Patterns and Correlates of Linkage to Appropriate HIV Care Following HIV Diagnosis in the United States Medicaid Population

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INTRODUCTION

- Timely linkage to appropriate care after HIV diagnosis is critical for optimizing patient outcomes[1].
- A key goal of the US National HIV/AIDS Strategy is to develop a "seamless system to immediately link people to continuous and coordinated quality care when they learn they are infected with HIV"[2].
- Information on the patterns and correlates of linkage is prerequisite to the development of optimal linkage policies.
- While several studies have investigated these issues, none have focused solely on Medicaid beneficiaries—the largest segment of the insured HIV population, which will grow even larger under the Affordable Care Act[3].
- This study examined patterns and correlates of linkage to appropriate HIV care following HIV diagnosis in the US Medicaid population.

METHODS

Data Source

- This study's data were de-identified Medicaid administrative healthcare claims extracted from the 2002–2010 Truven Health MarketScan® Multi-State Medicaid Database.
- This database comprises inpatient medical, outpatient medical, and outpatient prescription claims and encounter records collected from among 15 geographically dispersed states in the US that vary in size and sociodemographic composition.

Patient Selection Criteria

- Patients were included in the study sample if they met the following selection criteria:
  – aged 18 to 64 years;
  – had an HIV test claim between 1/1/2003 and 5/1/2010;
  – had a claim with an ICD-9-CM diagnosis code for HIV either on the same day as the HIV test or following the HIV test; "Test Index" corresponded to the HIV test that was temporally proximate to first HIV diagnosis;
  – had continuous insurance enrolment between the HIV test and the HIV diagnosis to ensure complete data capture; and
  – had continuous insurance enrolment for at least 180 days prior to the Test Index to include patients who were newly diagnosed with HIV.
- Patients were excluded if at any time prior to the Test Index they had any HIV-related antiretroviral therapy, any claims with an ICD-9-CM diagnosis code for HIV, or any CD4, HIV RNA viral load, or antiretroviral resistance testing.

Observation Period and Study Endpoints

- The observation period comprised a baseline period and an evaluation period:
  – Baseline period was used to measure patient characteristics such as demographics and comorbidities, and comprised a fixed 180-day period of time ending on the day before the Test Index.
  – Evaluation period was used to measure time to linkage to appropriate HIV care and comprised the variable-length period of time 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 6/30/2010.
- Primary study endpoint was linkage to appropriate HIV care, defined as the receipt of CD4 and HIV RNA viral load testing during the evaluation period.
  – This definition was 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 antiretroviral therapy[4,5].
- A more restrictive definition of linkage to appropriate HIV care—receipt of CD4, viral load, and antiretroviral resistance testing—was developed for use in sensitivity analyses.
  – During the study period, recommendations for the use of antiretroviral resistance testing were gradually adopted into the US treatment guidelines[6].

Measured Correlates of Linkage to Appropriate HIV Care

- Several variables were examined as potential correlates of linkage to appropriate HIV care:
  – Patient demographics (Table 1) were ascertained from the database as recorded by the Medicaid system for administrative purposes.
  – Patient clinical characteristics (Table 2) were ascertained from the database using healthcare service, drug, and diagnostic coding as recorded by the Medicaid system for administrative purposes.
    - Nosologists (medical coders) compiled all diagnosis and procedure coding used to measure patient clinical characteristics.

Statistical Analyses

- The Kaplan–Meier product-limit method[7] 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 6/30/2010.
- Multivariable logistic regression was used to characterize the association between patient characteristics and the probability of linkage to appropriate HIV care within 3 months after the Test Index.
  – This 3-month time threshold was informed by prior literature and the time-to-event analyses[8].
- The multivariable logistic regression expressed the probability of linkage to appropriate HIV care within 3 months after the Test Index as a function of:
  – patient demographics;
  – indicators for state Medicaid programs; and
  – a subset of the measured patient clinical characteristics, chosen on the basis of their prevalence and bivariate correlation with the study endpoint.

RESULTS

Baseline Characteristics

- After applying study inclusion and exclusion criteria, the total study sample comprised 6,864 newly diagnosed HIV patients.
- Tables 1 and 2 display patients' demographic and clinical characteristics, respectively.
- Over a median follow-up of 521 days after the Test Index, 1,473 (21.5%) patients linked to appropriate HIV care, 4,450 (64.8%) patients dis-enrolled from Medicaid benefits, and 941 (13.7%) patients reached the study end date of 6/30/2010.

Table 1. Patient Demographic Characteristics, Stratified by Linkage to Appropriate HIV Care ≤3 Months after Test Index, and Reported for All Patients

	Patients linked to appropriate HIV care ≤3 months after Test Index* (N=1,202)		Patients not linked to appropriate HIV care ≤3 months after Test Index* (N=5,155)		All patients (N=6,864)	
Age (Mean, SD)	35.3	11.7	34.9	12.1	35	12.2
Age group (N, %)						
18–34	615	51%	2,737	53%	3,621	53%
35–44	301	25%	1,145	22%	1,546	23%
45–54	201	17%	894	17%	1,171	17%
55–64	85	7%	379	7%	526	8%
Sex (N, %)						
Male	390	32%	1,531	30%	2,091	30%
Female	812	68%	3,624	70%	4,773	70%
Race (N, %)						
White	213	18%	1,334	26%	1,657	24%
Black	834	69%	2,182	42%	3,224	47%
Hispanic	56	5%	708	14%	841	12%
Other**	12	1%	131	3%	152	2%
Unknown	87	7%	800	16%	990	14%
Has ≥1 child covered under policy*** (N, %)	417	35%	1,312	25%	1,832	27%
Capitation**** (N, %)	556	46%	2,771	54%	3,608	53%
Test Index year (N, %)						
2003	253	21%	1,273	25%	1,567	23%
2004	254	21%	1,092	21%	1,388	20%
2005	224	19%	901	17%	1,318	19%
2006	126	10%	403	8%	567	8%
2007	100	8%	418	8%	554	8%
2008	102	8%	433	8%	573	8%
2009	121	10%	554	11%	753	11%
2010	22	2%	81	2%	144	2%

*Stratifications of 3-month appropriate HIV care status are based on patients with at least 3 months of post-Test-Index continuous enrolment or those who linked to appropriate HIV care within that timeframe, respectively.
** 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.

Table 2. Patient Clinical Characteristics, Stratified by Linkage to Appropriate HIV Care ≤3 Months after Test Index, and Reported for All Patients

	Patients linked to appropriate HIV care ≤3 months after Test Index* (N=1,202)		Patients not linked to appropriate HIV care ≤3 months after Test Index* (N=5,155)		All patients (N=6,864)	
Indices of overall health and linkage to the healthcare system						
Count of unique 3-digit ICD-9-CM						
Mean, SD	6.5	6.2	6.7	7.1	6.6	7.0
Median	5		5		5	
Count of unique NDCs						
Mean, SD	6.3	6.7	7.2	7.7	7.0	7.5
Median	5		5		5	
Count of claims for outpatient services						
Mean, SD	26.2	35.0	31.4	48.9	30.5	47.9
Median	16		17		17	
Total baseline healthcare expenditures						
Mean, SD	$3,783	$8,984	$5,584	$15,868	$5,249	$15,108
Median	$1,083		$1,072		$1,060	
Baseline outpatient office visit (N, %)	796	66.2%	3,597	69.8%	4,730	68.9%
Sexually transmitted infections (N, %)						
Gonorrhea	5	0.4%	22	0.4%	31	0.5%
Syphilis	1	0.1%	14	0.3%	16	0.2%
Chlamydial infection	3	0.2%	16	0.3%	21	0.3%
Herpes simplex	27	2.2%	74	1.4%	105	1.5%
Genital warts	8	0.7%	17	0.3%	28	0.4%
Other venereal diseases	7	0.6%	44	0.9%	53	0.8%
Clinical indicators for HIV (N, %)						
Oral infection	9	0.7%	14	0.3%	24	0.3%
Unexplained fever	80	6.7%	150	2.9%	246	3.6%
Herpes zoster	26	2.2%	28	0.5%	57	0.8%
Seborrheic dermatitis	7	0.6%	13	0.3%	21	0.3%
Night sweats	2	0.2%	7	0.1%	10	0.1%
Unexplained weight loss	32	2.7%	68	1.3%	107	1.6%
Lymphadenopathy	48	4.0%	48	0.9%	100	1.5%
Comorbid conditions (N, %)						
Hepatitis B	6	0.5%	33	0.6%	41	0.6%
Hepatitis C	22	1.8%	203	3.9%	240	3.5%
Alcohol disorders	26	2.2%	87	1.7%	122	1.8%
Drug dependence	28	2.3%	173	3.4%	211	3.1%
Nondependent abuse of drugs	126	10.5%	462	9.0%	632	9.2%
Drug-induced mental disorders	4	0.3%	40	0.8%	48	0.7%
Depression	112	9.3%	614	11.9%	782	11.4%
Other mental disorders	175	14.6%	1,097	21.3%	1,351	19.7%
Cognitive impairment	0	0.0%	0	0.0%	0	0.0%
Conditions associated with low CD-4 count (N, %)						
Atypical mycobacterial pulmonary infection	0	0.0%	1	0.0%	1	0.0%
Septicemia	5	0.4%	38	0.7%	52	0.8%
Intestinal infectious diseases	0	0.0%	4	0.1%	4	0.1%
Meningitis	1	0.1%	4	0.1%	5	0.1%
Renal diseases	14	1.2%	135	2.6%	178	2.6%
Other retinopathy	2	0.2%	7	0.1%	10	0.1%
Intracranial abscess	0	0.0%	0	0.0%	0	0.0%
Microsporidiosis	0	0.0%	0	0.0%	0	0.0%
Molluscum contagiosum	0	0.0%	2	0.0%	2	0.0%

*Stratifications of 3 month appropriate HIV care status are based on patients with at least 3 months of post-Test Index continuous enrolment or those who linked to appropriate HIV care within that timeframe, respectively; ICD-9-CM=International Classification of Diseases, Ninth Revision, Clinical Modification; NDC=National Drug Code.

Time to Linkage to Appropriate HIV Care

- Figure 1 displays the Kaplan–Meier plot of the time to linkage to appropriate HIV care.
  – The majority of patients who linked to appropriate HIV care (86.1%) did so within the first 3 months after the Test Index.
  – The 1-year Kaplan–Meier-estimated probability of linkage to appropriate HIV care was 21.0%, increasing to 26.4% after 5 years.

Figure 1. Kaplan–Meier Plot of Time to Linkage to Appropriate HIV Care
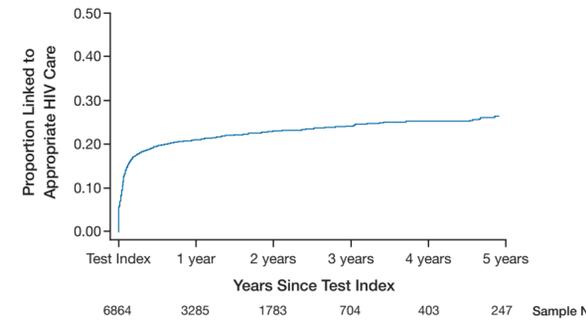
Predictors of Linkage to Appropriate Care

- Table 3 displays the results of the multivariable logistic regression.
  – The demographic factors that were most strongly and positively associated with linkage were black race (vs. white race) and male sex.
  – The clinical factor that was most strongly positively associated with linkage was having a diagnosis of any clinical indicator for HIV.
  – The clinical factors that were most strongly negatively associated with linkage were having a diagnosis of hepatitis B or C, a diagnosis of renal disease (though this was very rare), a diagnosis of other mental disorders or a baseline outpatient office visit.

Table 3. Logistic Regressions for the Odds of Linkage to Appropriate HIV Care ≤3 Months after the Test Index

	Linkage to appropriate HIV care 3 months after Test Index		
	Odds Ratio	P-Value	95% Confidence Interval
Male (vs. female)	2.018	0.003	1.267–3.215
Age in years	1.017	<0.001	1.009–1.025
Male*Age	0.986	0.023	0.975–0.998
Black (vs. white)	2.133	<0.001	1.772–2.568
Hispanic	0.823	0.262	0.585–1.157
Other race	0.629	0.153	0.333–1.188
Missing race	0.921	0.712	0.595–1.425
Index year: 2003 (vs. 2010)	1.238	0.112	0.951–1.613
Index year: 2004	1.22	0.137	0.938–1.587
Index year: 2005	1.294	0.057	0.992–1.687
Index year: 2006	1.246	0.141	0.929–1.672
Index year: 2007	1.23	0.183	0.907–1.667
Index year: 2008	1.142	0.39	0.844–1.547
≥1 child covered under policy (vs. no child)	1.069	0.464	0.893–1.280
Capitation (vs. no)	0.795	0.015	0.661–0.956
Baseline diagnosis of any clinical indicator for HIV	2.836	<0.001	2.276–3.533
Baseline diagnosis of hepatitis B or C	0.529	0.004	0.341–0.820
Baseline diagnosis of alcohol and drug disorders	1.212	0.099	0.964–1.524
Baseline diagnosis of depression	0.937	0.598	0.735–1.194
Baseline diagnosis of other mental disorders	0.647	<0.001	0.527–0.794
Baseline diagnosis of renal diseases	0.455	0.011	0.249–0.835
Baseline number of unique 3 digit ICD-9-CM	1.023	0.013	1.005–1.041
Baseline number of unique NDCs	0.981	0.007	0.968–0.995
Baseline total healthcare expenditures	1	0.001	1.000–1.000
Baseline outpatient office visit	0.79	0.004	0.674–0.925
Urban residence (vs. rural) output redacted*	x	x	x
Medicaid state indicators output redacted*	x	x	x
Constant	0.056	0	0.034–0.092
Observations	6,357		
C-statistic	0.737		

*The multivariable logistic regression models are based on patients with at least 3 months of post-Test Index continuous enrolment or those who linked to appropriate HIV care within that timeframe, respectively; Redacted state and urban residence indicators were adjusted for in the multivariable analyses but not displayed in accordance with confidentiality agreements; ICD-9-CM=International Classification of Diseases, Ninth Revision, Clinical Modification; NDC=National Drug Code; Within the multivariable logistic regressions, multicollinearity of the independent variables was tested by calculating the variance inflation factor—no evidence of substantive multicollinearity was detected in the models.

RESULTS

Sensitivity Analyses

- In sensitivity analyses using the restrictive definition of linkage to appropriate HIV care (data not shown):
  – The majority of patients who linked to appropriate HIV care (85.0%) also did so within the first 3 months after the Test Index.
  – The 1-year Kaplan–Meier-estimated probability of linkage to appropriate HIV care was 9.2%, increasing slightly to 11.5% after 5 years.
- Results were generally consistent with the findings from the primary analysis.

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 out of every 10 Medicaid patients diagnosed with HIV, only 1 to 2 linked to appropriate HIV care within 1 year of Test Index, with the majority of those doing so within the first 3 months after the Test Index.
- Time to linkage to appropriate HIV care varied by sex, race/ethnicity, and clinical factors.
- The finding that black race (vs. white race) was strongly associated with a higher odds of a linkage to appropriate HIV care contrasts with prior research showing disparities in access to HIV care favoring whites.
- This finding may be explained by the fact that this study examined a low income, socioeconomically homogenous sample in which everyone possessed healthcare coverage and was already linked into the general healthcare system.

LIMITATIONS

- The use of an observational study design and administrative claims data make this study's results potentially subject to under-coding, measurement error, and residual confounding.
- Study findings may not be generalizable to the entire US HIV-infected population.

CONCLUSION

- 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.

REFERENCES

1. 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:S205–7.
2. 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.
3. 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.
4. 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.
5. 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;49:651–81.
6. US 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.
7. Kaplan EL, Meier P. Nonparametric estimation from incomplete observations. J Am Stat Assoc 1958;53:457–81.
8. 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;23:765–73.