Patterns of Ambulatory Care for AIDS Patients, and Association with Emergency Room Use

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Objective. We examined the association of patterns of ambulatory care for AIDS patients with any use of the emergency room (ER) and the monthly rate of ER visits in the six months after AIDS diagnosis.

Data Sources/Study Setting. The study population was obtained from the New York State Medicaid HIV/AIDS Research Data Base and includes patients diagnosed with AIDS from 1983 to 1990.

Data Collection/Extraction Methods. To examine patterns of care and ER use not leading to hospitalization, we studied patients who survived at least six months after their first AIDS-defining diagnosis. The data base included person level information on visits to different provider sites and patient demographic and clinical characteristics.

Study Design. We defined the dominant provider as the site delivering the majority of ambulatory care for patients with a minimum of four ambulatory visits in the six months after AIDS diagnosis. Dominant providers were classified by specialty and setting: generalist physician; general medicine clinic; AIDS specialty clinic; and other specialty clinic or physician (e.g., cardiology). Patients without a dominant provider were grouped into those with four or more visits and those with fewer than four visits. Regression analysis was used to estimate relationships between ER use and patterns of ambulatory care and patient demographic and severity of illness characteristics.

Principal Results. The study population included 9,155 AIDS patients aged 13 to 60 years at diagnosis, continuously Medicaid-enrolled, and surviving at least six months after AIDS diagnosis. Among those with four or more visits (56 percent), over 70 percent had a dominant provider. Overall, 39 percent of the study population visited the ER while, in the group with four or more visits, 53 percent of those without a dominant provider had an ER visit. Patients without a dominant provider were estimated to have 32 percent higher odds of ER use than patients with a dominant provider. Among patients with a dominant provider, patients with a generalist or primary care clinic dominant site of care were estimated respectively to have 18 percent and 23 percent lower odds than patients with an AIDS specialty clinic as the dominant site of care. Drug users had higher odds of ER use, as did women.

Conclusions. In this Medicaid AIDS population, a dominant provider delivering the majority of a patient's care was associated with less use of the ER by the patient. Among patients with a dominant provider, ER use was lowest for those with a primary care provider. Further examination of the type and availability of ambulatory services in AIDS specialty clinics and primary care settings, as well as more detailed information on patient characteristics, may reveal reasons for these patterns of ER use.

Keywords. Ambulatory care, patterns of care, emergency room use, AIDS patient

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Progress in the management of individuals with advanced human immunodeficiency virus (HIV) infection and the acquired immune deficiency syndrome (AIDS) has altered the natural history of the disease from a rapidly fatal, devastating condition to a slowly progressive, chronic disease that can last for a number of years (Lemp, Payne, Neal, et al. 1990; Moore et al. 1991). As a result, ambulatory care has become a central component of the long-term clinical management of persons with advanced HIV disease. Similar to persons with other serious chronic diseases, such as insulin-dependent diabetes, atherosclerotic heart disease, and emphysema, the clinical course of persons with AIDS is now characterized by prolonged but stable intervals of chronic illness interrupted occasionally by acute complications requiring hospital care. Because numerous complex clinical complications are generally manifested by chronically ill HIV-infected patients, the expertise of

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multiple types of ambulatory providers is often necessary in patient care. However, continuity of care can be compromised when health care delivery becomes fragmented across many providers and sites of care.

AIDS has been promoted as a condition that can be managed primarily by general internists, family practitioners, and other generalists with specialists consulting only as needed (Northfelt, Hayward, and Shapiro 1988). Infectious disease and other AIDS specialist providers have also assumed the responsibility for directing ambulatory care for persons with advanced HIV infection (Satterwhite et al. 1991). Patterns of ambulatory care for persons with AIDS has not been assessed in large populations, despite the existence of very different models of care. In this study, we examined the impact of having a 'dominant' provider delivering the majority of care to persons with AIDS, the specialty and setting of the dominant provider, and ambulatory visit frequency on emergency room use as an example of potentially inappropriate and costly use of the health care system. We studied only emergency room visits not leading to a hospitalization because they may constitute an expensive and potentially ineffective substitute for ambulatory visits. In studies of Medicaid-enrolled patients with other diseases, greater emergency room use has been associated with more fragmented care (Hurley and Freund 1989). The emergency room offers an expensive alternative to care in a clinic or office, and it threatens patients' continuity of care. Additionally, persons with HIV infection have been observed to place increasing demands on emergency rooms in high prevalence cities (Kelen, DiGiovanna, Bisson, et al. 1989; Kelen, Johnson, DiGiovanna, et al. 1990; Schoenbaum and Webber 1993).

Mor and colleagues (1992) examined relationships between emergency room use and the type of usual source of care reported by 939 HIV-infected persons with and without AIDS who were involved in a study of case management and other means of integrating services. They studied the association of patient demographic and clinical characteristics as well as the type of usual source of care with emergency room use regardless of whether or not the visit directly preceded a hospital stay. However, they did not examine the specialty of the clinic or the amount of care delivered by the ambulatory provider identified as the usual source of care. Moreover, this population was involved in an investigation of special programs to improve coordination of health care delivery. Thus, the results of these analyses may not be relevant to populations of AIDS patients who lack the benefit of such services.

In this article, we examined patterns of ambulatory care within six months of the patient's first AIDS-defining diagnosis for a large cohort of New York State Medicaid-enrolled persons who were diagnosed with AIDS in 1983 through 1990. We identified the specialty and setting of

the "dominant" provider who delivered the majority of the patient's care. We estimated the relationship between patterns of ambulatory care and emergency room use controlling for patient disease characteristics, such as gender, intravenous drug use, and disease severity, which Mor and colleagues previously reported to be related to use of emergency services by HIV-infected persons (Mor et al. 1992).

METHODS

STUDY POPULATION

The study population was obtained from the New York State (NYS) Medicaid HIV/AIDS Research Data Base, which contains longitudinal resource use, clinical, and pharmacological treatment histories for persons diagnosed with AIDS in federal fiscal years 1983 through 1990. The data base includes individuals with AIDS found by a tested case-finding algorithm applied to all Medicaid claims (Keyes, Andrews, and Mason 1991). The first AIDS-related diagnosis consistent with the Centers for Disease Control's (CDC) 1987 AIDS surveillance case definition (Centers for Disease Control 1987) in each patient's longitudinal clinical history was identified by diagnoses coded by the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) (Turner, Markson, McKee, et al. 1991). The maximum number of ICD-9-CM diagnoses on inpatient and outpatient claims were five and two, respectively.

In our entire Medicaid HIV/AIDS Research Data Base in 1983–1990, we have 28,116 individuals with AIDS. For this analysis we excluded children younger than 13 ($N = 1{,}537$) and adults over 60 ($N = 273$), since children have a different spectrum of disease and review of clinical data on the oldest group's claims files suggested for many cases other potential causes of opportunistic infections and immunosuppression than HIV infection. We also excluded individuals without a specific AIDS-defining condition recorded in their Medicaid records because an AIDS code alone has been found to have low specificity for AIDS (Rosenblum, Buchler, Morgan, et al. 1993) and does not permit clinical staging ($N = 8{,}313$). Finally, we excluded persons who died or were not continuously eligible for six months after AIDS diagnosis ($N = 8{,}838$). These exclusions resulted in a final analysis file of 9,155 adults. We studied the first six months after AIDS diagnosis because patients were generally symptomatic during this time period, had ongoing health care needs, and would likely have depended on emergency care if they lacked an established source of ambulatory care.

The severity of the first AIDS-related diagnosis was determined by a three-stage classification of AIDS-defining conditions (Table 1) developed

by a panel of clinical experts and tested empirically (Turner, Markson, McKee, et al. 1991). Risk group information is established by an algorithm that searches for specific codes for drug dependence and methadone maintenance treatment. Drug users were identified by inpatient or outpatient ICD-9-CM–coded diagnoses indicating intravenous drug use or narcotic dependence or by claims for methadone maintenance program services. Other patient characteristics used in these analyses include sex, age, and an indicator of whether the patient had other insurance in addition to Medicaid. Racial and ethnic information was not available in our data base.

CLASSIFYING PATTERNS OF AMBULATORY CARE

We determined frequencies of unique outpatient encounters to each ambulatory care provider site and total number of hospital days in the six months after the first AIDS-related diagnosis. Physician specialty was identified from the 1988–1989 American Medical Association (AMA) Physician Masterfile. For clinics and physicians not in the AMA file (21 percent), we obtained specialty information from the NYS Medicaid provider file. Visits to physicians unlikely to provide ongoing clinical care, such as radiologists or pathologists, and visits to nonphysician providers such as dentists were deleted. Care by nurse practitioners or physician assistants are typically billed under a physician or clinic provider. This care was consequently included in our counts of ambulatory visits, but we were unable to distinguish these providers in our analyses.

Descriptive data on ambulatory care included number of physicians or clinics visited, the site of each visit, and the number of visits to each physician or clinic. Medicaid data do not distinguish visits to different providers in the same clinic. Private physicians in the same specialty and with the same billing address were considered a group practice, and visits were analyzed as visits to a single provider or site of care to render the data comparable for those with clinic visits. Consequently, our pattern of care analyses represent investigation of the effect of different provider sites on emergency room use (i.e., site continuity), and not the impact of individual physicians (i.e., physician continuity). Site continuity measures the degree to which the patient receives care from an organized group of providers at a single site who maintain a single patient medical record (Steinwachs 1979). In this study we use the term provider to refer either to a physician or a clinic.

We examined the distribution of types of providers for patients with at least four ambulatory visits in the first six months after the diagnosis of AIDS. The minimum of four ambulatory visits was chosen to permit a discernible pattern of care among providers to be established by the

Table 1: Distribution of the Study Population by Number of Ambulatory Visits and Patient Demographic and Clinical Characteristics

		Percent of Patients by Number of Visits		
Patient Characteristic	N	*At Least 4 Visits*	*Fewer than 4 Visits; < 120 Hospital Days*	*Fewer than 4 Visits; ≥ 120 Hospital Days*
All Patients	9155	56.3	37.9	5.8
Sex***				
Male	6882	54.8	39.2	6.0
Female	2273	60.9	33.9	5.2
Age (years)***				
13–29	1999	53.9	41.2	4.9
30–39	1855	56.0	38.3	5.7
40–49	1897	58.4	34.8	6.8
50–60	404	61.4	31.7	6.9
Drug user***				
Yes	4705	53.3	40.2	6.4
No	4450	59.4	35.4	5.2
Diagnosis year***				
Before 1989	5288	54.6	40.2	5.2
1989–1990	3867	58.7	34.7	6.6
AIDS-defining† diagnosis***				
Group 1	2185	59.7	35.4	4.9
Group 2	4981	57.1	39.1	3.8
Group 3	1989	50.4	37.7	11.9
Other insurance*				
Yes	1043	59.9	35.3	4.8
No	8112	55.8	38.2	6.0

*$p < .05$ from Chi-square test.

***$p < .001$ from Chi-square test.

†Severity group 1 includes Kaposi's sarcoma, chronic herpes simplex, disseminated tuberculosis, candida esophagitis, wasting syndrome, and recurrent *Salmonella* septicemia. Severity group 2 includes *Pneumocystis carinii* pneumonia (PCP). Severity group 3 includes disseminated *Mycobacterium avium* complex infection, cryptococcosis, disseminated cytomegalovirus infection, cryptosporidiosis or isosporiasis, toxoplasmosis, disseminated histoplasmosis, AIDS-associated lymphoma, AIDS dementia complex, disseminated coccidioidomycosis, and progressive multifocal leukoencephalopathy.

patient. Four visits has been reported as the minimum number necessary to quantify continuity of care using a commonly adopted measure (Roos, Roos, Gilbert, et al. 1980). This minimum visit frequency in six months was also determined by examining published guidelines for monitoring persons with advanced HIV infection. Most guidelines focus on defining visit frequencies necessary to follow changes in CD4+ lymphocyte counts and to monitor

the status of patients on anti-retroviral therapy or on PCP prophylaxis. A person on zidovudine who is stable clinically needs to be monitored every one to three months (National Institutes of Allergy and Infectious Diseases 1990). Even though zidovudine was not generally available until covered by Medicaid after April 1987, these guidelines indicate that a minimum frequency of four visits in six months could allow adequate monitoring of a patient after a serious AIDS-defining complication.

In the absence of guidelines regarding the optimal distribution of visits among various types of providers for persons with AIDS, we examined frequencies of visits to each patient's providers to identify patterns of care. Since we were examining the influence of the dominant site of ambulatory care on emergency room use, we excluded emergency room visits when specifying the patterns of ambulatory care. Other studies have reported that primary physicians were seen for an average of 60 to 78 percent of each patient's office visits (Deitrich, Nelson, Kirk, et al. 1988; Mendenhall, et al. 1979; Goldberg and Deitrich 1985). In studies where self-reported usual site of care was not available, a primary provider has usually been identified as the provider delivering a very high proportion of all visits. For example, a primary provider for mental health services was identified by Temkin-Greener and Clark (1988) when 75 percent of all visits were to one provider. Since AIDS patients may need to consult with specialists for diverse complications, we explored identifying a dominant provider using three cutoff points: >50 percent, >60 percent, and >75 percent of visits. As expected, the proportion of patients identified as having a dominant provider dropped as the cutoff rose. However, the choice of a cutoff point did not change the direction or significance of our analytical results. Consequently, we selected the >50 percent cutoff as the proportion of visits needed to define a dominant provider, because it designated the site of care delivering the majority of ambulatory care and it permitted the largest number of patients to have a dominant provider identified.

After identifying the specialty and setting of the dominant provider for the study population, we grouped the most frequent types of providers into the following categories:

1. **Primary care clinic.** Composed primarily of general medicine, adolescent medicine, and general pediatric clinics;
2. **AIDS specialty clinic.** Composed of infectious disease or hematology/oncology clinics as well as HIV/AIDS or primary care clinics in a designated-AIDS center hospital. These latter two types of clinics were indistinguishable in the medical files because no specialty code was available at that time for HIV/AIDS clinics;

3. **Generalist dominant physician.** Composed of family practitioners, general internists, pediatricians, and adolescent medicine specialists; and
4. **Other provider.** Composed of physicians and clinics in medical subspecialties or surgical specialties. Only 23 patients had an infectious disease or hematology/oncology physician as their dominant provider. Because emergency room use of patients followed by these providers was similar to that of patients whose dominant providers were physicians or clinics in other specialties, we combined these groups. The specialties within each of these three categories had no significant difference in emergency room use observed.

We specified two additional patterns of care for patients without a dominant provider:

5. **No dominant provider.** Includes patients with at least four visits and no more than 50 percent of their visits with one provider;
6. **Few visits.** Includes patients with fewer than four visits in the six-month interval.

We also analyzed the number of hospital days because this variable influenced the frequency of ambulatory and emergency room visits. The median number of hospital days for the study population within six months of AIDS diagnosis was 31. We examined the association of emergency room visits with the number of hospital days by 30-day intervals. Patients with 1 to 120 days of inpatient care had a similar probability of any emergency room use during the six-month study period; thus, we categorized hospital care into two groups by this cut point.

ANALYSIS PLAN

We examined health care delivery within six months of diagnosis for patients by two groups of ambulatory visits, fewer than four compared with four or more, and by two groups of hospital days: under 120 days and 120 or more days. We report the patterns of ambulatory care by sex, age, drug user status, year of AIDS diagnosis, severity of AIDS-defining diagnosis, and whether the patient had other insurance. We examined bivariate associations of these patient factors with emergency room use that did not lead to a hospitalization. We report mean hospital days, ambulatory visits, and emergency room visits by pattern of care and AIDS-defining diagnosis severity group. We measured emergency room use in two ways: (1) any emergency room use within six months after AIDS diagnosis, and (2) the rate of emergency room use per month of nonhospitalized days during the

same time interval. This second measure excludes inpatient care because prolonged hospital stays reduce the opportunity for emergency room visits.

Two types of multivariate equations were estimated to assess associations between the patterns of ambulatory care and emergency room care. First, the probability of any emergency room use was modeled using logistic regression analysis, categorizing the outcome measure as a bivariate dependent variable. The independent variables included the patterns of ambulatory care, hospital days, and patient clinical and demographic characteristics. We also report the odds of emergency room use after collapsing the patterns of care into three groups: no dominant provider, any type of dominant provider, and few visits. Second, negative binomial regression (Lawless 1987; McCullagh and Nelder 1983) was used to estimate the mean visit rates for each patient subgroup, accounting for differing periods at risk for emergency room visits excluding the duration of inpatient stays. In this second model, maximum likelihood regression techniques were used. The Appendix provides a technical explanation of the negative binomial regression model used. The independent variables used in the negative binomial regression were the same as those in the logistic model except that hospital days was modeled as a continuous variable rather than a categorical variable. Interactions between the independent variables were examined, and an important interaction between gender and drug use was reported. Finally, we also report estimated odds ratios from a model without this interaction to facilitate comparison with other studies.

RESULTS

The 9,155 persons with AIDS in our study population had a mean of 7.5 and standard deviation (s.d.) of 11.4 ambulatory care visits within six months of their first AIDS diagnosis. As shown in Table 1, 56 percent of all patients had at least four ambulatory care visits in the six months after AIDS diagnosis. This group included significantly more patients who were women, non-drug users, older at AIDS diagnosis, diagnosed after 1988, diagnosed with less severe AIDS-defining conditions, and beneficiaries of other insurance. The proportion of patients with fewer than four ambulatory care visits and 120 hospital days or more was over twice as large for the most severe AIDS-defining diagnosis group than for patients in the less severe AIDS-defining diagnosis groups.

Table 2 presents the distribution of care patterns in the six months after AIDS diagnosis for patients having at least four visits. Over 70 percent had a dominant provider delivering the majority of care. The most common type of dominant site was the AIDS specialty clinic followed by primary care

Table 2: Patterns of Care for Patients with At Least Four Visits during the Six Months after an AIDS-Defining Diagnosis

		Percent of Patients by Pattern of Ambulatory Care				
Type of Patient	N	*No Dominant*	*Primary Care Clinic*	*AIDS Specialty Clinic*	*Generalist Physician*	*Other Provider*
All Patients	5153	28.6	19.6	33.3	12.9	5.6
Sex***						
Male	3769	27.0	20.3	34.4	12.4	5.9
Female	1384	33.0	17.7	30.2	14.3	4.8
Age (years)***						
13–29	1078	27.3	20.8	33.5	13.5	5.0
30–39	2719	28.7	19.4	32.6	13.4	5.9
40–49	1108	29.8	19.2	32.6	13.4	5.9
50–60	248	27.4	19.3	32.3	13.3	7.7
Drug user***						
Yes	2509	35.8	17.2	28.3	12.6	6.2
No	2644	21.8	21.9	38.0	13.2	5.0
Diagnosis year***						
Before 1989	2885	28.9	20.4	29.4	15.5	5.8
1989–1990	2268	28.1	18.7	38.2	9.7	5.4
AIDS-defining† diagnosis***						
Group 1	1305	33.8	23.1	24.5	13.4	5.2
Group 2	2845	27.5	18.2	36.1	12.4	5.8
Group 3	1003	24.8	18.8	37.1	13.7	5.8
Other insurance*						
Yes	625	23.0	14.7	22.4	34.6	5.3
No	4528	29.4	12.7	19.2	33.1	5.6

*$p < .05$ from Chi-square test.

***$p < .001$ from Chi-square test.

†See footnote for Table 1.

clinics. Relatively small proportions of the population had a generalist or another type of dominant provider. A slightly smaller proportion of women than men and a higher proportion of non-drug users than drug users had an AIDS specialty clinic as the dominant provider. Larger proportions of patients with higher-severity AIDS-defining diagnoses and of patients diagnosed in more recent years had an AIDS specialty clinic as the dominant provider. On average, individuals without a dominant provider visited 5.8 (s.d., 5.4) different ambulatory care providers in the six months after AIDS diagnosis. In contrast, the average number of providers ranged from 1.9 (s.d., 1.1) for those with an AIDS specialty clinic dominant provider to 2.5 (s.d., 1.3) for those with physicians and clinics in other medical or surgical subspecialties as their dominant providers.

Among those with at least four visits, higher proportions of women, drug users, persons with less serious AIDS-defining diagnoses, and persons without other insurance did not have a dominant provider. Although we did not observe a secular trend in the proportion of the study group with a dominant provider, there was a trend for the dominant provider to shift from generalist physicians to AIDS specialty clinics.

Table 3 displays the health care resource use associated with the patterns of ambulatory care and the AIDS-defining diagnosis groups. The observed mean number of inpatient days was lowest for patients with an AIDS specialty clinic as the dominant site of care whereas patients having few visits generally had many inpatient days. The observed mean numbers of ambulatory visits and emergency room visits were highest for those without a dominant provider. We found that patients in severity groups 1 and 2 had virtually the same mean inpatient days while the most severe group had more inpatient days. Severity group 1 had, on average, more ambulatory and emergency room visits than severity group 2. However, severity group 2 had more ambulatory visits but a similar mean emergency room visits compared to severity group 3.

As shown in the first column of Table 4, over one-third of all patients had at least one emergency room visit. Emergency room care was more likely for women, drug users, older patients, patients diagnosed before 1989, and patients without other insurance in addition to Medicaid. Interestingly, a higher proportion of patients with less severe AIDS-defining diagnoses had emergency room care exclusive of visits that led to a hospitalization. The most severely ill patients likely had more emergency room visits that led to an inpatient stay because, as shown in Table 3, they had more inpatient care. Table 4 also shows that over half of the patients without a dominant provider visited the emergency room at least once. The rates of emergency room use per outpatient month are also shown on Table 4. These rates show similar patterns to those discussed above for the dichotomous outcome of any emergency room use.

Table 5 presents the results of a logistic regression model estimating the effect of patterns of care and other patient factors on any emergency room use. The estimated odds of emergency room use was greater for female drug users than for male non-drug users (the reference group). The odds of emergency room care decreased with increasing age at diagnosis and with AIDS diagnosis in more recent years. Patients with other insurance in addition to Medicaid were less likely to have any record of emergency room care. The odds of emergency room care were lower for persons diagnosed with *Pneumocystis carinii* pneumonia (PCP) (i.e., severity group 2) compared with persons having less severe AIDS-defining diagnoses, but patients in severity group 3 had slightly higher odds ($p = .06$).

Table 3: Hospital Days, Ambulatory Visits, and Emergency Room Use by Pattern of Ambulatory Care and Severity of AIDS-Defining Diagnosis in Six Months after AIDS Diagnosis

Characteristic	*Hospital Days Mean (s.d.)†*	*Ambulatory Visits Mean (s.d.)*	*Emergency Room Visits Mean (s.d.)*
Pattern of Ambulatory Care			
Four or more visits†			
No dominant provider	32.9(28.5)*	17.2(19.5)*	1.4(2.6)*
Dominant primary care clinic	32.5(29.9)	12.8(11.9)	0.8(1.4)
Dominant AIDS specialty clinic	28.5(25.2)	11.1(10.2)	0.7(1.2)
Dominant generalist physician	30.4(26.5)	9.7 (5.4)	0.9(1.4)
Other dominant provider	34.3(29.2)	12.4 (9.8)	0.7(1.1)
Fewer than four visits	58.2(48.2)	1.0 (1.1)	0.5(1.2)
AIDS-Defining Diagnosis			
Group 1	38.3(40.3)	9.6(15.5)**	1.0(2.1)**
Group 2	38.8(34.9)***	7.0 (9.6)***	0.8(1.3)
Group 3	58.9(48.1)	6.5(10.0)	0.7(1.4)

†(s.d.) = standard deviation.

*$p < .001$ for overall comparison of five patterns of care with four or more visits by Wilcoxon Rank Sum test.

**$p < .001$ for pairwise comparison between severity group 1 and 2 by Wilcoxon Rank Sum test.

***$p < .001$ for pairwise comparison between severity groups 2 and 3 by Wilcoxon Rank Sum test.

Table 5 shows that patients without a dominant provider had 17 percent higher odds of using the emergency room compared with patients having an AIDS specialty clinic as the dominant site of care, controlling for hospital use and patient characteristics. However, other types of dominant providers, especially generalist physicians, are associated with lower odds of emergency room care than AIDS specialty clinics. The lowest odds of emergency room use appeared for persons with few ambulatory visits. Higher odds of emergency room use in the six months after AIDS diagnosis are observed for persons who were hospitalized from 1 to 119 days compared to those who were not hospitalized during the study period.

We estimated two additional logistic models, not shown. First, we estimated a model without the gender–drug use interaction using men and non-drug users as reference groups. The estimated odds for women was 1.29 (95% CI 1.16, 1.42) and for drug users was 1.54 (95% CI 1.41, 1.68). Second, we estimated a model with three pattern of care groups collapsing all patients with a dominant provider into one group. Compared to those

Table 4: Emergency Room (ER) Use by Patient Characteristics for All Patients during the Six Months after an AIDS-Defining Diagnosis

Type of Patient	*Percent with ER Use*	*Rate of ER Visits per Month, Excluding Inpatient Days*
All Patients	39.2	.20
Sex		
Male	37.1***	.19***
Female	45.6	.23
Age (years)		
13–29	41.9***	.21***
30–39	39.4	.21
40–49	37.1	.17
50–59	33.2	.17
Drug user		
Yes	44.1***	.24***
No	33.0	.15
Diagnosis year		
Before 1989	40.3***	.21**
1989–1990	37.7	.19
AIDS-defining diagnosis		
Group 1	43.7***	.25***
Group 2	37.9	.18
Group 3	37.5	.19
Other insurance		
Yes	28.8***	.14***
No	40.5	.20
Pattern of ambulatory care		
No dominant provider	52.9	.29**
Dominant primary care clinic	41.8	.15
Dominant AIDS specialty clinic	45.5	.19
Dominant generalist physician	41.4	.18
Other dominant provider	41.7	.16
Fewer than four visits	30.2	.18

*$p < .05$; **$p < .01$; ***$p < .001$.

with a dominant provider, the odds of emergency room use for those without a dominant provider was 1.32 (95% CI 1.17, 1.50) and for those with few visits was 0.53 (95% CI 0.47, 0.59).

Table 6 displays the results of the negative binomial regression model that estimates the rate of emergency room visits per month of time that the patient was not in the hospital. The same patient characteristics associated with greater odds of any emergency room care also appear to affect the rate of emergency room use in the negative binomial model. The rate of ER visits decreased by about 1 percent for each increase of one year in

Table 5: Logistic Regression of Any Emergency Room Use

Parameter	*Parameter Estimate*	*Standard Error*	*Odds Ratio*
Intercept	−0.36	0.14	0.70
Gender-Drug Use Group			
Female non-drug user†	0.38	0.08	1.46***
Male drug user	0.49	0.05	1.63***
Female drug user	0.64	0.18	1.89***
Age	−0.01	0.00	0.99***
Diagnosis in 1989 or 1990	−0.14	0.05	0.87**
AIDS-Defining Diagnosis			
Group 1 (least severe)	0.25	0.05	1.29***
Group 3 (most severe)	0.11	0.06	1.11
Type of Ambulatory Care			
No dominant provider	0.16	0.07	1.17*
Dominant generalist	−0.26	0.09	0.77**
Dominant primary care clinic	−0.20	0.08	0.82*
Other dominant provider	−0.25	0.13	0.78
Fewer than four visits	−0.76	0.06	0.47***
Days Hospitalized			
1–119	0.45	0.07	1.57***
120+	−0.08	0.09	0.92
Other Insurance	−0.42	0.07	0.66***

*$p < .05$; **$p < .01$; ***$p < .001$.

†Reference groups for the model: male non-drug users, diagnosis before 1989, PCP (Group 2) as the first AIDS-defining diagnosis, AIDS specialty clinic dominant provider, no hospital days in the six months after AIDS diagnosis, no other insurance.

age. The effect of pattern of ambulatory care on the rate of emergency room visits was similar to that estimated by the logistic regression. Patients without a dominant provider had an estimated 30 percent higher emergency room visit rate compared to those treated in AIDS specialty clinics. Thus, patients without a dominant provider were not only more likely to have any emergency room care, but also used the emergency room at a higher average rate than those with an AIDS specialty clinic as the dominant site of care. Primary care clinic patients had a lower emergency room visit rate than did patients of an AIDS specialty clinic. As in the logistic model, individuals with few ambulatory visits had the lowest rate of emergency room visits. However, the coefficient for hospital days in Table 6 indicates that, on average, the emergency room visit rate increased by nearly 1 percent with each additional hospital day.

Table 6: Negative Binomial Regression of Emergency Room Visit Rates per Month of Nonhospital Time

Parameter	*Parameter Estimate*	*Standard Error*	*Multiplicative Effect*
Intercept	−1.743	0.108	
Gender–Drug Use Group			
Female non-drug user†	0.256	0.066	1.29***
Male drug user	0.413	0.045	1.51***
Female drug user	0.394	0.058	1.48***
Age	−0.013	0.003	0.99***
Diagnosis in 1989 or 1990	−0.119	0.038	0.88**
AIDS-Defining Diagnosis			
Group 1	0.259	0.045	1.30***
Group 3	0.037	0.050	1.04
Type of Ambulatory Care			
No dominant provider	0.261	0.059	1.30***
Dominant generalist	−0.147	0.079	0.86*
Dominant primary care clinic	−0.242	0.070	0.79***
Other dominant provider	−0.177	0.115	0.84
Fewer than four visits	−0.539	0.053	0.58***
Days Hospitalized	0.009	0.0006	1.01***
Other Insurance	−0.375	0.065	0.69***

*$p < .05$; **$p < .01$; ***$p < .001$.

†Reference groups for the model: male non-drug users, diagnosis before 1989, PCP (Group 2) as the AIDS-defining diagnosis, AIDS specialty clinic dominant provider, no other insurance.

DISCUSSION

A 1993 study by the American Hospital Association revealed that 35–51 percent of emergency room visits in four metropolitan areas were for nonurgent care not requiring hospitalization (McNamara, Witte, and Koning 1993). In this study, we were interested in examining emergency room use by persons with AIDS as a costly, possibly inappropriate alternative site of care. We were unable to assess whether care was for a nonurgent condition but we could exclude emergency room visits leading directly to a hospitalization. Our investigation into patterns of ambulatory care for persons with AIDS showed that, when one provider or site delivered the majority of care, the patient was less likely to have emergency room care that did not result in an inpatient stay. Even for complex patients such as those with AIDS, our results suggest benefits to having a dominant source for care. Patients without a dominant provider but with at least four ambulatory visits in the six-month interval tended to have many providers involved in their care.

These patients might have had perceived or actual barriers to identifying one of their many providers to manage their immediate medical problem. According to a recent review of research on factors influencing non-urgent emergency room care, the most commonly cited factor was unavailability of a source for urgent care (Padgett and Brodsky 1992).

Among patients who had a dominant provider, those with a primary care provider appeared to have a lower reliance on emergency room care than patients with an AIDS specialty clinic as their dominant site of care. In a study of a general population, Haddy, Schmaler, and Epting (1987) reported that patients with primary care physicians were less likely to use the emergency room for outpatient care than those without such care. Possibly AIDS specialty clinics might not have been able to meet urgent care needs as readily as primary care settings or, alternatively, AIDS specialty clinics might have had a different clinical spectrum of patients than other providers.

Our analyses take into account disease severity using a clinical classification of AIDS-defining diagnoses, based on expert opinion and previously found to be associated with significant differences in survival times (Turner, Markson, McKee, et al. 1991). Patients with PCP as their defining diagnosis (severity group 2) had the lowest observed odds of emergency room use. If patients with PCP survive their immediate risk of death, our data indicate that they recover and have lower use of both ambulatory and emergency room care than patients in severity group 1, which includes more chronic, less acutely life-threatening conditions such as Kaposi's sarcoma and candida esophagitis.

In a study of HIV-infected persons, Mor et al. (1992) reported higher odds of emergency room use associated with an AIDS diagnosis, more symptoms, and lower functional status. However, no distinction was made in that study between emergency room visits that did or did not directly lead to hospitalization. These differences make the results of these studies difficult to compare. Nevertheless, the proportion of AIDS patients observed to use the emergency room was quite similar between this study and Mor's study (39.2 percent versus 37.9 percent).

Compared to non-drug users, the proportions of drug users using the emergency room in our study and in Mor's were, respectively, 11 percent and 15 percent higher. Both studies showed that the proportion of women using the emergency room was approximately 10 percent higher than that of men. This difference was not significant in Mor's multivariate analysis whereas it was in our study. Hellinger (1993) reported that the number of outpatient visits, including both ambulatory and emergency room care as estimated from linear regressions, was higher for women than for men with AIDS. In non-HIV-infected patients, no significant differences by gender have been reported for emergency room use (Anson, Carmel, and Levin

1991). It is possible that gynecological complications may increase women's need for nonurgent care.

Our data indicate that persons with another source of insurance in addition to Medicaid had lower odds of emergency room use. Mor (1992) found that persons with public insurance had the highest estimated use of the emergency room. These data are consistent with the view that patients with only Medicaid insurance place greater demands on the emergency room compared to those with other insurance.

Our pattern of care analyses also demonstrate that, for New York State Medicaid-enrolled persons with AIDS, the most common dominant site of care was the clinic. Mor reported that patients with clinics as their usual source of care were more dependent on the emergency room. Our data suggest that this result might vary by clinic specialty. There is substantial provider burden associated with managing the complex clinical complications and the myriad of psychosocial issues of patients with advanced HIV disease. Many specialty clinics may not be equipped with sufficient personnel and appropriate skills to manage an increasing volume of patients who have both routine and urgent care needs.

In this project, we developed specific categories of ambulatory care as defined by the visit frequency and the proportion of care delivered by the most frequently visited site of care. We believe that patients identified as having a dominant provider site were likely to have had higher continuity of care. Several approaches have been developed in the past two decades to evaluate overall continuity of care (Bice and Boxerman 1977; Steinwachs 1979; Eriksson, 1990). When we examined the association of the Bice and Boxerman continuity of care measure with our patterns of care, we found that they were highly correlated. We decided to use only our categorical measure of pattern of care to offer a more interpretable result for clinicians and policymakers of the association of emergency room use with specific types of providers and sites of care.

Our study illustrates some of the difficulties associated with measuring patterns of outpatient care. For a significant proportion of patients, we could not identify a dominant provider due to their having only a few visits in the six-month interval. Patients in this category used the emergency room significantly less frequently than other patients but generally required prolonged inpatient care. In addition, we were unable to distinguish between care by one physician or multiple physicians within a clinic or a physician group practice. In our study, we focused on site continuity, presuming that clinics and physician groups use a common record and that providers in the same site readily share information. Finally, we might have missed some services delivered by providers who did not bill Medicaid or who had another payer for their services.

Our analyses of patterns of care were restricted to those surviving at least six months after AIDS diagnosis, thus excluding the most severely ill AIDS population. We also excluded thousands of individuals in the New York State Medicaid HIV/AIDS Research Data Base without a specific AIDS-defining diagnosis, because we were unsure of the point in time when they developed AIDS and could not clinically stage them. Thus we cannot comment on factors associated with emergency room use for a large subset of patients in the HIV/AIDS Research Data Base. Finally, we are unable to judge the appropriateness of care in the ambulatory setting and the emergency room since this would require chart review.

In summary, our analyses suggest that, when persons with AIDS have one site that delivers the majority of care, they use the emergency room less. Other studies should test the hypothesis that linking patients to dominant providers will reduce ER use. We have demonstrated that our categorical measure of ambulatory care can distinguish differences in outcomes of care such as emergency room use. These patterns of care variables can also be useful to characterize the changes in patterns of care over time (Turner et al. in press) and use of specific therapies for HIV-infected persons (Markson, Cosler, and Turner 1994).

APPENDIX

Negative Binomial Regression

In this study, logistic regression estimated the effects of patient and provider characteristics on whether a patient used the emergency room (ER) during the study period. However, logistic regression is not designed to estimate these effects on visit *rates*. Two of the most commonly used models for visit rates are Poisson regression and negative binomial regression.

The Poisson model assumes that ER visits occur randomly during periods of nonhospitalization. In particular, the model specifies that the number of ER visits per unit time for individual i has the following probability distribution:

$$\Pr(\#\ ER\ Visits\ = k \mid \lambda_i) = \frac{\lambda_i^k e^{-\lambda_i}}{k!} \qquad k = 0, 1, 2, \ldots.$$

λ_i is the expected ER use rate (per unit time). The Poisson regression model asserts that the expected use rate during T_i units of time is:

$$\mu_i = T_i\lambda_i = T_i \exp(X_i'\beta),$$

where T_i is the amount of nonhospital time that was available to patient i during the six months following the AIDS-defining diagnosis, X_i is a vector of covariates, and β is a vector of regression coefficients. This model can be re-expressed as a log-linear model: $\log \mu_i = \log T_i + X_i'\beta$. A restrictive property of the Poisson model is that the mean and the variance are equal.

Conditional on their covariates, estimated ER visit variances exceed their estimated means, a property often referred to as extra-Poisson variation. This suggests that a better model for these data might be the negative binomial distribution. The negative binomial model can be derived from the Poisson model on the assumption that the extra-Poisson variation arises because the expected rates λ_i are distributed according to a gamma distribution. The negative binomial regression that we fit is specified by the probability model (Lawless 1987):

$$\Pr(\#\ ER\ Visits = k \mid \mu_i) = \frac{\Gamma\left(k + \frac{1}{\alpha}\right)}{k!\Gamma\left(\frac{1}{\alpha}\right)} \left(\frac{\alpha\mu_i}{1+\alpha\mu_i}\right)^k \left(\frac{1}{1+\alpha\mu_i}\right)^{\frac{1}{\alpha}}$$

$$k = 0, 1, 2, \ldots.$$

where $\Gamma(.)$ is the gamma function; $\alpha \geq 0$ is sometimes referred to as a dispersion parameter; and the mean number of visits, μ_i, is a function of X_i defined as shown above for the Poisson model. The variance of ER visits is then equal to:

$$Var\ (\#\ ER\ Visits \mid \mu_i) = \mu_i + \alpha\mu_i^2.$$

Therefore, the variance exceeds the mean by $\alpha\mu_i^2$. As the value of the parameter α approaches zero, the distribution of visits approaches the Poisson distribution (mean equal to variance). For our data, we define T_i to be the number of *months* of nonhospital time for patient i (total nonhospital days divided by 30). Thus, each regression coefficient can be interpreted as the multiplicative change in the average number of ER visits per month due to a one-unit change in the corresponding predictor variable.

This model assumes that each patient has a positive probability of visiting the ER. That is, we assume that given enough time, every patient would eventually visit the ER. However, it does accommodate patients with zero *observed* visits because it specifies a positive probability of observing zero visits for each patient:

$$\Pr(\#\ ER\ Visits = 0 \mid X_i) = \left(\frac{1}{1+\alpha T_i e^{X_i'\beta}}\right)^{\frac{1}{\alpha}}$$

Notice that for $\alpha = 1$, this probability takes the form of a logistic regression:

$$\Pr(\textit{At least 1 ER Visit}) = 1 - \left(\frac{1}{1 + e^{X_i'\beta + \log T_i}}\right) = \frac{1}{1 + e^{-X_i'\beta - \log T_i}}$$

This is the form of the logistic regression that we fit earlier except that this regression has an "offset" term equal to $\log T_i$ that accounts for the various periods of "exposure" (free time) that patients had. Therefore, the coefficients estimated for the negative binomial regression may be close in value to the coefficients earlier estimated for the logistic regression, if α is near 1.

Following a procedure outlined by Lawless (1987), we first obtained maximum likelihood estimates for the regression parameters β under the Poisson model. We then used a method of moments estimator for α , which depended on the estimate of β. The resulting estimate of 1.64 for α was significantly different from zero, indicating that the Poisson model is a poor fit to the data. Finally, holding α constant at 1.64, we obtained maximum quasi-likelihood estimates of the regression parameters under the negative binomial model (McCullagh and Nelder 1983) and obtained estimates of their standard errors based on the observed information matrix as described by Lawless (1987).

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