Mental Health

Mental Illness and Length of Inpatient Stay for Medicaid Recipients with AIDS

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Objective. To examine the associations between comorbid mental illness and length of hospital stays (LOS) among Medicaid beneficiaries with AIDS.

Data Source and Collection/Study Setting. Merged 1992–1998 Medicaid claims and AIDS surveillance data obtained from the State of New Jersey for adults with ≥ 1 inpatient stay after an AIDS diagnosis from 1992 to 1996.

Study Design. Observational study of 6,247 AIDS patients with 24,975 inpatient visits. Severe mental illness (SMI) and other less severe mental illness (OMI) diagnoses at visits were ascertained from ICD–9 Codes. About 4 percent of visits had an SMI diagnosis; 5 percent had an OMI diagnosis; 43 percent did not have a mental illness diagnosis, but were patients who had been identified as having an SMI or OMI history; and 48 percent were from patients with no identified history of mental illness.

Principal Findings. The overall mean hospital LOS was 12.7 days. After adjusting for measures of HIV disease severity and health care access in multivariate models, patients presenting with primary and secondary severe mental illness (SMI) diagnoses had ~ 32 percent and ~ 11 percent longer LOS, respectively, than did similar patients without a mental illness history ($p<0.001$ for each). But in these adjusted models of length of stay: (1) diagnosis of OMI was not related to LOS, and (2) in the absence of a mental illness diagnosed at the visit, an identified history of either SMI or OMI was also not related to LOS. In adjusted models of time to readmission for a new visit, current diagnosis of SMI or OMI and in the absences of a current diagnosis, history of SMI or OMI all tended to be associated with quicker readmission.

Conclusions. This study finds greater (adjusted) LOS for AIDS patients diagnosed with severe mental illness (but not for those diagnosed with less severe mental comorbidity) at a visit. The effect of acute severe mental illness on hospitalization time may be comparable to that of an acute AIDS opportunistic illness. While previous research raises concerns that mental illness increases LOS by interfering with treatment of HIV conditions, the associations here may simply indicate that extra time is needed to treat severe mental illnesses or arrange for discharge of afflicted patients.

Key Words. AIDS, HIV disease, hospitalization, length of stay, mental illness

Minimizing length of stay (LOS) for hospitalized patients infected with AIDS without reducing quality of care or increasing frequency of hospitalization is desirable. Besides being expensive (Van Haastrecht et al. 1996), hospitalization

days put AIDS patients at risk for nosocomial infections and disrupt their economic and social lives. To this end, many studies have found substantial (i.e., of two to four days) reductions in hospital LOS for patients infected with HIV have occurred since the mid-1980s (Grabau, Kaufman, and Han 1991; Markson, Turner, and Fanning 1992; Paul et al. 1999; Kelly, Ball, and Turner 1989; Stein 1994; Bonuck and Arno 1997).

Recently several studies have suggested that psychiatric comorbidities may substantially increase the time required to treat and discharge HIV patients (Uldall et al. 1994; Uldall et al. 1998; Cheng et al. 2001). Uldall and others (Uldall et al. 1994; Uldall et al. 1998) found from 1990 to 1992 that nearly 30 percent of AIDS inpatient hospital admissions involved patients with psychiatric (including substance abuse) problems and that these patients had mean LOS 2–6 days longer (and also had shorter times to readmission to new hospital visits) than did patients without psychiatric illness. Cheng et al. (2001) found psychiatric diagnoses were associated with increased risk of >90 days hospitalization for patients with advanced HIV disease.

These previous studies suggested that psychiatric comorbidities might increase the time needed to treat HIV conditions through various mechanisms (Uldall et al. 1994; Uldall et al. 1998; Cheng et al. 2001). For example, manifestations of psychiatric illness could impede delivery of appropriate care to AIDS patients (Uldall et al. 1994), perhaps due to inability of the patient to work with the treatment team and comply with treatment (Uldall et al. 1998). Alternatively, underlying mental illness (in particular, depression) could lower immune function and thereby increase length of hospitalization (Uldall et al. 1998). More frequent readmission to hospitals could also result if mental illness caused HIV patients to have an inappropriately short LOS (i.e., be prematurely discharged) at a previous visit (Uldall et al. 1998).

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Indeed, if psychiatric illness increased hospital utilization for HIV conditions by hindering their treatment or discharge or by increasing frequency for which HIV-related care is sought, this would have major clinical significance. But other explanations for associations of mental illness with greater length of stay and more frequent readmissions of HIV patients are also possible.

Most notably, AIDS patients with psychiatric comorbidity need to be treated for two conditions (mental illnesses and HIV disease) while those without mental illness have only one condition (HIV disease) and, thus, the former might, for this reason, be expected to have greater LOS and shorter time to readmission. For example, patients experiencing acute psychiatric episodes (such as those that constitute the primary diagnosis for the hospitalization) may have more complex postdischarge care needs irrespective of HIV infection or AIDS. The need to arrange such placements might delay discharge of such patients (Bonuck and Arno 1997; Uldall et al. 1994; Uldall et al. 1998; Cheng et al. 2001; Uldall and Berghuis 1997). If this is the case, one would expect to observe greater LOS for hospitalizations of AIDS patients who are also diagnosed with a severe mental illness.

As is always the case with observational studies, confounding factors, such as access to care and severity of AIDS, may differ between persons with and without mental illness. These differences, rather than direct interaction of a patient's mental illness with HIV treatment and discharge, may influence LOS. For example, being under treatment for a mental illness may facilitate earlier recognition of HIV (Goulet et al. 2000), resulting in hospitalized HIV persons with mental illness tending to have mild-HIV conditions that require shorter LOS. To avoid biased estimates, demographic characteristics such as age and race/ethnicity also need to be controlled for, as they may be associated both with psychiatric comorbidity and length of stay.

Injection drug use (IDU) and other substance abuse further complicate direct measurement of the impact of mental illness on LOS. For example, physical illnesses that are more prevalent in this population, such as tuberculosis (Gollub et al. 1997) and hepatitis C viral infection (Bodsworth et al. 1996), can influence hospital costs and utilization. Compared to non-IDUs with HIV, HIV patients who inject drugs had more frequent and longer hospitalizations, and greater propensity for mental illness (Stein 1994; Seage et al. 1993; Johnston, Smith, and Stall 1994). Substance abuse (SA) is associated with many costly and disabling mental disorders (Solomon et al. 1991; Mor et al. 1992; Solomon et al. 1998) and has been shown to influence length and frequency of hospitalizations due to overdose and other acute SA-related conditions (Seage et al. 1993; Johnston, Smith, and Stall 1995). Other potential

confounders are gender, insurance coverage, social economic status, and season, all of which have been found to be associated with psychiatric illness (Eastwood and Stiasny 1978; Takei et al. 1992; Sturm and Wells 2000; McAlpine and Mechanic 2000; Stoskopf, Kim, and Glover 2001; Dal Pan, Skolasky, and Moore 1997; Fleishman and Mor 1993; Hellinger 1993; Federman et al. 2000). Among these characteristics, some studies have found: neurological disorders caused by HIV (Dal Pan, Skolasky, and Moore 1997) and insurance coverage (Fleishman and Mor 1993) were associated with increased length of stay; women received fewer hospital resources (Hellinger 1993); nonwhite patients had longer lengths of stay (Kelly, Ball, and Turner 1989; Stein 1994; Bonuck and Arno 1997); and admissions in the spring and summer had shorter LOS (Markson, Turner, and Fanning 1992). Longer LOS may increase the chance for a patient to be diagnosed with a psychiatric comorbidity as a secondary diagnosis (Cheng et al. 2001; Glesby and Hoover 1996).

In order to understand more fully the associations (and potential causal patterns) between psychiatric illness and length of stay, we analyzed 24,675 hospital visits among 6,497 patients diagnosed with AIDS and hospitalized at least once from 1992 to 1998. To account for potential confounding conditions, we considered a large number of covariates. Because type of mental illness may be important, we separately considered schizophrenia, bipolar illness, and major depression (which are believed to be more severe mental illnesses [Schinnar, Rothbard, Kanter, and Jung 1990]) from other mental illnesses. To better understand the relative impact of an acute mental illness diagnosis associated with the hospital stay as opposed to a history of mental illness, we separately compared visits for which mental illness was an acute (i.e., the primary or a secondary) diagnosis and those where there was no acute mental illness, but the patient had an identified history of mental illness (i.e., at other visits).

METHODS

Study Population

The patient population for this study was derived from file matching between New Jersey Medicaid eligibility files and the State's AIDS Registry through March 1996 under a cooperative agreement with the New Jersey Department of Health and Senior Services and Division of Medical Assistance and Health Services. This article includes 6,247 adult (18 years or older) Medicaid recipients identified through the match who were diagnosed with AIDS in New

Jersey by March 1996 and hospitalized at least once after that diagnosis from 1992 to 1998.

Measures

Length of Stay and Time to Readmission Outcomes. Length of Stay (LOS) was the number of days from the date of admission to the date of discharge. Because "one day hospitalizations" are usually clinic visits, they were excluded from the analyses (but the findings are essentially unaltered with one day hospitalizations included). For patients readmitted to a hospital on the same day as discharged (or transferred to another hospital), the two visits were combined. *Time to Readmission (TR)* was calculated as number of days from the date of discharge from a visit to the date of admission for a subsequent visit.

Mental and Neurological Illness. The following *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9) codes were considered to indicate mental illness: *295—Schizophrenic Disorders, 296—Affective Psychoses, 297—Paranoid States, 298—Other Nonorganic Psychoses, 300—Neurotic Disorders, 301—Personality Disorders, 302—Sexual Disorders, 306—Psychophysiologic Disorders, 307—Special Mental Symptoms Not Elsewhere Classified,* 308*—Acute Reaction to Stress, 309—Adjustment Reaction, 310—Nonpsychotic Brain Syndrome, 311—Depressive Disorder Not Elsewhere Classified, 312—Conduct Disturbance Not Elsewhere Classified, 313—Emotional Disorders of Adolescence, 314—Hyperkinetic Syndrome, 316—Psychic Factors with Other Disorders,* and *780—Alterations of Consciousness.* We are limited to diagnoses available in the Medicaid dataset; patients diagnosed with mental illnesses elsewhere were not identified.

We refer to hospital stays associated with one of these psychiatric codes as involving an "acute" psychiatric condition; if such codes were recorded on other health care encounters of the patient, but were not for that specific stay, we classified the stay as being from an individual with an identified history of psychiatric disorder.

Severe Mental Illness (Primary, Secondary, and History). If schizophrenia (ICD-9 code 295), bipolar disorder (ICD-9 codes: 2964, 2965, 2966, 2967, or 2968), and/or major depressive disorder (ICD-9 codes 29624 or 29634) appeared as a diagnosis on the hospitalization claim, then a severe acute mental illness (SMI) was considered to have occurred at the visit. Acute SMI was subdivided into *Primary SMI* if the severe mental illness was the primary diagnosis and *Secondary SMI* otherwise. All visits without an acute SMI diagnosis that came from patients with at least two inpatient visits or one

outpatient visit with acute SMI diagnoses were considered to be from patients with identified *SMI History*.

Other Less Severe Mental Illness (Acute and History). Visits with a mental illness diagnosis (ICD-9 codes 295-98, 300-02, 306-14, 316, or 780) that did not have SMI diagnoses (ICD-9 codes 295, 2964, 2965, 2966, 2967, 2968, 29624, or 29634) were classified as having acute other mental illness (OMI). We initially separated primary and secondary acute OMI, but as there were much fewer primary OMI diagnoses and the associations were similar for both, we combined these into *Acute OMI*. Visits without an Acute OMI diagnosis from patients without SMI History but whom did have at least two inpatient visits with an OMI diagnoses or one outpatient visit with an OMI diagnosis were considered to be from patients with *OMI History*.

HIV Dementia. HIV dementia is a neurological condition and thus not included in mental illness. But at each visit, ICD-9-CM codes 2901, 3109, 3238, 3239, 3319, 3418, 3438, and 3488 were used to create an indicator variable for diagnosis of HIV dementia.

Other Illnesses/Conditions—Acute Substance Abuse (ASA). Based on presence of ICD-9 codes 291, 292, and 303–305, we classified each visit into substance abuse diagnosis categories. If a substance abuse event was the primary diagnosis for the admission, the visit was classified as *Primary SA*. Otherwise, if a substance abuse diagnosis was recorded, but not as the primary diagnosis, the visit was classified as *Secondary SA*.

Severity of HIV Illness—Opportunistic Infections (OI). Since HIV is a chronic condition with varying severity and recovery, diagnosis of an OI at the current visit was used to indicate severity of illness. AIDS-defining opportunistic conditions were evaluated based on diagnostic codes conforming to the ICD-9. A complete list of the opportunistic infections included is available on request. *Death during the Hospital Visit* (yes, no) was also used as an indicator of HIV disease severity.

Timing of Visit Admission. To control for changes in treatment practices over time, *Year of Admission* was considered as a categorical variable with 1992 as the reference category for multivariate analysis. *Season of Admission* (Spring/Summer = 1) (Fall/Winter = 0) was also fit.

Other Patient Characteristics. Demographic characteristics (i.e., gender, race, county of residence), HIV exposure category, and date of HIV diagnosis were obtained from surveillance data. *Race/ethnicity* was characterized as non-Latino white, African American, and Latino. In multivariate analyses, non-Latino white was the reference category. *Age at Diagnosis* was categorized as:

18–29 years, 30–39 years, 40–49 years, and ≥ 50 (reference category). *Year of Diagnosis* of HIV infection was categorized as 1995–1996, 1993–1994, 1990–1992, and before 1990 (reference category). Persons living in the *Highest HIV Prevalence* counties, those nearest to New York City and Philadelphia, were compared to persons living elsewhere in New Jersey. *Risk Group* was based on information on injection drug use history from the AIDS Registry with patients classified as either IDU, non-IDU, or "Missing." Some participants in Medicaid were eligible for *Medicare.* Dual Medicare coverage (yes/no) was assessed from claim type recorded in paid Medicaid claims data. Some New Jersey Medicaid recipients are enrolled in ACCAP, an HIV-specific Medicaid home and community-based care waiver program, that offers case management and other services. *Participation in the ACCAP* was determined from procedure codes in Medicaid claims for waivered services. As an indicator of HAART therapy, from National Drug Codes recorded in pharmacy claims, we identified the use of Protease Inhibitor/Non-Nucleoside Reverse Transcriptase Inhibitor (PI/NNRTI) and the first date that an individual *Used a PI or NNRTI.* This was an intent-to-treat variable; patients were considered to be on PI/NNRTI for all visits after the initiation date.

Analytic Procedures

Both univariate (one predictor) and multivariate (all predictors) linear models for LOS and TR were fit using patient-visits as the observations. Since repeated visits from the same persons were used, we applied robust covariance methods (Diggle, Liang, and Zeger 1994) to account for correlations between repeated measures from the same patients with *SUDAAN* (Shah, Barnwell, and Bieler 1996). Due to skewed distributions (for the adjusted and unadjusted analyses of Table 2), LOS and TR were log (base e) transformed to improve symmetry and other statistical properties. Exponentiated values of differences in logs (which can be roughly interpreted as ratios) are reported. Some problems may exist from the censoring of very long patient stays and readmissions by the date of analysis, December 1998. While the technical issues are complicated, we believe the impact is minor as most patients had numerous (i.e., ~ 4) admissions and the study covered six years.

RESULTS

Of the 6,247 patients (data not tabled), 62 percent were male; 59 percent were African American, 18 percent Latino, and 23 percent non-Latino white. Half

(50 percent) were aged 30–49 years at diagnosis of HIV. The IDU was the largest HIV risk group (63 percent). Seventy percent of the study cohort lived in high HIV prevalence urban areas (near New York City or Philadelphia) at time of initial HIV diagnosis. A minority (26 percent) was enrolled in the ACCAP waiver program, and 29 percent received Medicare after diagnosis of AIDS. Thirty-two percent were alive as of December 1998. About 14 percent (868) were identified as having severe mental illness; 334 with schizophrenia, 96 with bipolar disorder (but not schizophrenia), and 438 with major depressive disorder (but not schizophrenia or bipolar disorder); 1,682 (27 percent) of other patients had identified admissions for less severe mental illnesses (OMI).

Table 1 displays inpatient stays of Medicaid recipients with AIDS along with mean LOS and time to readmission to the next visit (TR) by Mental Illness and other patient characteristics. The distribution of age, gender, ethnicity, exposure group, residence, and insurance coverage among all patient-visits was similar to the distribution by patients reported in the previous paragraph. The 14 percent of patients who had been diagnosed with a severe mental illness contributed $\sim$ 19 percent (= 2.4%+1.4%+14.8%) of the hospital visits and the 27 percent other patients who had been diagnosed with an OMI contributed $\sim$ 33 percent (= 5.0%+28.4%) of the visits. The 59 percent of patients without identified history of mental illness contributed only 48 percent of the visits.

Overall, compared to the mean LOS for visits from persons with no history of mental illness (13.5 days), the mean LOS was significantly shorter for person-visits with: Primary-SMI diagnoses (12.4 days), Secondary SMI diagnoses (11.9 days), no SMI diagnosis but from persons with history of SMI (11.3 days), Acute OMI diagnoses (12.4 days), and no acute mental illness diagnosis but from persons with history of OMI (12.4 days), collectively $p<0.001$. However, mean months to readmission for these groups ranged from 4.4 to 5.0 months with no systematic pattern. Older age, diagnosis of an OI at the visit, and death in the hospital, all of which indicate poorer health, were associated with substantially (4–10 days) higher unadjusted mean LOS ($p<0.001$, for each). Year of admission had a mean LOS reduction of over 4.5 days from 1992 to 1998 ($p<0.001$) and a quadrupling of mean months to readmission from 2.1 to 8.2 ($p<0.001$). Use of PI/NNRTI was associated with $\sim$ 3.5 days mean reduction in LOS ($p<0.001$) and $\sim$ 3 months greater mean TR ($p<0.001$). Medicare enrollees had substantially longer mean TR than did nonenrollees: 6.3 months versus 4.0 months $p<0.001$. Finally, while overall the mean LOS and TR did not differ substantially by injection drug use history, patients with a primary diagnosis of substance abuse (SA) had a mean

Table 1: Breakdown of 1992–1998 Inpatient Admissions, LOS, and Time to Readmission among HIV-Infected New Jersey Medicaid Recipients by Visit and Patient Characteristics

Characteristic	*Number of Admissions*	*Percentage of Admissions*	*Mean Length of Stay in Days*	*Mean Months to Readmission*
Total	*24,975*	*100.0*	*12.7*	*4.6*
Mental and Neurological Illness				
Mental Illness Diagnosis and History				
SMI—Primary	607	2.4	12.4	5.0
SMI—Secondary	347	1.4	11.9	4.8
SMI—History[a]	3,697	14.8	11.3	4.4
OMI—Acute	1,261	5.0	12.4	4.5
OMI—History[b]	7,086	28.4	12.4	4.7
No MI	11,977	48.0	13.5	4.5
HIV Dementia at or before Visit				
Yes	161	0.6	16.3	4.0
No	24,814	99.4	12.7	4.6
Other Patient-Visit Characteristics				
Opportunistic Infection at Visit				
Yes	9,463	37.9	15.6	4.1
No	15,512	62.1	11.0	4.9
Died in Hospital at Visit				
Yes	1,732	6.9	21.2	NA
No	23,243	93.1	12.1	NA
Substance Abuse Diagnosed at Visit				
Primary substance abuse	1,665	6.7	5.9	6.1
Secondary substance abuse	6,257	25.0	11.4	5.0
No substance abuse	17,053	68.3	13.9	4.3
Season of Admission for Visit				
Fall/Winter	12,360	49.5	12.9	4.6
Spring/Summer	12,615	50.5	12.6	4.5
Year of Admission for Visit				
1992	1,564	6.3	13.9	2.1
1993	4,583	18.4	14.8	3.2
1994	5,848	23.4	14.2	3.8
1995	5,782	23.2	13.0	4.0
1996	3,517	14.1	10.8	5.1
1997	2,131	8.5	9.2	6.9
1998	1,550	6.2	9.1	8.2
Age at Visit				
18–29 years	4,457	17.9	11.2	4.2
30–39 years	13,040	52.2	12.7	4.5
40–49 years	6,100	24.4	13.2	5.0
50 and older	1,378	5.5	16.8	5.2

continued

Table 1. *Continued*

Characteristic	*Number of Admissions*	*Percentage of Admissions*	*Mean Length of Stay in Days*	*Mean Months to Readmission*
PI/NNRTI Use at or before Visit				
Yes	3,562	14.3	8.9	6.9
No	21,413	85.7	12.4	4.0
Other Patient Characteristics				
Gender				
Female	10,632	42.6	12.5	4.7
Male	14,343	57.4	13.0	4.4
Race/Ethnicity				
Non-Latino white	4,816	19.3	11.3	5.1
African American	15,542	62.2	13.3	4.6
Latino	4,534	18.2	12.3	3.9
Risk Group				
Missing	1,933	7.7	13.9	4.4
IDU	16,896	67.7	13.0	4.5
Non-IDU	6,146	24.6	12.5	4.7
County of Residence at Visit of HIV Diagnosis				
High Prevalence	18,318	73.4	13.2	4.5
Elsewhere	6,657	26.1	11.4	4.8
Waiver Participation at Visit of HIV Diagnosis				
ACCAP	6,915	27.7	13.0	4.2
Non-ACCAP	18,060	72.3	12.7	5.7
Medicare Enrollment at Visit of HIV Diagnosis				
No Medicare	18,220	72.9	12.0	4.0
Medicare	6,755	27.1	13.0	6.3
Year of Initial HIV Disease Diagnosis				
Before 1990	1,739	7.0	12.4	5.1
1990–1992	8,305	33.3	12.9	4.9
1993–1994	12,191	48.8	12.9	4.4
1995–1996	2,740	11.0	11.8	4.3

[a]For visits without a Severe Mental Illness Diagnosis.

[b]For visits without a Mental Illness Diagnosis.

Note: Based on HIV-diagnosed persons 18 years of age and older, receiving Medicaid with at least one inpatient stay from 1992 to 1998. Values may not add up to 100 percent due to rounding.

Abbreviations: AIDS: Acquired Immune Deficiency Syndrome. PI/NNRTI: Protease Inhibitor or Non-Nucleoside Reverse Transcriptase Inhibitors; MI: Mental Illness; SMI: Severe Mental Illness; OMI: Other (nm-severe) Mental Illness; IDU: Injection Drug User; ACCAP: AIDS Community Care Alternatives Care Program.

LOS of 5.9 days versus 13.9 days for those with no SA diagnosis ($p<0.001$), with mean TR also longer for patients diagnosed with substance abuse.

Table 2 presents unadjusted and adjusted logistic regression models for log transformed LOS and TR comparing the row category to the baseline category of that variable. In unadjusted models only the categorized row variable (versus its baseline value) is in the model. In the adjusted models all variables in Table 2 are included. The point estimates of the coefficients for log transformed comparisons and 95 percent confidence limits are exponentiated to obtain approximate point estimates and confidence limits of ratios for mean LOS and TR. For example, the upper left entry of 1.05 (0.97, 1.14) in Table 2 for the unadjusted comparison indicates that, overall, patient-visits with Primary Acute SMI diagnoses have LOS 105 percent as long as did those from patients with no mental illness diagnosis history, with a 95 percent confidence limit of 97 percent to 114 percent for ratio of LOS.

In the adjusted model for LOS of visits with Primary Acute SMI versus its baseline category (visits from persons with no mental illness history) the upper entry in the second column of Table 2 is 1.32 (1.21, 1.44). This means that if all other characteristics in Table 2 are the same (i.e., age at diagnosis, severity of HIV disease, and so on), then LOS for a visit with a Primary Acute SMI diagnosis tends to be $\sim$ 132 percent as long as the LOS of a visit from a person with no history of mental illness, with a 95 percent confidence limit of 121–144 percent as long. The change from 1.05 ($\sim$ 105 percent as long) in the unadjusted model to 1.32 (132 percent as long) in the adjusted model reflects adjustment for the fact that visits with Primary Acute SMI tend to be from persons with less severe AIDS conditions, younger persons, and having other characteristics that are independently associated with shorter LOS (data not shown). For most variables, the unadjusted ratios for LOS and TR in Table 2 are similar to the patterns reflected by mean LOS and TR in Table 1, so we focus on adjusted ratios. Minor differences between the patterns of Table 1 and unadjusted ratios of Table 2 can occur since mathematically means of log-transformed variables do not necessarily correspond ordinally to means of untransformed variables.

After adjusting for other variables in Table 2 (including access to health care and severity of HIV disease measures), person-visits with Primary SMI diagnoses had stays that were 32 percent longer (95 percent CI: 1.21–1.44) and those with Secondary SMI diagnoses had stays that were 11 percent longer (95 percent CI: 1.00–1.21) than did similar visits from persons with no identified history of mental illness. But adjusted length of stay for visits with an acute OMI diagnosis or for visits with no mental illness diagnosed from persons with

Table 2. Robust Least Squares Regression on Log Length of Stay (in Days) and Log Time (in Months) to Readmission, Adjusted and Unadjusted Ratios (e^{β}) (with 95% Confidence Intervals)

	Length of Stay Ratio		*Time to Readmission Ratio*	
	Unadjusted Effect	*Adjusted Effect*	*Unadjusted Effect*	*Adjusted Effect*
Mental and Neurological Illness				
Mental Illness Diagnosis and History				
SMI Acute Primary	1.05 (0.97, 1.14)	1.32 (1.21, 1.44)***	1.14 (0.97, 1.13)	0.98 (0.85, 1.13)
SMI Acute Secondary	0.91 (0.83, 1.01)	1.11 (1.00, 1.21)*	1.01 (0.83, 1.23)	0.90 (0.75, 1.09)
SMI History	0.83 (0.78, 0.88)***	0.97 (0.93, 1.01)	0.93 (0.83, 1.05)	0.84 (0.77, 0.90)***
OMI Acute	0.89 (0.84, 0.94)***	1.04 (0.99, 1.10)	1.04 (0.96, 1.13)	0.84 (0.75, 0.94)***
OMI History	0.91 (0.88 0.95)***	0.98 (0.94, 1.02)	1.01 (0.93, 1.09)	0.93 (0.88, 0.99)*
No MI History	—	—	—	—
HIV Dementia at or Prior to Visit				
Yes	1.38 (1.22, 1.55)***	1.31 (1.13, 1.52)***	0.81 (0.68, 1.03)	0.98 (0.73, 1.33)
No	—	—	—	—
Other Patient-Visit Characteristics				
Opportunistic Infection Diagnoses at Visit				
Yes	1.49 (1.46, 1.52)***	1.42 (1.38, 1.46)***	0.87 (0.82, 0.92)***	0.98 (0.94, 1.02)
No	—	—	—	—
Died in Hospital at Visit				
Yes	1.46 (1.38, 1.55)***	1.27 (1.20, 1.35)***	NA	NA
No	—	—	—	—
Substance Abuse Diagnosis at Visit				
Primary substance abuse	0.49 (0.47, 0.51)***	0.57 (0.54, 0.60)***	1.45 (1.29, 1.63)***	1.49 (1.34, 1.66)***
Secondary substance abuse	0.85 (0.82, 0.89)***	0.87 (0.84, 0.90)***	1.16 (1.10, 1.23)***	1.17 (1.11, 1.24)***
No substance abuse	—	—	—	—
PI/NNRTI Use at or before Visit				
Yes	0.72 (0.69, 0.75)***	0.90 (0.85, 0.95)***	1.49 (1.38, 1.61)***	1.02 (0.90, 1.05)
No	—	—	—	—

Season of Admission for Visit				
Fall/Winter	1.04 (1.02, 1.06)**	1.03 (1.01, 1.06)*	1.06 (1.02, 1.10)**	1.06 (1.02, 1.11)***
Spring/Summer	—	—	—	—
Year of Admission of Visit				
1998	0.68 (0.63, 0.73)***	0.75 (0.69, 0.82)***	2.83 (2.47, 3.25)***	3.39 (2.81, 4.08)***
1997	0.68 (0.62, 0.74)***	0.74 (0.69, 0.80)***	2.59 (2.30, 2.91)***	3.00 (2.56, 3.52)***
1996	0.79 (0.75, 0.84)***	0.79 (0.74, 0.84)***	2.03 (1.84, 2.24)***	2.41 (2.10, 2.76)***
1995	0.91 (0.86, 0.97)**	0.84 (0.80, 0.90)***	1.60 (1.45, 1.76)***	1.97 (1.74, 2.24)***
1994	0.98 (0.92, 1.04)	0.90 (0.86, 0.96)***	1.57 (1.42, 1.73)***	1.84 (1.63, 2.08)***
1993	1.03 (0.97, 1.09)	0.97 (0.91, 1.04)	1.38 (1.25, 1.52)***	1.54 (1.37, 1.72)***
1992	—	—	—	—
Other Patient Characteristics				
Gender				
Female	1.00 (0.96–1.04)	1.01 (0.95, 1.06)	0.95 (0.90 – 1.01)	1.08 (1.02, 1.15)**
Male	—	—	—	—
Age at Initial Diagnosis of HIV Disease				
18–29 years	0.68 (0.63, 0.74)***	0.71 (0.66, 0.77)***	0.76 (0.66, 0.87)***	0.78 (0.68, 0.89)***
30–39 years	0.79 (0.73, 0.85)***	0.80 (0.75, 0.86)***	0.82 (0.73, 0.92)**	0.83 (0.74, 0.94)**
40–49 years	0.81 (0.75, 0.88)***	0.85 (0.80, 0.91)***	0.92 (0.80, 1.06)	0.94 (0.83, 1.07)
50 years and older	—	—	—	—
Race/Ethnicity				
Latino	1.07 (1.01, 1.14)*	1.05 (1.00, 1.10)*	0.79 (0.72, 0.88)***	0.82 (0.75, 0.90)***
African American	1.16 (1.12, 1.21)***	1.14 (1.09, 1.19)***	0.90 (0.84, 0.98)*	0.91 (0.85, 0.99)*
Non-Latino white	—	—	—	—
Risk Group				
Missing	1.03 (0.97, 1.09)	1.02 (0.99, 1.05)	1.04 (0.90, 1.19)	0.91 (0.82, 1.01)
IDU	0.95 (0.91, 1.99)**	1.06 (1.00, 1.13)*	0.96 (0.88, 1.04)	0.90 (0.84, 0.96)***
Non-IDU	—	—	—	—
County of Residence at Initial Diagnosis of HIV Disease				
High Prevalence	1.14 (1.10, 1.18)***	1.14 (1.10, 1.18)***	0.95 (0.90, 1.01)	0.94 (0.88, 1.01)
Elsewhere	—	—	—	—

continued

Table 2. *Continued*

	Length of Stay Ratio		*Time to Readmission Ratio*	
	Unadjusted Effect	*Adjusted Effect*	*Unadjusted Effect*	*Adjusted Effect*
Waiver Participation at Initial Diagnosis of HIV Disease				
ACCAP	1.05 (1.01, 1.09)**	1.04 (1.00, 1.08)*	0.88 (0.83, 0.93)***	0.89 (0.84, 0.94)***
Non-ACCAP	—	—	—	—
Medicare Enrollment at Initial Diagnosis of HIV Disease				
Medicare	0.94 (0.91, 0.98)***	0.98 (0.94, 1.02)	1.88 (1.77, 1.99)***	1.82 (1.70, 1.95)***
No Medicare	—	—	—	—
Year of Initial Diagnosis of HIV Disease				
1995–1996	1.02 (0.94, 1.10)	0.95 (0.88, 1.02)	0.78 (0.68, 0.90)***	0.61 (0.52, 0.70)***
1993–1994	1.00 (0.92, 1.08)	0.94 (0.89, 1.00)*	0.81 (0.72, 0.91)***	0.77 (0.69, 0.87)***
1990–1992	1.02 (0.94, 1.10)	0.93 (0.88, 0.99)*	0.93 (0.83, 1.05)	1.01 (0.85, 1.18)
Before 1990	—	—	—	—

Note: Based on HIV-diagnosed persons aged 18 and older, receiving Medicaid with at least one inpatient stay between 1992 and 1998. Parameter estimates are based on robust ordinary least squares regression on log length of stay and log time in months to readmission. The regressions include an intercept term. The asterisks denote significant effects relative to the reference group:

***$p<0.001$;

**$p<0.01$;

*$p<0.05$.

Abbreviations: AIDS: Acquired Immune Deficiency Syndrome; PI/NNRTI: Protease Inhibitor or Non-Nucleoside Reverse Transcriptase Inhibitors; MI: Mental Illness; SMI: Severe Mental Illness; OMI: Other (non-severe) Mental Illness; OI: Opportunistic Infection; IDU: Injection Drug User; ACCAP: AIDS Community Care Alternatives Care Program; NA: Not applicable.

SMI history or OMI history did not significantly differ from LOS for visits of persons with no mental illness history. As noted in the Methods section, associations for Primary and Secondary OMI did not differ. While HIV Dementia diagnosis was associated with longer adjusted LOS, ratio = 1.31 (95 percent CI: 1.13–1.52), this adjusted increase was less than that for diagnoses of other AIDS illnesses 1.42 (95 percent CI: 1.38–1.46).

In adjusted models, Time to Readmission (TR) ranged from being 2 percent to 16 percent shorter for each of the mental illness categories considered (Primary SMI, Secondary SMI, SMI History, Acute OMI, and OMI History) compared to visits of persons with no mental illness history. These differences were significant at $p < 0.001$ for SMI history and Acute OMI and at $p < 0.05$ for OMI History.

Almost all of the non-mental-health variables considered here remained significantly (and often very strongly) associated with LOS and/or TR in the adjusted models of Table 2. Indicators of more severe HIV disease (i.e., death in hospital) or worse underlying health of patient (i.e., older age) were associated with longer LOS and shorter TR in adjusted models. Medicare enrollment was associated with a TR almost two times longer; and from 1993 to 1998 (versus 1992), LOS systematically reduced to a ratio of 0.75 while TR ratio increased to 3.39, all significant at ($p < 0.001$) in adjusted models. Those diagnosed with Primary and Secondary Substance Abuse each (versus those not diagnosed with Substance Abuse) had shorter adjusted LOS (ratios 0.57, [95 percent CI: 0.54–0.60] and 0.87 [95 percent CI: 0.84–0.90], respectively) and longer times to readmission (ratios 1.49 [95 percent CI: 1.34–1.66) and 1.17 [95 percent CI: 1.11–1.24], respectively).

DISCUSSION

This article explored associations between acute mental illness episodes and underlying mental illness history with inpatient length of stay (LOS) and time to readmission (TR) among AIDS patients insured by Medicaid. Of particular interest was whether mental illness comorbidities increased the time to treat and/or discharge HIV conditions. In this large study with 6,247 AIDS patients and 24,975 visits from 1992 to 1998, treatment of mental illness was not uncommon; $\sim$ 9 percent of visits involved an acute mental illness diagnoses. Persons who had been diagnosed with a severe mental illness at some time from 1992 to 1998 contributed 19 percent of the hospital stays, while persons

diagnosed with less severe "other" mental illness from 1992 to 1998 contributed $\sim$ 33 percent of the stays.

In Table 1, the mean LOS for all subgroups of AIDS patients experiencing acute mental comorbidity at the visit or who had been diagnosed with mental illness at some other visit ranged from 11.3 to 12.4 days, which was *shorter* than the mean LOS for patients with no known mental illness history (13.5 days). This compares to LOS being 2–6 days *longer* for admissions with psychiatric comorbidity among Washington State AIDS patients (Uldall et al. 1994; Uldall et al. 1998). But the different findings of these studies could reflect differences in study population characteristics rather than different effects of mental illness.

After adjusting for the large number of patient and patient-visit characteristics in Table 2, we observed that, compared to LOS for AIDS patients with no mental illness history, the LOS for hospital stays of AIDS patients who presented with Primary Severe and Secondary Severe Mental Illness diagnoses were $\sim$ 32 percent and 11 percent longer, respectively. This supports previous findings (Uldall et al. 1994; Uldall et al. 1998; Cheng et al. 2001) of positive association between mental illness and LOS in HIV-infected persons. But the substantially greater increase in adjusted LOS for a Primary SMI diagnosis than for a Secondary SMI diagnosis suggests that treating the severe mental illness, rather than interaction of mental comorbidity with treating and discharging HIV conditions, may be more responsible for increased LOS.

Furthermore, in the adjusted comparisons in Table 2, neither acute episodes of less severe mental illness (OMI) nor having a known history of mental illness (in the absence of an acute severe mental illness) were associated with greater LOS. This suggests that any impact on LOS is minimal from (1) acute comorbidity from less severe mental illnesses and (2) having a propensity for mental illness (in the absence of an acute diagnosis).

While these findings cannot rule out interference of Severe Mental illness conditions with time to treat HIV conditions, including a negative effect of depression on the immune function, they are more consistent with an increased LOS in patients with Acute (in particular Primary) Severe Mental Illness due to time needed to treat and discharge the Severe Mental Illness itself. But needs to take medications for Severe Mental Illness in addition to a substantial number of AIDS medicines could result in lack of use of one or more prescribed medicines due to cumulative toxicities or medicine interactions (Tseng and Foisy 1999). As AIDS may be considered more life-threatening, mental illnesses medications might thus be "preferably" discontinued,

which may contribute to the adjusted 32 percent increase in LOS for persons with Severe Mental Illnesses that we observed.

The adjusted models in Table 2 also suggest that for persons with AIDS, time to readmission was 2 percent to 16 percent shorter for visits in all categories of acute mental illness and mental illness history than for visits of other patients with similar characteristics, but no history of mental illness. Uldall et al. (1998) (in unadjusted analysis) also found that hospitalized AIDS patients "ever diagnosed with a psychiatric morbidity" had shorter times to hospital readmission than did persons not diagnosed with psychiatric morbidity. Quicker readmission may reflect that in addition to HIV diseases, AIDS patients with mental illness also experience mental disorders that need hospitalization, perhaps due to inadequate treatment of mental illnesses at current or prior visits.

The associations between indicators of severity of disease and access to health care on the one hand, and LOS and TR on the other that were observed in this study, are mostly expected and consistent with prior findings (Kelly, Ball, and Turner 1989; Stein 1994; Bonuck and Arno 1997; Dal Pan, Skolasky, and Moore 1997). Diagnosis of a major opportunistic AIDS illness at the visit was associated with an adjusted 42 percent increase in LOS, which is only somewhat greater than the 32 percent increase in LOS associated with a primary diagnosis of severe mental illness. This indicates that hospitalization time needed for primary severe mental illness episodes among persons with AIDS may be comparable to that needed for advanced AIDS diseases.

The most notable associations with LOS and TR observed in this study are for calendar trends from 1992 to 1998. Mean LOS declined by more than 4.5 days and TR increased by $\sim$ 6 months. After adjusting for year of visit, our variable for use of PI/NNRTI by the patient was associated with only a 10 percent reduction in LOS and had no association with TR. However, this likely is an underestimate since we incorporated PI/NNRTI as an intent-to-treat variable (once started always considered using PI/NNRTI) to eliminate well-known selection biases related to ability to stay on these regimens; for example, the sickest patients may not be able to tolerate treatment (Glesby and Hoover 1996). Furthermore, we only have data prior to 1999. If recent widespread use of PI/NNRTI has further reduced the time needed to hospitalize for HIV (but not for mental illness), current associations between diagnoses of acute Primary and Secondary severe mental illnesses and hospitalization time for AIDS patients could now be even greater than those reported here.

Some potential study limitations should be noted. We studied New Jersey Medicaid patients and it cannot be ruled out that association between

mental illness and hospital LOS for AIDS patients differs between countries and by insurance coverage in the United States. The data available in Medicaid claims limit our ability to utilize criteria of duration and severity of mental illness to define subgroups of interest; the bias here should be conservative (harder to find associations with mental illness) since some patients with history of mental illness may be not be identified as such, and misclassified as no mental illness. As our measures of chronic mental illness were based on number of contacts with the medical system, there is also some bias toward identification of Mental Illness History in patients who had had longer contact with the medical system. However, as all patients had been diagnosed with AIDS by 1996 and data were collected until the end of 1998, we believe this bias was small. Some patients may have gone off of Medicaid eligibility during the evaluation period, which might make time to readmission estimates for these persons unreliable. Even the large number of variables we used to adjust for stage of disease and access to health care may still not be able to remove all confounding with mental illness. Most notably, we did not have CD4 counts, a strong predictor of HIV disease progression. If those diagnosed with mental illness were more likely to be at earlier stages of AIDS, this could create a conservative bias.

In conclusion, the adjusted analyses of this study of 24,975 hospital visits from 2,247 patients finds longer inpatient stays were associated with a diagnosis of acute severe mental illness (schizophrenia, bipolar disorder, or major depression), and that these increased stays may reflect nontrivial burden to the care of AIDS patients. The greater (adjusted) increase of LOS for a Primary ($\sim$ 32 percent) than for a Secondary ($\sim$ 11 percent) Severe Mental Illness diagnosis suggests, but does not prove, that treatment (or discharge) of the mental illness itself, rather than the mental illness interfering with treating HIV conditions, may be most responsible for increased length of stay. While these findings at least partially confirm previous studies (Uldall et al. 1994; Uldall et al. 1998; Cheng et al. 2001), we did not observe associations between episodes of less severe mental illnesses and LOS for patients with AIDS. As mental illness history alone (in the absence of a severe mental illness diagnosis at a visit) was not associated with LOS in adjusted models, underlying mental illness may not affect length of stay unless the patient experiences an acute severe mental illness at that visit.

Given the association patterns observed here, to better understand causal relationships between mental illness and hospital LOS among HIV patients, it may be important for future studies to distinguish between severe and less-severe mental illnesses and to consider primary (and secondary)

diagnoses of acute mental illnesses at a visit separately from underlying patient history of mental illness. Further studies of the association of mental illness with the total cost of care for AIDS patients may also be needed. However, given the large number of factors (such as calendar time, indicators of HIV disease severity, and access to health care) that have strong associations with LOS in this population, these characteristics may also need to be considered in future studies of associations between mental illness and LOS of HIV patients.

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