after diagnosis.

The impact of morbidity and mortality among patients with human immunodeficiency virus (HIV) has been well documented.[1] Since the introduction of HIV antiretroviral therapy (ART), a large proportion of HIV-related morbidity, mortality, and reduced quality of life has become avoidable.[2] However, the social and clinical pathways through which HIV-infected individuals must travel to optimize clinical outcomes are often complex and characterized by barriers to testing, timely linkage, and retention in appropriate HIV care; comprehensive reviews of this process and the inherent complexities of engagement in HIV medical care have been presented elsewhere.[3–5]

For low-income individuals, barriers to appropriate HIV care can be particularly challenging, which is clearly of concern in the United States where most patients with HIV receiving care have low income.[6–9] Indeed, approximately 42% of patients with HIV receiving care have health insurance coverage through the means-tested (ie, subject to financial eligibility requirements) Medicaid program, making it the largest source of health insurance for patients with HIV in the United States.[10]

One of 3 primary goals of the Office of National AIDS Policy's National HIV/AIDS Strategy is to increase access to care and improve health outcomes for people living with HIV.[11] Two core pillars intended to achieve this goal are the implementation of the *Affordable Care Act*, which will expand Medicaid eligibility to all lower-income individuals younger than 65 years, and the establishment of a "seamless system to immediately link people to continuous and coordinated quality care when they learn they are infected with HIV."[11,12]

Information on the patterns and correlates of linkage is prerequisite to the design and implementation of policies and practices targeted toward better linkage of HIV-diagnosed individuals with appropriate HIV care. Although several studies have examined this, none have focused solely on the largest and soon-to-be expanded segment of the insured HIV population, namely, Medicaid beneficiaries. Therefore, the objective of this study was to examine patterns in the duration of time from HIV diagnosis until linkage to appropriate HIV care and the association between patients' characteristics and the probability of linkage to appropriate HIV care after HIV diagnosis in the US Medicaid population.

MATERIALS AND METHODS

Data

Study data were administrative health care claims extracted from the 2002 to 2010 years of the Truven Health MarketScan Multi-State Medicaid (Medicaid, Truven Health Analytics, Ann Arbor, Mich) Database. This database comprises data collected from a nonprobability sample of 15 geographically dispersed Medicaid states that vary in size and sociodemographic composition. During the study period, more than 23 million patients were represented in the Medicaid database. The Medicaid database includes covered inpatient medical, outpatient medical (including laboratory claims but not laboratory results) and outpatient pharmaceutical claims and encounter records, along with

From the *Truven Health Analytics, Washington, DC; †Bristol-Myers Squibb, Plainsboro, NJ; and ‡University of Maryland School of Pharmacy, Baltimore, MD

Supported by Bristol-Myers Squibb. Stephen Johnston, Nicole Fulcher, Amanda Farr, and Bong-Chul Chu are employees of Truven Health Analytics (formerly known as the Healthcare Business of Thomson Reuters), which was paid by Bristol-Myers Squibb to conduct this research. Timothy Juday, Daniel Seekins, and Tony Hebden are employees of Bristol-Myers Squibb. C. Daniel Mullins has received a consulting fee from Thomson Reuters; has served as a consultant to Amgen, Bayer, BMS, Celgene, GSK, Mitsubishi, Novartis, Novo Nordisk, and Pfizer; has received grants from Bayer and Pfizer; and has received payment for lectures including service on speakers bureaus from Celgene.

Correspondence: Stephen S. Johnston, MA, 4301 Connecticut Ave NW, Suite 330, Washington, DC 20008. E-mail: stephen.johnston@truvenhealth.com.

Received for publication April 9, 2012, and accepted August 20, 2012.
DOI: 10.1097/OLQ.0b013e3182782014

Copyright © 2012 American Sexually Transmitted Diseases Association
All rights reserved

Copyright © 2012 by the American Sexually Transmitted Diseases Association. Unauthorized reproduction of this article is prohibited.

patient enrollment records and demographic information such as age, sex, and race. Because of confidentiality agreements between Truven Health Analytics and the states that contribute data to the Medicaid database, further public disclosure of identifying information about the State Medicaid programs is restricted. The data contained in the Medicaid database are statistically deidentified and fully compliant with the Health Insurance Portability and Accountability Act Privacy Regulations; as such, institutional review board approval and written informed consent were not required for this study.

Study Sample Selection

Included patients were those aged 18 to 64 years with an HIV test claim between January 1, 2003, and May 1, 2010. Patients were required to have a claim with an *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) diagnosis code for HIV either on the same day as the HIV test or after the HIV test. The date of the HIV test that was temporally proximate to the first HIV diagnosis was designated as the "Test Index." Among patients whose HIV diagnosis followed the HIV test (as opposed to being on the same day), continuous insurance enrollment was required between the HIV test and the HIV diagnosis to ensure complete data capture. In addition, patients were required to have continuous insurance enrollment for at least 180 days before the Test Index in an attempt to ensure that all selected patients were newly diagnosed as having HIV.

Because the study focused on newly diagnosed patients with HIV, patients were excluded if, at any time before the Test Index, they had any HIV-related ART, any claims with an *ICD-9-CM* diagnosis code for HIV, or any CD4, HIV RNA viral load, or antiretroviral resistance testing.

Observation Period

The observation period comprised a baseline period and an evaluation period. The baseline period was used to measure patient characteristics such as demographics and comorbidities and comprised a fixed 180-day period ending on the day before the Test Index. The evaluation (follow-up) period was used to measure time to linkage to appropriate HIV care and comprised the variable-length period beginning on the Test Index and ending at linkage to appropriate HIV care or censoring at either disenrollment from Medicaid benefits or reaching the study end date of June 30, 2010. The Test Index, as opposed to HIV diagnosis, was chosen as the starting point for measuring time to linkage to appropriate HIV care because delays in collecting an HIV diagnosis may be considered part of a delay in linkage.

Study End points

The primary study end point was linkage to appropriate HIV care, which was defined as the receipt of CD4 and HIV RNA viral load testing during the evaluation period (henceforth referred to as the "standard definition"). This definition is based on guidelines from the US Department of Health and Human Services and the HIV Medicine Association of the Infectious Diseases Society of America, which stipulate that when a patient is linked to care, an appropriate baseline evaluation must include measurement of HIV RNA viral load and CD4 cell count to determine disease stage and indications for ART.[2,13] Patients who are not monitored through such testing are placed at risk for late initiation of ART. Late initiation of ART has been associated with poorer virologic response and higher mortality.[14] In addition, the Centers for Disease Control and Prevention have used records of CD4 and HIV RNA viral load testing as the basis to development of a nationally representative surveillance system to monitor delays in receiving HIV care.[15]

A more restrictive definition of linkage to appropriate HIV care was developed for the sensitivity analysis, which was receipt of CD4, HIV RNA viral load, and antiretroviral resistance testing during the evaluation period (henceforth referred to as the "restrictive definition"). During the study period, recommendations for the use of resistance testing were gradually adopted into the US treatment guidelines.[16]

Measured Correlates of Linkage to Appropriate HIV Care

We examined several variables as potential correlates of linkage to appropriate HIV care. Patient demographics, which are listed in Table 1, were ascertained from the database as recorded by the Medicaid system for administrative purposes.

Patient clinical characteristics, which are listed in Table 2, were ascertained from the database using health care service, drug, and diagnostic coding recorded by the Medicaid system for administrative purposes. Nosologists (medical coders) compiled all diagnosis and procedure coding used to measure patient clinical characteristics. Because a patient's general health status

TABLE 1. Patient Demographic Characteristics and Crude HRs for Time to Linkage to Appropriate HIV Care After Test Index (Standard Definition of Appropriate HIV Care)

	All Patients (n = 6864)	Crude HR*	*P*	95% CI
Age, mean (SD), y	35 (12.2)	1.002	0.374	0.998–1.006
Age group, n (%)				
18–34	3621 (53)	0.940	0.231	0.849–1.04
35–44	1546 (23)	1.147	0.021	1.021–1.29
45–54	1171 (17)	1.005	0.937	0.88–1.148
55–64	526 (8)	0.858	0.146	0.699–1.054
Sex, n (%)				
Male	2091 (30)	1.082	0.155	0.971–1.207
Female	4773 (70%)	0.924	0.155	0.828–1.03
Race, n (%)				
White	1657 (24)	0.608	<0.001	0.53–0.697
Black	3224 (47)	3.001	<0.001	2.682–3.357
Hispanic	841 (12)	0.318	<0.001	0.249–0.407
Other†	152 (2)	0.393	<0.001	0.233–0.663
Unknown	990 (14)	0.416	<0.001	0.34–0.51
Has ≥1 child covered under policy‡, n (%)	1832 (27)	1.455	<0.001	1.309–1.619
Capitation§, n (%)	3608 (53)	0.740	<0.001	0.669–0.82
Test Index year, n (%)				
2003	1567 (23)	0.851	0.011	0.751–0.963
2004	1388 (20)	1.090	0.164	0.966–1.231
2005	1318 (19)	1.024	0.726	0.898–1.167
2006	567 (8)	1.346	<0.001	1.142–1.586
2007	554 (8)	0.971	0.754	0.805–1.17
2008	573 (8)	1.016	0.866	0.845–1.221
2009	753 (11)	0.874	0.139	0.731–1.045
2010	144 (2)	0.886	0.561	0.589–1.333
Diagnosed as having HIV in inpatient setting	1409 (21)	1.670	<0.001	1.493–1.867

*Hazard ratios greater than 1 indicate that the characteristic is associated with a shorter time to linkage to appropriate HIV care after Test Index.

†Asian, Native American, Pacific Islander.

‡Indicator for whether the patient had at least 1 child (<18 years of age) covered under the patient's same Medicaid benefits policy.

§Indicator for whether the patient was a member of a health plan with capitated (vs. fee-for-service) payment arrangements.

CI indicates confidence interval; HR, hazard ratio.

Copyright © 2012 by the American Sexually Transmitted Diseases Association. Unauthorized reproduction of this article is prohibited.

TABLE 2. Patient Clinical Characteristics and Crude HRs for Time to Linkage to Appropriate HIV Care After Test Index (Standard Definition of Appropriate HIV Care)

	All Patients (n = 6864)	Crude HR*	*P* Value	95% CI
Indices of overall health and linkage to the health care system				
Count of unique 3-digit *ICD-9-CM*				
Mean (SD)	6.6 (7.0)	0.993	0.056	0.986–1
Median	5			
Count of unique NDCs				
Mean (SD)	7.0 (7.5)	0.984	<0.001	0.977–0.991
Median	5			
Count of claims for outpatient services				
Mean (SD)	30.5 (47.9)	0.997	<0.001	0.996–0.999
Median	17			
Total baseline health care expenditures				
Mean (SD)	$5249 ($15,108)	1.000	<0.001	1–1
Median	$1,060			
Baseline outpatient office visit, n (%)†	4730 (68.9)	0.857	0.005	0.77–0.954
Sexually transmitted infections, n (%)				
Gonorrhea	31 (0.5)	1.105	0.792	0.524–2.33
Syphilis	16 (0.2)	0.534	0.363	0.138–2.065
Chlamydial infection	21 (0.3)	0.893	0.815	0.345–2.311
Herpes simplex	105 (1.5)	1.422	0.050	1.001–2.021
Genital warts	28 (0.4)	1.792	0.071	0.951–3.377
Other venereal diseases	53 (0.8)	0.656	0.232	0.329–1.309
Clinical indicators for HIV, n (%)				
Oral infection	24 (0.3)	1.877	0.068	0.955–3.69
Unexplained fever	246 (3.6)	1.976	<0.001	1.596–2.447
Herpes zoster	57 (0.8)	3.709	<0.001	2.713–5.071
Seborrheic dermatitis	21 (0.3)	1.693	0.156	0.818–3.503
Night sweats	10 (0.1)	1.388	0.579	0.435–4.428
Unexplained weight loss	107 (1.6)	1.680	0.002	1.209–2.334
Lymphadenopathy	100 (1.5)	4.035	<0.001	3.262–4.991
Comorbid conditions, n (%)				
Hepatitis B	41 (0.6)	0.648	0.297	0.287–1.464
Hepatitis C	240 (3.5)	0.449	<0.001	0.304–0.661
Alcohol disorders	122 (1.8)	1.141	0.475	0.795–1.636
Drug dependence	211 (3.1)	0.776	0.125	0.562–1.073
Nondependent abuse of drugs	632 (9.2)	1.158	0.079	0.983–1.364
Drug-induced mental disorders	48 (0.7)	0.436	0.063	0.182–1.048
Depression	782 (11.4)	0.724	<0.001	0.605–0.865
Other mental disorders	1351 (19.7)	0.696	<0.001	0.605–0.801
Cognitive impairment	0 (0.0)	NA	NA	NA
Conditions associated with low CD-4 count, n (%)				
Atypical mycobacterium pulmonary infection	1 (0.0)	<0.001	<0.001	0–0
Septicemia	52 (0.8)	0.619	0.201	0.297–1.291
Intestinal infectious diseases	4 (0.1)	<0.001	<0.001	0–0
Meningitis	5 (0.1)	0.947	0.956	0.14–6.434
Renal diseases	178 (2.6)	0.429	0.001	0.266–0.692
Other retinopathy	10 (0.1)	1.375	0.547	0.488–3.876
lntracranial abscess	0 (0.0)	NA	NA	NA
Microsporidiosis	0 (0.0)	NA	NA	NA
Molluscum contagiosum	2 (0.0)	<0.001	<0.001	0–0

*Hazard ratios greater than 1 indicate that the characteristic is associated with a shorter time to linkage to appropriate HIV care after Test Index.
†An outpatient office visit is defined as a visit to any office-based outpatient provider, regardless of specialty
CI indicates confidence interval; HR, hazard ratio; NA, not available; NDC, National Drug Code.

and prior general linkage to the health care system may play an important role in their probability and time to linkage to appropriate HIV care, we measured several claims-based proxies of these characteristics within the baseline period. We also measured several other clinical variables that were hypothesized to be correlated with linkage to appropriate HIV care, including indicators for specific sexually transmitted infections that are known to be HIV risk factors[17]; indicators for documented clinical indicators of possible HIV infection[17]; indicators for comorbidities and co-occurring disorders associated with lower likelihood of receipt of ART[18–21]; and indicators for conditions associated with low CD4 count.[22]

Statistical Analyses

The Kaplan-Meier product-limit method[23] of survival analysis was used to visually depict the distribution of time to linkage to appropriate HIV care or censoring at either disenrollment from Medicaid benefits or reaching the study end date of June 30, 2010.

Copyright © 2012 by the American Sexually Transmitted Diseases Association. Unauthorized reproduction of this article is prohibited.

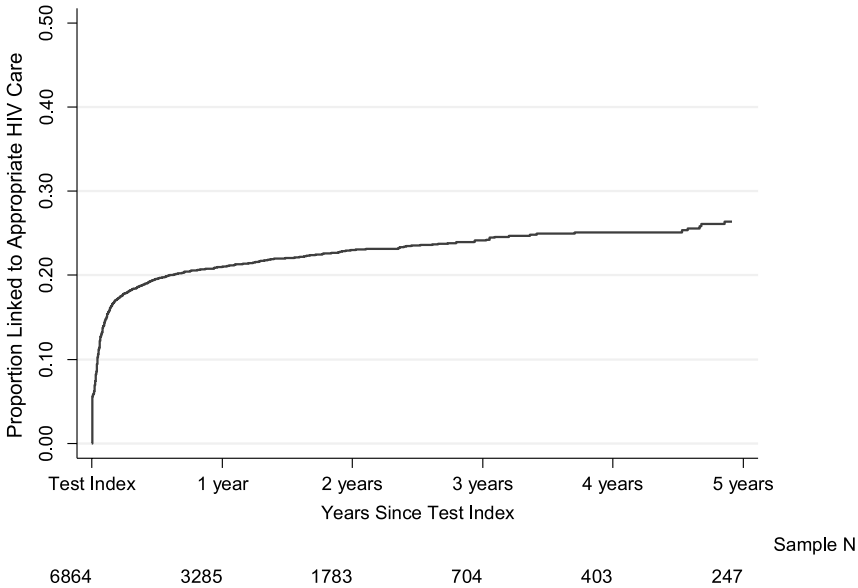

Figure 1. Kaplan-Meier plot of time to linkage to appropriate HIV care (standard definition of appropriate HIV care).

Multivariable Cox proportional hazards regressions were used to characterize the association between patient characteristics and time to linkage to appropriate HIV care after the Test Index (standard and restrictive definitions separately). These models expressed the time to linkage to appropriate HIV care after the Test Index as a function of all measured patient demographics, indicators for State Medicaid programs, and a subset of the measured patient clinical characteristics. Variables were included in the model if they had a bivariate association ($P < 0.10$ for crude hazard ratio) with time to linkage to appropriate HIV care or if they were thought to be theoretically critical to the model specification regardless of the statistical significance of their bivariate association (e.g., sex). Certain variables that were conceptually similar (e.g., clinical indicators for HIV) were combined into single composite measures. Variables that were statistically significant but had very low counts (e.g., atypical mycobacterium pulmonary infection, which was diagnosed in only 1 patient) were not included in the models. The Schoenfeld test was used to verify that all variables met the proportionality assumption of the Cox proportional hazard modeling approach.

RESULTS

Study Sample

From a total of 25,706,831 patients in the Medicaid database for the period spanning January 1, 2003, to May 1, 2010, 6% (1,540,361 patients) had at least 1 HIV test. Of these, 14,045

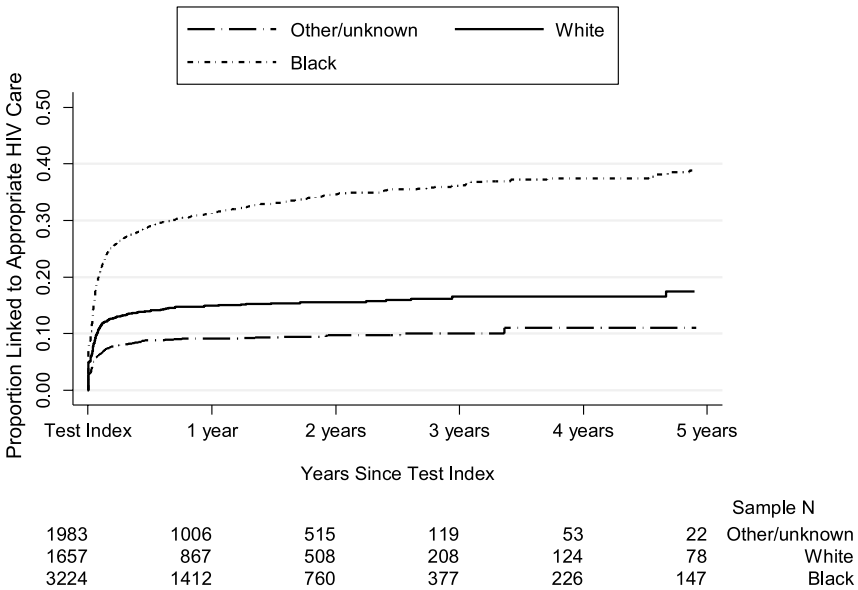

Figure 2. Kaplan-Meier plot of time to linkage to appropriate HIV care, stratified by race (standard definition of appropriate HIV care).

Copyright © 2012 by the American Sexually Transmitted Diseases Association. Unauthorized reproduction of this article is prohibited.

TABLE 3. Cox Proportional Hazards Regressions for the Time to Linkage to Appropriate HIV Care After Test Index (Standard and Restrictive Definitions of Appropriate HIV Care)

	Time to Linkage to HIV Appropriate HIV Care After Test Index (Standard Definition)			Time to Linkage to HIV Appropriate HIV Care After Test Index (Restrictive Definition)		
	HR	*P*	95% CI	HR	*P*	95% CI
Male (vs. female)*	1.700	0.002	1.212–2.386	1.452	0.138	0.887–2.375
Age*	1.013	0.000	1.007–1.019	1.007	0.119	0.998–1.016
Male † Age	0.988	0.006	0.980–0.997	0.989	0.093	0.977–1.002
Black (vs. white)	2.034	0.000	1.751–2.363	2.675	0.000	2.092–3.421
Hispanic	0.803	0.159	0.591–1.090	1.034	0.918	0.544–1.969
Other race	0.621	0.076	0.367–1.051	0.929	0.870	0.386–2.237
Missing race	1.002	0.991	0.709–1.417	1.166	0.570	0.686–1.982
Index year: 2003 (vs. 2009/2010)	1.202	0.086	0.974–1.483	0.699	0.019	0.519–0.943
Index year: 2004	1.225	0.054	0.996–1.505	0.715	0.022	0.538–0.952
Index year: 2005	1.234	0.045	1.004–1.516	0.765	0.071	0.572–1.024
Index year: 2006	1.243	0.059	0.992–1.556	0.985	0.921	0.736–1.320
Index year: 2007	1.153	0.248	0.906–1.467	1.072	0.648	0.796–1.442
Index year: 2008	1.169	0.197	0.922–1.483	1.012	0.936	0.753–1.361
Diagnosed with HIV in inpatient setting	1.360	0.000	1.195–1.548	1.133	0.202	0.936–1.371
≥1 child covered under policy (vs. no child)	0.994	0.933	0.868–1.138	0.918	0.393	0.755–1.117
Capitation (vs. not)	0.890	0.111	0.771–1.027	1.043	0.695	0.844–1.289
Baseline diagnosis of herpes simplex	1.280	0.186	0.888–1.845	1.044	0.885	0.584–1.865
Baseline diagnosis of genital warts	1.608	0.134	0.864–2.995	2.233	0.050	1.000–4.986
Baseline diagnosis of any clinical indicator for HIV	2.190	0.000	1.878–2.554	2.244	0.000	1.781–2.826
Baseline diagnosis of hepatitis B or C	0.546	0.001	0.380–0.784	0.708	0.192	0.421–1.190
Baseline diagnosis of alcohol and drug disorders	1.214	0.027	1.022–1.441	1.134	0.358	0.867–1.484
Baseline diagnosis of depression	0.855	0.119	0.702–1.041	0.938	0.671	0.699–1.260
Baseline diagnosis of other mental disorders	0.759	0.001	0.650–0.887	0.922	0.498	0.728–1.167
Baseline diagnosis of renal diseases	0.465	0.003	0.279–0.776	0.355	0.022	0.146–0.864
Baseline number of unique 3 digit *ICD-9-CM*	1.007	0.339	0.993–1.021	0.999	0.921	0.980–1.018
Baseline number of unique NDCs	0.988	0.024	0.978–0.998	0.995	0.526	0.981–1.010
Baseline total health care expenditures	1.000	0.002	1.000–1.000	1.000	0.216	1.000–1.000
Baseline outpatient office visit	0.839	0.004	0.745–0.946	0.790	0.012	0.657–0.950
Urban residence (vs. rural), output redacted*	x	x	x	x	x	x
Medicaid state indicators, output redacted*	x	x	x	x	x	x
Observations	6864			6864		
No. patients linking to appropriate HIV care	1473			647		

*The interpretation of these hazard ratios is as follows: the hazard of linkage to appropriate HIV care after the Test Index is 70% higher in males than in females when age is 0. With each additional year of age in females, the hazard of linkage to appropriate HIV care after the Test Index increases by 1.3%, whereas in males, it decreases by 1.2%.

CI indicates confidence interval; HR, hazard ratio; NDC, National Drug Code.

†Redacted state and urban residence indicators were adjusted for in the multivariable analyses but not displayed in accordance with confidentiality agreement. Within the multivariable regressions, multicollinearity of the independent variables was tested by calculating the variance inflation factor—no evidence of substantive multicollinearity was detected in the models. The Schoenfeld test was used to verify that all variables met the proportionality assumption of the Cox proportional hazard modeling approach.

had an HIV diagnosis after HIV testing, and of these, 2688 were not aged 18 to 64 years at the time of the Test Index and a further 3745 did not have at least 180 days of continuous enrollment before the Test Index. In addition, 199 patients had claims for HIV-related ART before the Test Index, and a further 323 had an HIV diagnosis before the Test Index. Among the remaining patients, 189 did not have continuous enrollment between the Test Index and HIV diagnosis. Finally, an additional 57 patients had CD4, HIV RNA viral load, or antiretroviral resistance testing before the Test Index. Ultimately, the total study sample comprised 6864 patients.

Time to Linkage to Appropriate HIV Care

Among all newly diagnosed patients with HIV meeting the study selection criteria, regardless of whether they linked to appropriate HIV care, the mean (median) duration of data available for observation was 653 (521) days. A total of 4179 (60.9%) patients had an HIV diagnosis on the same day as their Test Index, and 443 (an additional 6.5%) had an HIV diagnosis the next day. The 50th, 75th, 90th, and 95th percentiles of the distribution of time from the Test Index to the HIV diagnosis were 0, 14, 130, and 367 days, respectively.

Figure 1 displays the Kaplan-Meier plot of the time to linkage to appropriate HIV care (standard definition) for all patients combined. Most patients who linked to appropriate HIV care did so within the first 3 months after the Test Index. The 1-year Kaplan-Meier estimated probability of linkage to appropriate HIV care (standard definition) was 21.0%, increasing to 26.4% after 5 years. Using the restrictive definition (data not shown), most patients who linked to appropriate HIV care also did so within the first 3 months after the Test Index, with the 1-year Kaplan-Meier estimated probability of linkage to appropriate HIV care being 9.2%, increasing slightly to 11.5% after 5 years.

Correlates of Linkage to Appropriate HIV Care

Table 1 displays patients' demographic characteristics. Compared with other racial/ethnic categories, blacks had substantially

Copyright © 2012 by the American Sexually Transmitted Diseases Association. Unauthorized reproduction of this article is prohibited.

shorter times to linkage to appropriate HIV care. Figure 2 displays the Kaplan-Meier plot of time to linkage to appropriate HIV care (standard definition), stratified by race. The Kaplan-Meier estimated probabilities of patients linked to appropriate HIV care within 3 months after the Test Index were 26.3% black, 13.0% white, 6.8% Hispanic, and 8.8% other/unknown race/ethnicity patients.

Table 2 displays patient clinical characteristics. Patients with clinical indicators for HIV had shorter times to linkage to appropriate HIV care (with varying levels of statistical significance), whereas patients with "other" mental disorders had longer times to linkage to appropriate HIV care.

Table 3 displays the results of the multivariable Cox regressions. When examining the standard definition of time to linkage to appropriate HIV care, the demographic factors that were most strongly associated with shorter time to linkage were black race (vs. white race) and male sex. The clinical factor that was most strongly associated with shorter times to linkage was having a diagnosis of any clinical indicator for HIV. The clinical factors that were most strongly associated with longer times to linkage were having a diagnosis of hepatitis B or C, a diagnosis of renal disease (although this was very rare), a diagnosis of other mental disorders or a baseline outpatient office visit.

When examining the restrictive definition of time to linkage to appropriate HIV care, results were generally consistent with the findings from the model using the standard definition. The time to linkage became increasing lower as the test index occurred in earlier years, likely a reflection of the restrictive definition of linkage to appropriate HIV care being adopted into clinical practice over time.

DISCUSSION

This is the first study of linkage to appropriate HIV care that has focused solely on the Medicaid population. Depending on the operational definition of appropriate HIV care, time to event analyses indicate that 1 in 10 to 2 in 10 patients linked to appropriate care within 1 year of the Test Index, with most of those doing so within the first 3 months after the Test Index.

In a prior study of data from the years spanning 2000 to 2004, Centers for Disease Control and Prevention researchers found that 28% of respondents self-reported delayed entry to HIV care, which was defined as self-reported care entry greater than 3 months after HIV diagnosis.[24] The comparatively higher proportion of individuals who were not linked to care within 3 months of the Test Index in the present study (approximately 80%) may be explained by our inclusion of patients who may have never linked to appropriate care. Given that the Centers for Disease Control and Prevention researchers recruited their study subjects largely from among HIV care facilities and 99% of their sample reported having previously entered HIV medical care at the time of the interview, the lack of patients who had not linked to appropriate care would have resulted in underestimation of the time to linkage to appropriate HIV care.

Because prior research has generally shown disparities in access to HIV care favoring whites, the finding that black race (vs. white race) was strongly associated with a higher odds of linkage to appropriate HIV care was unexpected. We conducted several investigations of the study data to test this finding's robustness to alternative analytical circumstances. First, we tested whether this finding varied across states by fitting state-specific Cox proportional hazards models. Second, we fit 10 separate Cox proportional hazards models, chosen based on variables that differed significantly across individuals with black race/ethnicity versus all other races/ethnicities. The goal of these sensitivity analysis models was to examine whether the race or other findings would differ in various subgroups. These models were fit in the following subgroups: males, females, patients with at least 1 child covered under their policy, patients with no children covered under their policy, patients in age group 18 to 34 years, patients not in age group 18 to 34 years, patients with other mental disorders, patients without other mental disorders, patients in urban locations, and patients in rural locations. All sensitivity analyses yielded results that were consistent with the main study findings in terms of the direction, magnitude, and statistical significance of the hazard ratios for each variable.

We hypothesize that the unexpected race finding is due to our examining a low-income, socioeconomically homogenous sample in which everyone possessed health care coverage and was already linked into the general health care system in that they had been diagnosed as having HIV. Although prior research has generally shown disparities in access to HIV care favoring whites, lack of health insurance, low income, and poor access to appropriate medical care have been suggested as strong drivers of racial disparities.[6–8] In addition, the observed results reflect access to care among diagnosed patients. Unobserved or unmeasured differences in the severity of HIV at the time of diagnosis across Medicaid patients of different races could partially explain our race findings.

Other findings including the positive association between linkage and clinical indicators for HIV, which may indicate symptomatic disease, the positive association between linkage and male sex, and the negative association between linkage and having a diagnosis for mental illness, were in line with our expectations and prior research.[18,25–27] However, the finding of a negative association between linkage and having had a baseline outpatient office visit was unexpected. We defined an outpatient office visit as a visit to any office-based outpatient provider, regardless of specialty. We hypothesize that the unexpected finding may have to do with patients who have competing health demands being less likely to seek medical attention for their HIV, which may especially be the case if their other conditions are symptomatic. In a prior qualitative study, patients who were diagnosed by non-HIV specialty physicians reported being overwhelmed and fearful of their disease.[28] Although our outpatient office visit definition does not directly reflect the phenomenon reported within the qualitative study, it is possible that some patients in the present study had similar experiences.

The requirement that patients have continuous insurance enrollment for at least 180 days before the Test Index was applied in an attempt to ensure that all selected patients were newly diagnosed as having HIV. This requirement, however, may have eliminated from the sample patients who could have differed systematically from the studied sample. For example, patients within the studied sample may be healthier overall and therefore less likely to link to appropriate HIV care after diagnosis. To address this potential bias, we reconstructed the sample using all inclusion and exclusion criteria, except the one requiring the 180 days of continuous insurance enrollment before the test index. Although refitting the multivariable Cox proportional hazards models using this expanded sample was not possible because the sample included patients who lacked the full baseline period during which correlates were measured, we reestimated the Kaplan-Meier estimators for the standard and restrictive definitions of time to linkage to appropriate HIV care. The Kaplan-Meier estimated probability of linkage to appropriate HIV care (standard definition) was 25.5% at 1 year and 30.3%; these were slightly higher than the primary analysis findings of 21.0% at 1 year and 26.4% after 5 years. The

Copyright © 2012 by the American Sexually Transmitted Diseases Association. Unauthorized reproduction of this article is prohibited.

Kaplan-Meier estimated probability of linkage to appropriate HIV care (restrictive definition) was 10.5% at 1 year and 12.4%; these were slightly higher than the primary analysis findings of 9.2% at 1 year and 11.5% after 5 years.

This study had analytical limitations. First, administrative claims data are not primarily collected for research purposes and are subject to coding error, which could result in misclassifying patients' HIV status. The likelihood of such error would be directly related to a whether a health care provider would accidentally record a diagnosis of HIV when a patient does not indeed have HIV or fail to record a diagnosis of HIV when the patient does indeed have HIV. Although Medicaid administrative claims data have formed the basis of numerous epidemiologic studies and are thought to possess sufficient validity for such research, we are not able to quantify the exact likelihood of such coding error within the present study. Furthermore, claims data sets reflect those who are diagnosed as having a disease, and there may be considerable underdetection of HIV among Medicaid enrolled individuals. Second, although patients with evidence of HIV infection any time before the Test Index were eliminated, it is possible that patients may have had such evidence during a period not covered by their enrollment and therefore may have been misclassified. Third, the study database comprises a nonprobability sample of 15 Medicaid States and therefore may not be generalizable to non-Medicaid individuals or the entire US Medicaid population. In addition, because of confidentiality agreements, we were unable to describe and explore specific aspects of state-level HIV coverage policies and linkage programs. Fourth, the study database does not include several important factors that could affect the likelihood of linkage to appropriate HIV care, including the level of community support for patients with HIV, clinic and provider characteristics, and information on other cultural factors. Although this information would not be likely to change our finding that the proportion of patients who link to appropriate HIV care is suboptimal, it could confound our estimates of the odds ratios in the multivariable logistic regressions. Fifth, the exclusion of 189 patients (2.8% of the final sample) who did not have continuous enrollment between the Test Index and HIV diagnosis resulted in a sample of individuals who were more likely to retain insurance coverage. Such patients may have better access to care. Consequently, the impact of this exclusion may have been to modestly increase our estimates of the overall probability of linkage to appropriate HIV care. Finally, the database would not have captured HIV testing or care provided outside the Medicaid system. Although, it seems somewhat unlikely that any large proportion of patients with HIV with Medicaid insurance coverage would not use their health insurance benefits to seek medical attention for their HIV, it is possible that some patients may have tested positive for HIV outside the Medicaid system and then received a first diagnosis within the Medicaid system. These patients would not have been included within the present study sample because we would not have observed their HIV test. Although it is plausible that patients who are diagnosed outside the Medicaid system would be retested upon entry into the Medicaid system, this cannot be confirmed within the present study and the impact of this potential limitation is unknown.

This study's primary analytical strengths were its large sample size and anonymous observation of the linkages to appropriate HIV care. Survey-based methods that ask participants to self-report their behaviors can be subject to social desirability biases where patients who perceive that a given behavior is more socially desirable are then more likely to erroneously report such behavior.[29]

Aims for future research include further elucidating the drivers of poor linkage to appropriate HIV care, which would help to inform the design of more effective linkage interventions. Studies that examine whether persons who had linked to appropriate HIV care late were seen by other health care providers before linkage may help to quantify the extent to which linkage opportunities are missed in routine practice. In addition, future Medicaid-based research that examines the patterns and correlates of retention within appropriate HIV care, as well as timely initiation of ART, would be useful to better understand the continuum of HIV engagement in this important segment of the US HIV population.[3]

In conclusion, this study's findings contrast with prior research showing disparities in access to HIV care favoring whites. Furthermore, it was observed that across all races, the proportion of patients who linked to appropriate HIV care was very low given the availability of effective treatment, suggesting the need for more effective interventions promoting timely linkage to appropriate HIV care after diagnosis.[3]

REFERENCES

1. CDC. HIV surveillance—United States, 1981–2008. MMWR Morb Mortal Wkly Rep 2011; 60:689–693.
2. US Department of Health and Human Services. Panel on Antiretroviral Guidelines for Adults and Adolescents. Guidelines for the use of antiretroviral agents in HIV-1–infected adults and adolescents. October 14, 2011;1–167. Available at: http://www.aidsinfo.nih.gov/ContentFiles/AdultandAdolescentGL.pdf. Accessed February 3, 2012.
3. Mugavero MJ, Norton WE, Saag MS. Health care system and policy factors influencing engagement in HIV medical care: Piecing together the fragments of a fractured health care delivery system. Clin Infect Dis 2011; 52(suppl 2):S238–S246.
4. Tobias C, Cunningham WE, Cunningham CO, et al. Making the connection: The importance of engagement and retention in HIV medical care. AIDS Patient Care STDS 2007; 21(suppl 1):S3–S8.
5. Mayer KH. Introduction: Linkage, engagement, and retention in HIV care: Essential for optimal individual- and community-level outcomes in the era of highly active antiretroviral therapy. Clin Infect Dis 2011; 52(suppl 2):S205–S207.
6. RAND Health. Disparities in Care for HIV Patients. Results of the-HCSUS Study. Available at: http://www.rand.org/pubs/research_briefs/2006/RAND_RB9171.pdf. Accessed February 17, 2012.
7. Krawczyk CS, Funkhouser E, Kilby JM, et al. Delayed access to HIV diagnosis and care: Special concerns for the Southern United States. AIDS Care 2006; 18(suppl 1):S35–S44.
8. Moore RD. Epidemiology of HIV infection in the United States: Implications for linkage to care. Clin Infect Dis 2011; 52(suppl 2): S208–S213.
9. Kates J, Levi J. Insurance coverage and access to HIV testing and treatment: Considerations for individuals at risk for infection and for those with undiagnosed infection. Clin Infect Dis 2007; 45(suppl 4): S255–S260.
10. Bozzette SA, Berry SH, Duan N, et al The care of HIV-infected adults in the United States. New Engl J Med 1998; 339:1897–1904.
11. The White House Office of National AIDS Policy. National HIV/AIDS Strategy for the United States. Available at: http://www.whitehouse.gov/sites/default/files/uploads/NHAS.pdf. Accessed February 16, 2012.
12. Pub.L. 111–148, 124 Stat. 119, to be codified as amended at scattered sections of the Internal Revenue Code and in 42 U.S.C.
13. Aberg JA, Gallant JE, Anderson J, et al. Primary care guidelines for the management of persons infected with human immunodeficiency virus: 2009 update by the HIV medicine Association of the Infectious Diseases Society of America. Clin Infect Dis 2009; 49: 651–681.
14. Rodríguez-Arenas MA, Jarrín I, del Amo J, et al. Delay in the initiation of HAART, poorer virological response, and higher mortality among HIV-infected injecting drug users in Spain. AIDS Res Hum Retroviruses 2006; 22:715–723.

Copyright © 2012 by the American Sexually Transmitted Diseases Association. Unauthorized reproduction of this article is prohibited.

15. Fagan JL, Bertolli J, McNaghten AD. Understanding people who have never received HIV medical care: A population-based approach. Public Health Rep 2010; 125:520–527.
16. U.S. Department of Health and Human Services. Panel on Antiretroviral Guidelines for Adults and Adolescents. Archived guidelines for the use of antiretroviral agents in HIV-1–infected Adults and Adolescents. Available at: http://www.aidsinfo.nih.gov/guidelines/archive/adult-and-adolescent-guidelines/. Accessed February 3, 2012.
17. Klein D, Hurley LB, Merrill D, et al. Review of medical encounters in the 5 years before a diagnosis of HIV-1 infection: Implications for early detection. J Acquir Immune Defic Syndr 2003; 32:143–152.
18. Tucker JS, Burnam MA, Sherbourne CD, et al. Substance use and mental health correlates of nonadherence to antiretroviral medications in a sample of patients with human immunodeficiency virus infection. Am J Med 2003; 114:573–580.
19. Herrmann S, McKinnon E, John M, et al. Evidence-based, multifactorial approach to addressing non-adherence to antiretroviral therapy and improving standards of care. Intern Med J 2008; 38:8–15.
20. Sherr L, Lampe F, Norwood S, et al Adherence to antiretroviral treatment in patients with HIV in the UK: A study of complexity. AIDS Care 2008; 20:442–448.
21. Lovejoy TI, Suhr JA. The relationship between neuropsychological functioning and HAART adherence in HIV-positive adults: A systematic review. J Behav Med 2009; 32:389–405.
22. Walkup JT, Wei W, Sambamoorthi U, et al. Sensitivity of an AIDS case-finding algorithm: Who are we missing? Med Care 2004; 42: 756–763.
23. Kaplan EL, Meier P. Nonparametric estimation from incomplete observations. J Am Stat Assoc 1958; 53:457–481.
24. Reed JB, Hanson D, McNaghten AD, et al. HIV testing factors associated with delayed entry into HIV medical care among HIV-infected persons from eighteen states, United States, 2000–2004. AIDS Patient Care STDS 2009; 23:765–773.
25. Goldman DP, Bao Y. Effective HIV treatment and employment. Health Serv Res 2004; 39:1691–1712.
26. Chander G, Himelhoch S, Moore RD. Substance abuse and psychiatric disorders in HIV-positive patients: Epidemiology and impact on antiretroviral therapy. Drugs 2006; 66:769–789.
27. Aziz M, Smith KY. Challenges and successes in linking HIV-infected women to care in the United States. Clin Infect Dis 2011; 52(suppl 2): S231–S237.
28. McCoy SI, Miller WC, MacDonald PD, et al. Barriers and facilitators to HIV testing and linkage to primary care: Narratives of people with advanced HIV in the Southeast. AIDS Care 2009; 21:1313–1320.
29. Catania JA, Gibson DR, Chitwood DD, et al. Methodological problems in AIDS behavioral research: Influences on measurement error and participation bias in studies of sexual behavior. Psychol Bull 1990; 108:339–362.
30. Mugavero MJ, Norton WE, Saag MS. Health care system and policy factors influencing engagement in HIV medical care: Piecing together the fragments of a fractured health care delivery system. Clin Infect Dis 2011; 52(suppl 2):S238–S246.

Copyright © 2012 by the American Sexually Transmitted Diseases Association. Unauthorized reproduction of this article is prohibited.