



CHAIN Report 2007-4

Prevalence of
Chronic Diseases &
Comorbid Conditions in
the CHAIN Cohort of
PLWHA

Peter Messeri
Gunjeong Lee
Sara Berk

Columbia University
Mailman School of Public Health
In collaboration with the NYC Department of
Health and Mental Hygiene, the Westchester
Department of Health the NY Health &
Human Services HIV Planning Council, and
Public Health Solutions

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INTRODUCTION

The occurrence of chronic comorbid conditions among people living with HIV/AIDS (PLWHA) has become of increasing concern since the introduction of Highly Active Antiretroviral Therapy (HAART). With longer life expectancy, PLWHAs are expected to experience increasing prevalence of chronic health conditions associated with the normal aging process. As mortality rates for PLWHAs have declined, deaths among people with AIDS in New York City attributable to non-HIV causes have increased from 7% in 1995 to 26% in 2003 (NYCDOHMH, 2005). Chronic diseases that are prevalent in the general population, cardiovascular disease, cancer and diabetes, are also among the leading causes of non-HIV-related deaths among New York City's PLWHAs (Sackoff, Hanna, Pfeiffer, and Torian 2006). Although age is associated with increased mortality for both HIV-related and non-related causes, the age gradient is much steeper for non-HIV-related causes (Sackoff et al., 2006). Consistent with the New York City mortality trends, national rates of hospitalization and length of stay have steadily declined since the introduction of HAART (Hellinger 2007), and AIDS defining illnesses represent a diminishing proportion of diagnoses at time of admissions (Betz et al. 2005).

The epidemiological and clinical research literature further suggest that besides the normal aging process, HIV infection itself and the side effects of HAART may increase vulnerability to various chronic disease and health conditions. HIV infection has been implicated in an increase in pulmonary arterial hypertension (Limsuksorn, 2006; Simonneau, 2004), arthritis and rheumatism (Saraux, 1997; Bilecktot, 1998), sinusitis (Gurney, Lee and Murr, 2003), hepatitis C (Marino, 2003) and cervical abnormalities in women (Chiasson et al., 1997; Flavia et al., 2001). The exceptionally high prevalence of the last two conditions among PLWHAs undoubtedly stems not from the virus itself, but from common behavioral risk factors

for HIV, Human Papillomavirus (HPV) and hepatitis C infection. Nonetheless some researchers have speculated that HIV infection may independently hasten the onset of various disease sequelae of HPV and hepatitis C.

Long-term HAART use has a beneficial effect on many chronic conditions by strengthening the immune system, but HIV medical care guidelines emphasize attention to possible adverse side effects from these medications including increased risk of diabetes (Butt, 2004; Justman, 2003; and Carr, 1999) and lipid disorders (Carr, 1999; Sadr et al., 2005; Carpentier, 2005) with consequences for heart disease (Barbaro, 2008, Friedl, 2000; Lundgren 2003); and rheumatic conditions (Louthrenoo, 2008).

A multi-state chart review study of hospital admissions by Betz et al. (2005) illustrates the complex etiology of comorbid conditions in HIV infected populations. The authors report that gastrointestinal disease, mental illness and circulatory disease were the most common non-AIDS defining illnesses diagnosed at time of inpatient admissions. Age was an independent risk factor for increased hospitalization for two of the three conditions, gastrointestinal and circulatory diseases. Increased hospitalization for all three diseases was associated with both advanced stage of HIV as measured by low CD4 counts and a history of injecting drug use. HAART use was associated with increased hospitalization for gastrointestinal disease but not circulatory disease.

With the exception of the Sackoff et al. (2006) cause of death study, we were unable to find published studies that summarize prevalence for multiple chronic disease conditions in the general HIV+ population or their independent and cumulative impact on increased health care utilization. An earlier CHAIN report (Messeri et al., 2002), *Chronic Disease and Clinical Comorbidities* investigated this question for the 1994 New York City CHAIN cohort several

years after HAART became widely available. At that time (2000), more than 80 percent of the members of that cohort were diagnosed with at least one chronic health condition. The most common non-HIV chronic conditions were hypertension, asthma, and arthritis or rheumatism. This study updates the findings of the earlier report for the 2002 New York City CHAIN cohort and the 2001 Tri-County CHAIN cohort residing in Westchester, Putnam, and Rockland counties.

This report addresses the following questions:

- What is the prevalence of non-HIV chronic diseases and health conditions in the NYC and Tri-County cohorts?
- What is the prevalence of chronic diseases for different sociodemographic groups?
- Does the prevalence of chronic diseases differ by lifestyle behaviors such as smoking, drug use, and sexual behavior?
- Is the prevalence of chronic diseases associated with HIV disease progression as indicated by length of time since diagnosis and current CD4 count?
- How do the chronic diseases taken individually and cumulatively affect general physical and mental health?
- Does having a chronic disease or the number of chronic diseases increase acute inpatient care and/or utilization of ambulatory services?

KEY FINDINGS

- The prevalence of each chronic disease is similar among current CHAIN NYC and Tri-County cohorts and the original 1994 NYC cohort.
- At the time of the fourth round of interviews, over 90% of CHAIN participants reported being diagnosed by a physician with at least one of 9 chronic diseases or health conditions. Over 80 percent of CHAIN participants have at least two conditions, and approximately a quarter report five or more conditions.
- The pattern of chronic disease prevalence is similar for the New York City and Tri-County cohorts.
 - In New York City, lifetime prevalence ranged from 13% for diabetes to 56% for cervical abnormalities among women. Prevalence for the remaining chronic diseases clustered between 40% and 49%.

- In Tri-County, lifetime prevalence ranged from 17% for diabetes to 55% for arthritis or rheumatism. Prevalence for most of the remaining chronic conditions ranged between 32% and 51%.

- These chronic conditions are a source of continuing need for medical care. Among people ever diagnosed with each chronic condition, 50% or more report current problems with their conditions. The overwhelming majority reporting current problems are receiving treatment for these conditions.
 - Older age and female gender are the most consistent sociodemographic factors associated with chronic diseases.
 - Blacks are more likely to report hypertension than whites or Hispanics for both NYC and Tri-County cohorts.
 - Histories of substance abuse, smoking, and injecting drug use are all related to higher rates of hepatitis. Rates of hepatitis are three times higher among injecting drug users than among non-users.
 - Length of time since diagnosis of HIV and CD4 count were unrelated to lifetime occurrence of almost all chronic conditions.
 - When compared to the general New York City population matched on age, gender and race/ethnicity, New York City CHAIN participants experience substantially higher lifetime prevalence for 4 of 5 chronic conditions for which comparison data are available.
 - Each additional chronic disease condition has a substantial negative impact on physical and mental health status.
 - Use of medical services increases with the number of chronic diseases reported by CHAIN cohort members.
- In New York City, each additional chronic disease condition is associated with, on average, 0.16 extra inpatient days, 0.04 extra emergency room visits and 0.23 extra inpatient visits over a six month period.
- In Tri-County each additional chronic disease condition is associated with, on average, 0.38 extra inpatient days, 0.06 extra emergency room visits and 0.21 extra inpatient visits.
- We estimate that in New York City management of chronic disease conditions accounts for 10% of all outpatient visits, 35% of inpatient days and 25% of ER visits. In Tri-County the comparable percentages are 14%, 46% and 39%, respectively.

METHODOLOGY

Data on non-HIV chronic health conditions were obtained through interviews with the two current CHAIN cohorts of HIV-infected individuals residing in New York City and the Tri-County region to the north of New York City.

Cohort Recruitment and Study Samples

2002 NYC Cohort

The 2002 NYC cohort was sampled and recruited following a protocol similar to that for the 1994 NYC cohort. A two-step sampling procedure was followed. A list of eligible recruitment sites was created from all NYC agencies where the 1994 NYC cohort reported receiving medical and social services. Service providers were randomly selected from this list, stratified by type of agency (medical versus social service agency) and borough. With the assistance of agency staff, clients were randomly selected from agency client rosters or through an onsite sequential recruitment procedure. Recruitment was conducted at 34 sites between July 2002 and December 2003, and baseline interviews were completed with 684 clients. A small sample (n=25) of HIV-positive individuals unconnected to medical care was contacted through outreach activities and completed shorter interviews. Nine of these completed the full CHAIN questionnaire and are included in the study cohort.¹

The gender composition of the 2002 NYC CHAIN cohort (40% females, 60%) is similar to that for all persons living with HIV in New York City at the time of recruitment. The ethnic distribution for female CHAIN cohort members closely approximates that for all females living with HIV in New York City in June 2003. In contrast, white men are underrepresented in the

¹ A detailed description of the recruitment of the 2002 NYC cohort, CHAIN Report 2004-4: Field Notes: Recruiting a Longitudinal Cohort is available on request.

CHAIN cohort with a corresponding overrepresentation of black and Hispanic males. The cohort's gender and ethnic makeup closely tracks the profile of clients using Ryan White CARE Act services for the fiscal year starting in March 2001. A small number of cohort members, 66, who completed a shortened version of the baseline interview were dropped from the study sample as they were not asked questions about lifetime prevalence for 8 of the 9 chronic conditions examined in this paper. The NYC cohort members who were dropped from the study were more likely to have very low incomes and not to have completed high school and had poorer mental and physical health status than individuals included in the study.

Tri-County Cohort

The Tri-County cohort was recruited using methods and protocols similar to those used for the New York City cohort. Recruitment was conducted in 28 agencies in Westchester, Rockland and Putnam Counties. Baseline surveys were completed by 398 individuals between November 2001 and November 2002.² The cohort was augmented with recruitment of 84 individuals, who represented a “refresher sample”, and were interviewed for the first time during the third round of interviews. Compared to the gender and ethnic composition of surviving AIDS cases in Tri-County at the end of 2000, females were somewhat overrepresented in the CHAIN cohort, but ethnic composition within gender closely approximated the AIDS case data. This study sample excludes 12 individuals from the original cohort and 12 individuals from the refresher sample who completed shortened baseline interviews and therefore did not provide information on lifetime prevalence for the chronic conditions examined in this report. The Tri-

² A detailed description of the recruitment of the Tri-County cohort, Tri-county CHAIN Report 2002-4: Field Notes: Recruiting a Longitudinal Cohort, is available on request

County cohort members dropped from the study were very similar to those included in study, except that they were less likely to have completed high school.

Measures

CHAIN interviews collect self-reported information on nine chronic disease or health conditions. Two disease conditions, hepatitis and cervical abnormalities among women, have been associated with HIV infection prior to the HAART era. Questions about the seven remaining conditions -- 1) asthma, 2) hypertension/high blood pressure, 3) heart problems, 4) diabetes, 5) arthritis or rheumatism, 6) high cholesterol, and 7) chronic sinusitis -- were first included in the eighth and final round of interviews with the 1994 NYC CHAIN cohort and were retained in the baseline and follow-up interviews with the current CHAIN cohorts. The conditions were selected based upon recommendations from a panel of HIV medical care specialists. They include health conditions common in the general adult populations. For most of these conditions there is clinical and epidemiological evidence that HIV infection or long-term use of HAART medication may increase susceptibility. For this report, these conditions are regarded as chronic conditions that require continuing medical attention and may increase utilization of different types of medical care services beyond that required for HIV infected individuals free of comorbid conditions. We further hypothesize that these conditions may exert independent and varying effects on perceived quality of life

Interview questions were worded to limit self-reports to conditions that were either diagnosed or involved some level of past or current medical attention. For each condition, participants were asked at baseline interviews the following sequence of yes/no questions: "Has a doctor *ever* told you that you have any of the following health conditions?" If yes, "Are you currently having any problems with this condition? Are you currently being treated for this

condition?” In follow-up interviews participants were only asked if they were currently having problems or being treated for previously diagnosed conditions. For hepatitis and cervical abnormalities, there was no question regarding current treatment. We asked about all types of hepatitis, and cervical abnormalities are indicated by a positive response to any of the following conditions: cervical cancer, cervical dysplasia or an abnormal pap smear. When analyses combine data from both sexes, all men are assigned to the “no” category for cervical abnormalities.

For most study analyses, we report lifetime prevalence rather than current occurrence. Participants are classified as having a condition at first interview if they report ever being told that they had it. They continue to be classified as having the condition in subsequent interviews even if they indicate that they are not currently having a problem. Individuals are added to the lifetime prevalence category at the follow-up interview in which they first report having a problem. Chart abstraction information regarding diagnosis and treatment are currently unavailable to verify the reliability of self reports.

Sociodemographic characteristics, life style behaviors, and HIV disease progression are the basis for more detailed analyses of distribution of chronic disease morbidity. Sociodemographic characteristics include age, gender, ethnicity, educational level, and household income. Lifestyle behaviors include substance abuse, injecting drug use, smoking, and current unsafe sexual activity. Year of HIV diagnosis and most recent CD4 count measure HIV disease progression. Multi-item, standardized physical and mental health status scales, with ranges between 0 and 100, are included that measure perceived quality of life. These scales have a mean value of 50 and standard deviation of 10 for the general U.S. population. Indicative of the two cohorts’ impaired health status, average scores on these scales

Table 1: Study Sample Characteristics at Baseline Interview

		NYC (N=617)	Tri-County (N=458)
Sociodemographic Characteristics			
Age	<35	26%	28%
	35-49	44	48
	50+	31	24
Gender	Female	40%	50%
	Male	60	50
Ethnicity	White	9%	20%
	Black	53	49
	Hispanic	37	27
	Other	2	3
Education	High school +	62%	67%
	Less than HS	38	33
Household Income	More than \$7500	51%	82%
	Less than \$7500	49	18
Life Style Behaviors			
Substance abuse	Never	26%	34%
	Past	48	47
	Current	26	19
Smoking	Never	20%	22%
	Past	20	18
	Current	60	60
Ever injected drugs	No	64%	65%
	Yes	36	35
Unsafe Sex (6mo)	No	92%	91%
	Yes	8	9
Health Status			
Physical health status			
	Mean (SD)	42.40 (11.02)	43.49 (10.19)
Mental health status			
	Mean (SD)	43.33 (12.15)	42.32 (11.79)
HIV Disease Experience			
Year of HIV Dx	1978-1989	24%	22%
	1990-1995	42	40
	1996-2000	28	29
	2001-2005	6	9
TCell count	0-200	23%	21%
	201-500	46	45
	500+	31	34

are significantly below averages for a general population and range between 42.3 and 43.5. The medical care utilization measures are self reports of 1) number of days hospitalized, 2) number of visits to the emergency department, and 3) number of outpatient visits during the six month period preceding each interview. Table 1 displays the means and proportions at baseline interview for key study variables. Table 2 displays the lifetime prevalence for the chronic diseases examined in this study

Statistical Analysis

Study results are presented separately for the New York City and Tri-County cohorts. Chi-square tests for statistical significance of relationships between lifetime prevalence of the ten chronic disease conditions and each of the independent variables are listed in Tables 5-1, 5-2, 6-1, and 6-2. We compared lifetime prevalence of hypertension, arthritis, diabetes, high cholesterol, and asthma for the NYC CHAIN cohort with a sample of New York City residents matched on age, gender and ethnicity. Lifetime prevalence for New York City residents was obtained by pooling data from the 2004 NYC Health and Nutritional Examination Survey (NYC HANES), and the 2002 through 2006 annual NYC Community Health Surveys. The NYC data are public use data sets available from the NYCDOHMH website (www.nyc.gov). These surveys use wording very similar to that of the CHAIN interviews to obtain respondent self reports for lifetime chronic disease prevalence. Appendix A describes in more detail the methodology for obtaining the New York City prevalence.

Multiple regression analysis was used to estimate the marginal change in mental and physical health status, the number of inpatient days, and outpatient and emergency room visits associated with each of the ten chronic conditions. Data are pooled from all observations for all rounds of interviews completed by CHAIN participants eligible for the study (e.g. those who

answered chronic disease questions at baseline). The regression coefficients for each chronic condition measure the changes in the quality of life and health care utilization measures attributed to the lifetime occurrence of each condition after controlling for the demographic, behavioral and HIV disease variables listed in Table 1 and the co-occurrence of other chronic conditions. The models were re-estimated substituting the number of chronic conditions experienced by each participant for the individual chronic condition variables. The regression coefficients for the count of chronic conditions measure change in the quality of life and health care utilization measures for each additional chronic condition again adjusting for participant characteristics. Complete results of the regression analysis are presented in Appendix B.

FINDINGS

Prevalence of Chronic Conditions

Table 2 displays the lifetime prevalence of self-reported chronic disease for the 2002 NYC and Tri-County cohorts at baseline and fourth rounds of interviews. Through the fourth rounds of interviews, over 90% of the members of both cohorts reported being diagnosed with at least one chronic condition. Approximately 80% of the cohort has at least two conditions, and over 20% have five or more conditions.

Lifetime prevalence increased substantially, often by ten or more percentage points, during the approximately four to five years between baseline and fourth round interviews. Even the small percent change in diabetes is a proportionately large increase from the low baseline levels. Although these increases may be distorted due to either sample attrition bias or delayed disclosure, these artifacts seem unlikely to account for more than a small fraction of the observed increases. On the one hand the trends in Table 2 may *underestimate* increases in lifetime prevalence, as sample attrition through round four may have been greater among participants,

who were less healthy at baseline. Comparison of prevalence of chronic conditions at baseline between the full sample and those who were interviewed through round 4 is consistent with this pattern, but the differences are very small. Baseline differences in prevalence were almost always two percent or less between the full baseline cohort and those who continued in the study through round 4. Another possibility is that CHAIN participants may have delayed disclosing existing conditions until follow-up interviews. Although there is no way to assess the extent of such underreporting at baseline, it is worth noting that the large increases in prevalence are reported even though question wording on the follow-up interviews expressly asks about “currently having a problem” as opposed to lifetime occurrence.

Table 2: Lifetime Prevalence for Selected Chronic Diseases

	NYC 2002-2008 % Lifetime prevalence at:		Tri County 2001-2007 % Lifetime prevalence at:	
	Baseline (n=617)	Round 4 (n=358)	Baseline (n=382)	Round 4 (n=223)
Asthma	31	40	27	32
Hypertension	29	46	32	46
Heart Problems	14	23	18	26
Diabetes	8	13	13	17
Arthritis or Rheumatism	26	44	28	55
High Cholesterol	28	49	26	41
Chronic Sinusitis	22	41	18	33
Hepatitis	44	49	43	48
Cervical Abnormality	36	56	39	51
Number of chronic diseases				
0	14	8	15	6
1	25	10	22	12
2	22	16	23	18
3	19	22	22	23
4	11	19	9	19
5 or more	8	26	10	22

Table 2 shows that lifetime prevalence for the New York City cohort as of round four interviews ranged from a low of 13% for diabetes to just under half for high cholesterol and hepatitis. Fifty-six percent of the women reported a cervical abnormality. The lifetime prevalence for four of the remaining chronic conditions in New York City ranged between 40% and 46%. A similar pattern is evident for the Tri-County cohort. Lifetime prevalence ranged from a low of 17% for diabetes to a high of 55% for arthritis or rheumatism. Fifty-one percent of the women reported cervical abnormalities. Five of the remaining six chronic conditions clustered between 32% and 48%. Although prevalence for most conditions is similar for the two cohorts, arthritis or rheumatism is substantially higher in Tri-County, whereas asthma, high cholesterol and chronic sinusitis are more widespread in New York City. In both regions, approximately a quarter of the sample reports heart problems.

Substantial numbers of members of both CHAIN cohorts were experiencing problems with these conditions at the time of follow-up interviews, as shown in Table 3. When lifetime prevalence in Table 2 is compared with Table 3, we find that more than half of CHAIN participants with a history of each condition reported “currently having a problem” at follow-up interviews and the great majority of the latter were being treated for the condition. For example, an average of 27% of NYC cohort members reported current problems with asthma at the second, third, and fourth rounds of interviews. This means that among the 40% of NYC cohort members ever diagnosed with asthma, 70% report experiencing problems with this condition at time of interview and almost 9 in 10 with a current problem are receiving medical treatment.

Table 3. Current Problems with Chronic Conditions and among those with Problems, Percent Being Treated (Observations are pooled from rounds 2, 3, and 4 interviews.)

	NYC		TRI-COUNTY	
	% Currently having a problem with...	% treated among those with problem	% Currently having a problem with...	% treated among those with problem
Asthma	27%	89%	23%	93%
Hypertension	33%	89%	31%	88%
Heart Problems	11%	64%	11%	70%
Diabetes	10%	86%	13%	86%
Arthritis or Rheumatism	27%	60%	34%	60%
High Cholesterol	27%	69%	25%	65%
Chronic Sinusitis	19%	75%	17%	66%
Hepatitis	30%	na	19%	na
Cervical Abnormalities (Women only)	23%		20%	

Comparison with New York City Prevalence Data

To investigate the extent to which the burden of chronic disease experienced by people living with HIV differs from that of the general population, we obtained self reported lifetime prevalence for five chronic conditions available from NYCDOHMH's 2002 to 2006 Community Health Surveys and 2004 NYC NHANES examination data. As described in Appendix A, NYC prevalence estimates were adjusted to match the CHAIN cohort's gender, age and ethnic composition. Table 4 presents the NYC CHAIN prevalence alongside the comparable New York

City estimates and the difference is reported as lifetime cases per 1,000 population. With the exception of diabetes, Table 4 shows that CHAIN cohort members had higher lifetime prevalence for these chronic diseases, often by a substantial margin. For example, the CHAIN cohort experienced excess hypertension amounting to 70 cases per 1,000 population, an additional 180 cases of arthritis, 150 cases of elevated cholesterol and 260 cases of asthma.

Table 4: Round 3 CHAIN and New York City Lifetime Prevalence for 5 Chronic Diseases

	NYC	Adjusted NYC*	NYC CHAIN	NYC CHAIN Excess cases per 1,000 persons
Hypertension	0.30	0.35	0.42	78
Arthritis	0.17	0.22	0.40	180
Diabetes	0.10	0.13	0.12	-10
High Cholesterol	0.28	0.31	0.46	150
Asthma	0.13	0.14	0.40	260

*NYC prevalence rates are adjusted to match the age by gender by race/ethnic composition of the NYC CHAIN cohort

Subgroup Analysis of Chronic Disease Prevalence

Among the sociodemographic variables listed in Table 1, age and gender are the most consistent correlates of chronic disease prevalence (Tables 5-1 and 5-2). With the exceptions of asthma, chronic sinusitis, and cervical abnormalities, the prevalence of chronic conditions increases with age. The age gradient is strongest for hypertension, heart problems, arthritis or rheumatism, and hepatitis. Rates of chronic conditions in the study sample are generally higher among women than among men, and the gender differences are more pronounced in New York

City than in Tri-County. Women are particularly prone to asthma and chronic sinusitis, whereas rates of hepatitis are higher among men.

Consistent with race and ethnic patterns in the general population, hypertension is much more prevalent among blacks than among the other ethnic/race groups. Diabetes is higher among blacks and Hispanics than among whites. Blacks in Tri-County, but not in New York City, have elevated rates of heart problems (confirmed in regression analysis). Whites are more likely than either Hispanic or black CHAIN participants to report chronic sinusitis and hepatitis. Whites are also more prone to elevated cholesterol in Tri-County but not in New York City.

Among CHAIN participants, unhealthy behaviors (substance abuse, injecting drug use, smoking and unsafe sex) are generally not associated with elevated risk for chronic disease conditions (Table 6-1 and 6-2). Hepatitis is an obvious exception: substance abuse, smoking, and injecting drug use are all related to higher rates of hepatitis. History of injecting drug use is three times more prevalent among individuals with hepatitis. Drug use is associated with elevated rates of a small number of conditions in Tri-County but not in New York City. Specifically, in Tri-County substance abuse is associated with elevated rates of asthma and arthritis, while historical injecting drug use is associated with increased risk for hypertension and heart problems.

Smoking itself is a major health problem for HIV populations. Approximately 80% of CHAIN participants report smoking at some times in their lives and 61% of the New York City cohort and 58% of the Tri-County cohort continue to smoke. Both former and current smokers have higher rates of asthma and hepatitis than never-smokers among both cohorts.

HIV disease progression, as measured in terms of length of time since diagnosis and current CD4 count, exhibits only limited association with other chronic disease conditions. For

both cohorts, the longer one has lived with HIV the higher are rates of hepatitis. Diabetes is more prevalent among those who were diagnosed prior to 1995. Women with low CD4 counts (<200) are more likely to have cervical abnormalities. The data suggest that in Tri-County but not in New York City the risk of heart problems is higher among individuals with low CD4 counts (<200).

Table 5-1. Lifetime Prevalence of Chronic Conditions by Sociodemographic Characteristics at Round 3 Interviews

	NYC (%)						Tri-County (%)					
	(N)	Asthma	Hyper-tension	Heart Problems	Diabetes	Arthritis or Rheumatism	(N)	Asthma	Hyper-tension	Heart Problems	Diabetes	Arthritis or Rheumatism
All	(415)	40	42	22	12	40	(312)	32	41	22	16	44
Age			***	*		***			***	**	*	***
<35	(56)	45	20	9	7	18	(65)	39	19	8	6	23
35-49	(174)	41	39	24	10	34	(147)	32	36	23	16	44
50+	(185)	37	53	25	14	52	(100)	26	63	29	23	56
Gender		***				***		***				
Female	(185)	49	42	20	15	50	(168)	43	41	22	17	47
Male	(230)	32	43	24	9	33	(142)	18	41	22	16	40
Ethnicity			**						***			
White	(38)	39	32	24	3	37	(56)	27	31	16	11	44
Black	(223)	35	49	24	11	42	(161)	30	52	28	18	51
Hispanic	(147)	47	33	19	15	37	(81)	37	30	17	17	33
Education		*						**				
High school +	(264)	35	42	23	11	39	(209)	26	41	22	17	43
Less than HS	(151)	48	42	21	13	43	(101)	44	42	23	15	45
Household Income												
More than \$7500	(275)	38	43	21	12	40	(252)	31	41	23	17	45
Less than \$7500	(140)	44	41	25	11	41	(58)	33	42	18	11	39

All numbers represent percentages, except the category sample sizes in parentheses.

* p <0.05, **p<0.01, ***p<0.001

Table 5-2. Lifetime Prevalence of Chronic Conditions by Sociodemographic Characteristics at Round 3 Interviews

	NYC (%)					Tri-County (%)				
	(N)	High Cholesterol	Chronic Sinusitis	Hepatitis	Cervical abnormalities (women)	(N)	High Cholesterol	Chronic Sinusitis	Hepatitis	Cervical abnormalities (women)
All	(415)	46	39	48	52	(312)	35	30	47	47
Age		***		***					***	
<35	(56)	25	38	36	64	(65)	33	30	28	37
35-49	(174)	41	38	41	46	(147)	32	29	48	51
50+	(185)	56	39	59	54	(100)	42	31	59	47
Gender				***					**	
Female	(185)	50	43	37	52	(168)	38	34	40	47
Male	(230)	42	35	57	-	(142)	33	25	56	-
Ethnicity				*			**			
White	(38)	47	47	63	42	(56)	47	38	57	42
Black	(223)	44	35	44	51	(161)	34	29	45	46
Hispanic	(147)	48	39	52	54	(81)	33	28	47	45
Education										
High school +	(264)	46	39	45	46	(209)	37	30	49	47
Less than HS	(151)	45	38	54	59	(101)	32	30	43	45
Household Income										
More than \$7500	(275)	48	39	46	50	(252)	37	30	48	45
Less than \$7500	(140)	42	38	52	55	(58)	28	26	47	50

All numbers represent percentages, except the category sample sizes in parentheses.

* p <0.05, **p<0.01, ***p<0.001

Table 6-1. Lifetime Prevalence of Chronic Conditions by Life Style Behaviors and HIV Disease Experience at Round 3 Interviews

	NYC (%)						Tri-County (%)					
	(N)	Asthma	Hyper-tension	Heart Problems	Diabetes	Arthritis or Rheumatism	(N)	Asthma	Hyper-tension	Heart Problems	Diabetes	Arthritis or Rheumatism
Substance abuse					*			*				*
<i>Never</i>	(87)	32	41	23	18	32	(93)	23	34	18	14	32
<i>Past</i>	(213)	42	44	21	12	43	(172)	33	45	22	18	49
<i>Current</i>	(115)	41	40	23	5	41	(52)	42	42	29	15	46
Smoked								**				
<i>Never</i>	(76)	34	42	26	17	32	(61)	21	37	19	16	40
<i>Past</i>	(87)	43	49	21	15	41	(65)	22	38	23	20	48
<i>Current</i>	(252)	40	40	21	9	42	(184)	39	44	23	15	44
Ever Injected drugs						*			**	*		
No	(265)	39	40	21	10	36	(194)	32	35	18	13	38
Yes	(150)	41	47	24	14	47	(115)	31	52	30	21	53
Unsafe Sex (6mo)									**			
No	(394)	39	43	23	11	40	(284)	30	44	23	17	44
Yes	(21)	48	38	14	19	52	(26)	46	15	15	8	38
Year of HIV Dx											*	
1978-1989	(93)	30	42	22	10	41	(60)	28	45	20	15	52
1990-1995	(179)	42	40	21	15	39	(124)	36	41	22	24	48
1996-2000	(121)	44	45	22	10	41	(92)	28	36	26	9	37
2001-2005	(22)	41	50	32	0	45	(32)	31	44	19	9	34
CD4 Count										*		
0-200	(77)	44	44	27	6	40	(52)	38	43	36	12	51
201-500	(190)	34	41	19	9	43	(136)	35	40	19	14	43
500+	(148)	45	43	24	17	37	(89)	28	47	22	20	43

All numbers represent percentages, except the category sample sizes in parentheses.

* p <0.05, **p<0.01, ***p<0.001

Table 6-2. Lifetime Prevalence of Chronic Conditions by Life Style Behaviors and HIV Disease Experience at Round 3 Interviews

	NYC (%)					Tri-County (%)				
	(N)	High Cholesterol	Chronic Sinusitis	Hepatitis	Cervical abnormalities (women)	(N)	High Cholesterol	Chronic Sinusitis	Hepatitis	Cervical abnormalities (women)
Substance abuse				***				*	***	
<i>Never</i>	(87)	54	38	21	45	(93)	39	25	22	40
<i>Past</i>	(213)	46	39	56	56	(172)	34	36	58	48
<i>Current</i>	(115)	38	38	54	50	(52)	34	19	60	57
Smoked		***		***					***	
<i>Never</i>	(76)	54	45	22	49	(61)	40	31	28	47
<i>Past</i>	(87)	60	41	53	64	(65)	33	34	48	53
<i>Current</i>	(252)	38	36	54	49	(184)	34	28	54	44
Ever Injected drugs				***			**		***	*
No	(265)	48	41	26	48	(194)	41	31	25	41
Yes	(150)	41	34	88	60	(115)	26	28	86	58
Unsafe Sex (6mo)										
No	(394)	47	39	49	51	(284)	36	29	49	46
Yes	(21)	29	33	33	63	(26)	27	38	31	50
Year of HIV Dx				***					***	
1978-1989	(93)	46	39	65	63	(60)	34	34	64	59
1990-1995	(179)	43	40	47	53	(124)	41	32	53	46
1996-2000	(121)	48	35	36	44	(92)	31	26	34	37
2001-2005	(22)	55	45	50	50	(32)	28	19	28	61
CD4 Count		*								*
0-200	(77)	39	36	48	60	(52)	37	37	44	71
201-500	(190)	41	40	49	47	(136)	32	27	48	41
500+	(148)	55	38	47	53	(89)	45	29	51	44

All numbers represent percentages, except the category sample sizes in parentheses.

* p <0.05, **p<0.01, ***p<0.001

Participant attributes associated with increasing number of chronic conditions³, in both CHAIN cohorts, are older age, female gender and history of substance use. Increased number of chronic conditions is associated, as well, with depressed CD4 count and more recent year of HIV diagnosis.

Chronic Disease and Quality of Life

The next set of tables examines the association between chronic disease conditions and marginal changes in quality of life and medical service utilization controlling for personal characteristics, behaviors and stage of HIV disease. Turning first to quality of life, Table 7 shows a strong association between the number of chronic diseases and lower physical health status scores. For each additional chronic disease, physical health status measured by the SF-12 physical component summary (Ware, et al. 2002) declines by 1.5 points for the New York City cohort and 1.9 for the Tri-County cohort. As a point of reference, the decline in physical health associated with each additional chronic disease condition corresponds to about half the decline associated with CD4 count below 200 as compared to a CD4 count of 500 or above.

With the exception of high cholesterol and cervical abnormalities for women, each of the chronic disease conditions is independently associated with lower physical health status score, but the strength of association across disease conditions is uneven and not consistent between the two CHAIN cohorts. For both cohorts, individuals with asthma and arthritis/rheumatism have significantly lower physical health status. The decline on the physical health status scale associated with these two conditions is similar to the decline estimated when CD4 count drops below 200. Individuals with hypertension, heart problems and diabetes have statistically significant lower physical health in Tri-County but not in New York City. Chronic sinusitis is

³ Detailed results of subgroup by number of chronic conditions are available on request from the authors.

associated with a significant decline in physical health status in New York City but not Tri-County.

The association between lifetime occurrence of chronic disease conditions and mental health status as measured by the SF-12 mental health scale (Ware, et al. 2002) is weaker. Each additional health condition is associated with an average decline in mental health score of 0.77 for New York City and 0.57 for Tri-County, or about half the size of the average decline in physical health score for NYC and one-third for Tri-County. The weaker association between mental health and the number of chronic diseases is in line with its diminished association with

Table 7: Presence of Chronic Conditions and Marginal Change in Physical and Mental Health Status.

	New York City		Tri County	
	Physical Health	Mental Health	Physical Health	Mental Health
# of Conditions	-1.5	-0.77	-1.9	-0.57
Asthma	-2.5	0.51	-3.2	-0.15
Hypertension	-0.86	-1.4	-2.1	-0.16
Heart Problems	-1.0	-0.86	-3.1	-2.4
Diabetes	-1.6	0.19	-3.1	-0.62
Arthritis or Rheumatism	-4.0	-1.5	-3.6	-1.15
High Cholesterol	0.16	-0.69	0.65	0.10
Chronic Sinusitis	-1.9	-1.4	-1.2	-0.35
Hepatitis	-1.2	-0.57	-1.5	0.33
Cervical Abnormalities (women)	0.12	-0.04	1.3	-0.18
CD4 <200	-3.1	-2.0	-3.1	-1.7

Table values are regression coefficients correspond to change in physical and mental health status (measured on a scale of 0-100) associated with lifetime occurrence of each condition, adjusted for all other conditions and the following covariates: age, age square, gender, ethnic group, high school graduate, annual income below \$7500, ever used substance, current and past smoking, ever injected drugs, unsafe sex in last six months, and year of HIV diagnosis.

* bold: p <0.05

low CD4 count. Individual chronic diseases generally have negative but weak associations with mental health status with little consistency between cohorts. For the New York City cohort, individuals with hypertension, arthritis or rheumatism, and chronic sinusitis exhibit the largest declines in mental health status. For Tri-County, having heart problems is the strongest correlate of poorer mental health status.

Medical Service Utilization and Chronic Disease

Table 8 presents marginal changes in inpatient days, emergency room and outpatient visits associated with the occurrence of chronic disease, net of HIV disease progression and other correlates of medical care utilization. In New York City, each additional chronic disease condition is associated with an average of 0.16 extra inpatient days, 0.04 extra emergency room visits and 0.23 extra outpatient visits over a six-month period. Results are qualitatively similar in Tri-County, although compared to NYC each additional chronic disease is associated with double the number of additional inpatient days.

Taken separately, most chronic diseases are associated with higher levels of medical care utilization, but the strength of associations is generally weak. The chronic conditions associated with the largest increase in service utilization differ across cohorts. In New York City, women with cervical abnormalities report the largest number of additional inpatient days (more than 1 extra day over a six month period); individuals with asthma have the highest number of additional ER visits. Individuals with hypertension and those with heart problems report on average an extra 0.7 outpatient visits over a six month period.

Tri-County cohort members with asthma and heart problems, respectively, report an additional 1.4 and 2.4 inpatient days. Those with hypertension, heart problems and chronic

Table 8. Presence of Chronic Conditions and Change in Days or Visits During the Last Six months

	NYC			Tri-County		
	Marginal Change in Days Hospitalized	Marginal Change in ER Visits	Marginal Change in Outpatient Visits	Marginal Change in Days Hospitalized	Marginal Change in ER Visits	Marginal Change in Outpatient Visits
# of Conditions	0.16	0.04	0.23	0.38	0.06	0.21
Asthma	-0.07	0.12	0.35	1.4	0.08	0.43
Hypertension	0.18	0.04	0.70	0.05	0.15	0.16
Heart Problems	0.53	0.04	0.66	2.4	0.12	1.2
Diabetes	0.18	0.04	0.36	0.26	0.09	1.3
Arthritis or Rheumatism	-0.30	0.06	-0.02	-0.42	-0.02	0.17
High Cholesterol	-0.32	-0.04	-0.36	0.17	-0.01	0.23
Chronic Sinusitis	0.54	0.04	-0.004	-0.80	0.11	-0.22
Hepatitis	0.21	-0.004	0.29	-1.0	0.00	-0.86
Cervical Abnormalities (women only)	1.3	-0.005	0.28	0.58	0.05	-0.33

Cell entries are regression coefficients that measure marginal change in average service utilization associated with each health condition, net of other factors influencing medical care utilization. Appendix B presents estimates of the complete utilization models.

* bold: p <0.05

sinusitis report the largest increment in ER visits. Heart problems and diabetes were associated with the largest increase in outpatient visits.

Chronic Disease and Overall Medical Care Utilization

We now use the results of the utilization analysis presented in Table 8 and Appendix B to gauge the amount of medical services devoted to managing and treating the non-HIV chronic disease conditions reported by the CHAIN cohorts. Using the models that estimate medical services utilization with increasing number of chronic conditions, we extrapolated the number of days/visits for each medical service *had the study sample been entirely free of all non-HIV chronic conditions*. The difference between the actual rates of utilization reported by the study sample and the hypothetical levels of use in a chronic disease-free state may be understood as the *extra* utilization of medical care devoted to management and treatment of non-HIV chronic conditions.

Table 9 presents estimates for the total number of days/visits for 1,000 person-years, the percentage of all days/visits, and the extra days/visits per 1,000 person-years that the simulation attributes to medical services utilization associated with comorbid chronic disease. The results control for individual characteristics (e.g. age, race, gender and stage of HIV disease) that are among the potential causes of both the level of chronic disease risk and medical care utilization.

We urge caution when interpreting the results in Table 9. The interview data are prone to error in recalling counts of hospital days and doctor visits. Nor do interview questions separate HIV from non-HIV medical care. For instance, standard HIV medical care incorporates periodic screening and tests for many of the chronic disease conditions included in this study. It follows that the current analysis would attribute the prevention and early detection of non-HIV disease provided routinely to all patients to HIV medical care and not specifically to chronic disease management.

In short, Table 9 is best understood as presenting rough approximations of the additional medical care utilization associated with the presence of chronic diseases. Particularly for inpatient care and ER visits, the results of this exercise strongly suggest that a substantial amount of medical care received by HIV-infected individuals is devoted to managing comorbid chronic disease conditions. Although there are differences in the quantitative results, the qualitative pattern is similar for the two cohorts. For example, 10% of all outpatient visits in New York City and 14% in Tri-County are attributed to management of non-HIV chronic conditions. These translate into an extra 1,040 outpatient visits in New York City and 1,700 visits in the Tri-County region per 1,000 person-years. It is clear from Table 9 that non-HIV conditions are associated with an even larger share of hospitalizations and ER use.

Table 9: Estimated Medical Services Utilization Attributable to Managing Chronic Conditions for the CHAIN cohorts.

	New York City Cohort			Tri- County Cohort		
	Total days/ visits per 1,000 person-years	Use attributed to managing nonHIV chronic conditions		Total days/visits per 1,000 person-years	Use attributed to managing nonHIV chronic conditions	
		% of all days/visits	Extra annual days/visits		% of all days/visits	Extra annual days/visits
Outpatient Visits	10,240	10%	1,040	12,460	14%	1,700
Inpatient Days	3,460	35%	1,220	5,440	46%	2,480
ER visits	716	29%	210	780	39%	306

DISCUSSION

Very limited data exist for New York City or for the rest of the country on the prevalence of non-HIV chronic diseases in general HIV populations and the use of medical services to manage and treat these conditions. Although not always consistent in detail, the general findings are similar for the New York City and Tri-County cohorts. Almost all CHAIN participants report being diagnosed for at

least one of the 9 comorbid conditions included in this study, and the majority has been diagnosed for multiple conditions. Equally important, most CHAIN participants who have ever been diagnosed with a chronic disease report current problems at time of interview and the great majority are receiving medical treatment for the condition. Lifetime prevalence of most conditions included in this study substantially increased during the four to five years between baseline and fourth round interviews. In addition to aging, there are several plausible factors that may contribute to the large increases in chronic disease condition prevalence reported by the CHAIN cohort during the study period. Complications due to HIV infection and long-term effects of taking HAART medications may accelerate the onset of new conditions. During the study period (2002-2006) clinicians may have stepped up their efforts to detect early stage chronic conditions in their HIV+ patients. This may have resulted in a temporary increase in the diagnosis of previously undetected disease, particularly asymptomatic conditions (e.g. hypertension and high cholesterol).

CHAIN participants suffer from many of the same conditions common in the general adult population: asthma, high cholesterol, hypertension, and arthritis or rheumatism, but they are susceptible, as well, to diseases such as chronic sinusitis, hepatitis, and cervical abnormalities that are relatively rare in the general population. Although this study is not able to assess the extent to which HIV infection and long-term use of HAART contribute to the two cohorts' chronic disease burden, the data clearly suggest that in the case of New York City the CHAIN cohort is at much higher risk for four of five common chronic conditions when compared to city-wide prevalence data matched on age, gender and race/ethnicity.

Chronic disease prevalence was only weakly related to sociodemographic characteristics. Not surprisingly, age was the one exception. Older cohort members report higher rates for most disease conditions examined in this report. Smoking had only a limited association with the presence of a

comorbid condition, but the adverse health effects may be obscured because of the large percentage of the CHAIN participants, approximately 80 percent, who were either current or former smokers.

The study further documented the association between chronic disease and poorer quality of life. Study findings indicate that the decline in physical and mental health status associated with each additional chronic condition is comparable to the decline associated with a CD4 count below 200. The cross sectional design of the study and limitations in data collection preclude an assessment of the causal processes that might underlie the association between chronic health conditions and poorer health status. However several published studies confirm that the scale used in this study reliably detects decrements in physical health status for many of the conditions examined in this report (Ware et al. 2000: 160). The weaker association between chronic conditions and mental health status is also consistent with published studies investigating the properties of this study's mental health status scale. Nonetheless, several studies indicate that comorbid physical conditions are often associated with decreases in both physical and mental health (Ware et al. 2002: 161-162).

Inpatient days, emergency room visits and outpatient visits all rose with increases in the number of comorbid conditions reported. Findings were less clear cut when it came to changes in medical care utilization for specific disease conditions. On the one hand, chronic conditions such as asthma and heart disease exhibited expected increases in use of medical services. On the other hand, the more than one additional hospital day associated with cervical abnormalities for New York City women and a nonsignificant but still large increase for Tri-County women were contrary to expectations, since most women with cervical abnormalities are treated as outpatients. Further research is needed both to confirm this unexpected finding and to probe for unmeasured factors such as stage of disease that may be the cause of increased hospitalization among women with cervical abnormalities.

Extrapolations based upon the estimates of the additional use of medical care services with increasing number of disease conditions suggest that medical management and treatment of chronic diseases may account for a substantial amount of CHAIN participants' use of medical services, particularly inpatient care and ER visits. This finding is in line with a recent study of medical records that found that a majority of hospital admissions for HIV patients were for non AIDS-Defining Illnesses (Betz et al. 2005). Nonetheless, we caution that these results only roughly approximate the actual level of medical services devoted to treating the CHAIN cohort's non-HIV conditions. It is not only possible that those individuals with chronic conditions use more services to treat the chronic conditions, but they may also use more services for treatment of HIV related conditions than individuals free of other chronic conditions. Further analysis is clearly needed to corroborate and refine the crude estimates in this first effort to investigate the relationship between comorbid conditions and medical care utilization among HIV patients. Of equal policy interest would be analyses that examine the relationship between medical care utilization for chronic conditions and different medical care models for linking HIV treatment to chronic disease management.

Since PLWHA are living longer, the prevalence of chronic conditions and the consequent need for health care will continue to increase for the foreseeable future. Other CHAIN reports raise concerns about how well the health care system will be able to manage HIV as a chronic condition in conjunction with other chronic conditions. A previous CHAIN report about older PLWHA (Lee, 2007) elaborated on this point. This report found that older PLWHA have more limited informal social support networks to help with impairment of daily activities that might occur with these conditions. Another CHAIN report on satisfaction with health services (Aidala & West, 2008) summarized CHAIN participants' concerns about medical providers' competencies to manage HIV and the complications arising from comorbid conditions.

Efforts to improve medical management of comorbid conditions among HIV+ patients should engage both providers and patients. Professional training on medical management of common chronic disease conditions among PLWHA should be a high training priority. Equally as important, increased attention should be given to the development and strengthening of formal referral and linkage arrangements between HIV and other chronic disease specialists. Health care profession-focused initiatives should be complemented by extending HIV patient education to self management of comorbid chronic disease conditions. Current HAART treatment adherence programs are already training patients in skills that may be readily extended to self management of other chronic conditions.

HAART has caused dramatic increases in the life expectancy of PLWHA. Studies on chronic diseases and HIV infection have been conducted in clinical settings and have focused on the biological connections between HIV or HAART and progression of other chronic conditions. However, living with non-HIV chronic diseases in addition to HIV/AIDS also affects PLWHA in everyday life. Given that living with HIV increasingly means living with other chronic conditions, more studies are needed that address the quality of life and social implications of chronic diseases among PLWHA.

Appendix A: Estimating New York City Chronic Disease Prevalence

Self reported lifetime prevalence for asthma, hypertension, diabetes, arthritis (but not rheumatism) and high cholesterol were collected as part of the 2004 NYC HANES interviews and between one and four of the NYC Community Health telephone surveys conducted annually between 2002 and 2006. For each study in which data were available (between one and five studies), we calculated age-gender-race/ethnic (white, black, Hispanic and other) specific lifetime prevalence for the five health conditions. Age was divided into four groups (18-24, 25-44, 45-64, 65+) that corresponded to the age groupings available on the public use data sets for the community health surveys. The prevalence data from the individual surveys were combined into a single data set. Age-gender-race/ethnic specific rates of each chronic condition were averaged across surveys using weighted least squares. Weights were the sample size used in calculating each of the prevalence estimates. The data were fit to linear models in which age, gender and race/ethnicity were the main factors and all statistically significant ($p < 0.05$) two-way interaction terms among the three factors (three-way interactions were not statistically significant for any of the conditions). R-squares of final models were all in excess of 90%. Separate models confirmed the absence of statistically significant differences in overall prevalence estimates across surveys.

Age-gender-race/ethnic specific New York City prevalence estimates for each of the health conditions were generated from the fitted regression models. These estimates were then merged with the New York City CHAIN data set, matching the appropriate prevalence to a CHAIN member's gender, race/ethnicity and age grouping. The mean of the NYC prevalence estimates across the complete CHAIN study sample, reported in Table 4, generated prevalence rates for a general NYC sample matched to the CHAIN cohort's age, gender and race/ethnic sample distribution.

Appendix B: Complete Medical Care Utilization Regression Models

Linear regression models were estimated using population averaged options for GEE procedure in Stata 10.0. This procedure adjusts standard errors for the clustering of multiple observations for individual CHAIN participants.

New York City Medical Care Utilization Regression Models: coefficients and (standard errors). (bold: p <0.05)

	Outpatient Visits		Inpatient Visits		Emergency Room Visits	
# of chronic conditions		0.23 (0.084)		0.16 (0.081)		0.037 (0.0091)
Asthma	0.35 (0.30)		-0.068 (0.28)		0.12 (0.032)	
Hypertension	0.70 (0.30)		0.18 (0.28)		0.038 (0.032)	
Heart Problems	0.66 (0.35)		0.53 (0.33)		0.044 (0.038)	
Diabetes	0.36 (0.45)		0.18 (0.43)		0.042 (0.049)	
Arthritis or Rheumatism	-0.017 (0.30)		-0.30 (0.29)		0.062 (0.033)	
High Cholesterol	-0.36 (0.30)		-0.32 (0.28)		-0.042 (0.032)	
Chronic Sinusitis	-0.0035 (0.30)		0.54 (0.28)		0.041 (0.032)	
Hepatitis	0.29 (0.33)		0.21 (0.32)		-0.0041 (0.036)	
Cervical Abnormality	0.28 (0.42)		1.3 (0.40)		-0.0049 (0.045)	
Mean-centered Age	-0.013 (0.019)	-0.016 (0.018)	-0.0038 (0.018)	-0.023 (0.017)	-0.0039 (0.0020)	-0.0049 (0.0020)
Mean-centered Age Squared	-0.0017 (0.0014)	-0.0015 (0.0013)	-0.0011 (0.0013)	0.000051 (0.0013)	-0.000034 (0.00014)	0.000000045 (0.00017)
Male	-0.20 (0.35)	-0.095 (0.30)	-0.071 (0.33)	-0.40 (0.29)	-0.12 (0.038)	-0.12 (0.033)
Black	-0.90 (0.48)	-0.73 (0.47)	-0.43 (0.45)	-0.42 (0.45)	-0.026 (0.051)	-0.023 (0.051)

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(Continued)	Outpatient Visits		Inpatient Visits		Emergency Room Visits	
Latino	-0.71 (0.49)	-0.67 (0.49)	0.18 (0.46)	0.16 (0.46)	0.011 (0.053)	0.020 (0.053)
Less than High School Education	-0.34 (0.30)	-0.32 (0.29)	0.071 (0.28)	0.17 (0.28)	0.012 (0.032)	0.019 (0.032)
Poor	-0.12 (0.26)	-0.11 (0.26)	-0.18 (0.26)	-0.14 (0.26)	-0.030 (0.029)	-0.026 (0.029)
Ever used drugs	0.59 (0.40)	0.52 (0.40)	1.3 (0.38)	1.3 (0.39)	0.089 (0.044)	0.094 (0.044)
Ever Injected Drugs	0.0012 (0.37)	0.10 (0.33)	0.068 (0.35)	0.082 (0.32)	0.0089 (0.040)	-0.0070 (0.036)
Unsafe Sex	-0.029 (0.50)	-0.073 (0.50)	0.18 (0.50)	0.076 (0.50)	0.021 (0.055)	0.019 (0.055)
Year of HIV Dx	-0.028 (0.029)	-0.027 (0.029)	0.042 (0.028)	0.034 (0.028)	0.00019 (0.0032)	0.00085 (0.0032)
Low CD4	0.58 (0.36)	0.68 (0.36)	1.1 (0.35)	1.19 (0.35)	0.13 (0.040)	0.14 (0.039)
Moderate CD4	0.36 (0.28)	0.39 (0.28)	0.045 (0.28)	0.12 (0.28)	-0.010 (0.031)	-0.0041 (0.031)
Current Smoking	-0.041 (0.41)	0.0078 (0.41)	-0.53 (0.39)	-0.57 (0.39)	-0.049 (0.044)	-0.038 (0.044)
Past Smoking	-0.55 (0.45)	-0.54 (0.45)	-0.59 (0.43)	-0.63 (0.43)	-0.051 (0.048)	-0.053 (0.049)
N of observation	616	617	616	617	616	617
N of individual	1819	1833	1819	1833	1818	1832

Tri-County Medical Care Utilization Regression Models: coefficients and (standard errors). (bold: p <0.05)

	Outpatient Visits		Inpatient Visits		Emergency Room Visits	
# of chronic conditions		0.21 (0.12)		0.38 (0.17)		0.058 (0.011)
Asthma	0.43 (0.46)		1.4 (0.64)		0.085 (0.044)	
Hypertension	0.16 (0.44)		0.046 (0.61)		0.15 (0.041)	
Heart Problems	1.2 (0.51)		2.4 (0.72)		0.12 (0.049)	
Diabetes	1.3 (0.56)		0.26 (0.78)		0.087 (0.053)	
Arthritis or Rheumatism	0.17 (0.42)		-0.42 (0.59)		-0.022 (0.040)	
High Cholesterol	0.23 (0.42)		0.17 (0.59)		-0.0071 (0.040)	
Chronic Sinusitis	-0.22 (0.46)		-0.80 (0.64)		0.11 (0.043)	
Hepatitis	-0.86 (0.49)		-1.0 (0.68)		-0.0018 (0.046)	
Cervical Abnormality	-0.33 (0.55)		0.58 (0.76)		0.052 (0.052)	
Mean-centered Age	0.0059 (0.028)	0.013 (0.027)	0.0015 (0.039)	-0.011 (0.040)	-0.0082 (0.0027)	-0.0068 (0.0026)
Mean-centered Age Squared	-0.0029 (0.0020)	-0.0025 (0.0020)	-0.0016 (0.0027)	-0.0012 (0.0029)	-0.000022 (0.00019)	0.0000027 (0.00018)
Male	-0.44 (0.50)	-0.39 (0.44)	-0.22 (0.69)	-0.66 (0.63)	-0.022 (0.047)	-0.033 (0.041)
Black	-0.20 (0.54)	0.081 (0.52)	0.75 (0.75)	1.3 (0.74)	0.046 (0.051)	0.083 (0.048)
Latino	-0.83 (0.59)	-0.65 (0.58)	-0.17 (0.81)	0.19 (0.83)	-0.0062 (0.055)	0.022 (0.054)
Less than High School Education	0.55 (0.45)	0.48 (0.45)	1.3 (0.62)	1.3 (0.64)	0.083 (0.042)	0.073 (0.041)
Poor	1.3 (0.51)	1.0 (0.50)	0.77 (0.74)	0.55 (0.76)	-0.0038 (0.050)	0.0082 (0.048)

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(Continued)	Outpatient Visits		Inpatient Visits		Emergency Room Visits	
Ever used drugs	-0.34 (0.54)	-0.39 (0.53)	0.00037 (0.75)	0.16 (0.78)	-0.027 (0.051)	-0.023 (0.050)
Ever Injected Drugs	1.1 (0.55)	0.69 (0.49)	1.4 (0.77)	0.48 (0.71)	0.17 (0.052)	0.13 (0.046)
Unsafe Sex	0.22 (0.62)	0.34 (0.61)	-1.0 (0.91)	-1.2 (0.95)	-0.12 (0.061)	-0.11 (0.060)
Year of HIV Dx	-0.0067 (0.043)	-0.0048 (0.043)	0.00037 (0.059)	0.0078 (0.061)	-0.00087 (0.0040)	0.00039 (0.0039)
Low CD4	1.6 (0.51)	1.6 (0.50)	2.5 (0.75)	3.3 (0.76)	0.19 (0.050)	0.18 (0.048)
Moderate CD4	-0.09 (0.38)	-0.15 (0.38)	0.55 (0.57)	0.69 (0.58)	0.056 (0.038)	0.059 (0.037)
Current Smoking	-0.37 (0.58)	-0.42 (0.57)	-0.85 (0.80)	-0.77 (0.82)	-0.0023 (0.055)	0.013 (0.053)
Past Smoking	0.70 (0.63)	0.62 (0.63)	0.40 (0.88)	0.20 (0.91)	0.036 (0.060)	0.044 (0.059)
N of observation	454	455	454	455	454	455
N of individual	1158	1218	1157	1217	1158	1218

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