Distribution Agreement:

Joshua Saul Josephs

Quality of Care and Healthcare Utilization among Individuals with HIV Infection

Joshua Saul Josephs
Doctor of Philosophy

Epidemiology

____
Patrick Sullivan
Advisor

____
Kelly A. Gebo
Committee Member

____
Brent A. Johnson
Committee Member

____
Carlos Del Rio
Committee Member

____
Jacek Skarbinski
Committee Member

Accepted:

____
Lisa A. Tedesco Ph.D.
Dean of the James T. Laney School of Graduate Studies

____
Date

Quality of Care and Healthcare Utilization among Individuals with HIV Infection

By

Joshua Saul Josephs
B.A. University of Rochester, 2005
M.H.S. Johns Hopkins Bloomberg School of Public Health, 2008

Advisor: Patrick S. Sullivan D.V.M. Ph.D.

An abstract of
A Dissertation submitted to the Faculty of the
James T. Laney School of Graduate Studies of Emory University
in partial fulfillment of the requirements for the degree of
Doctor of Philosophy
in Epidemiology
2013

Abstract

Quality of Care and Healthcare Utilization among Individuals with HIV Infection

By Joshua Saul Josephs

HIV infection remains a common cause of healthcare utilization and an important driver of healthcare costs in the United States today. An estimated 1.1 million individuals are currently living with the disease. Although healthcare utilization among HIV-infected individuals has been studied extensively, there have been no national probability estimates of the frequency of healthcare utilization since the Healthcare Services and Utilization Study in 1998.

We aimed to analyze two common measures of healthcare utilization, use of the emergency department and hospital admissions. We sought to estimate the frequency of these measures as well as explore new methods for modeling healthcare utilization. In addition to the standard technique of logistic regression, we used structural equation modeling (SEM). SEM has not been used to evaluate healthcare utilization; in particular, we examined the Gelberg-Andersen-Aday model, a commonly invoked, but infrequently analyzed, model of healthcare utilization. We also explored the predictive validity of the logistic regression model compared to the SEM. Finally, prompted by the National AIDS Strategy, which has measuring quality of care as one of its goals, we assessed five different composite quality measures along with their variance properties.

We explored emergency department and hospital utilization using data from the Medical Monitoring Project (MMP). The MMP is a CDC-funded surveillance system of HIV-infected individuals in care in the United States. A smaller percentage of participants, 10.8% and 7.4%, respectively made visits to the emergency department or hospital, in 2009 than in prior studies. Using logistic regression we found that socio-demographic disparities and clinical variables such as CD4 count and viral load remain associated with healthcare utilization. Structural equation modeling generally found that the associations proposed by the Gelberg-Andersen-Aday model were supported by the data. Comparisons of the logistic regression and SEM found that the logistic model produced better specificity, while the SEM provided greater sensitivity.

Using data from the HIV Research Network, a national longitudinal study, we found that the type of scoring system used produced radically differing scores, which ranged from 20%-80% depending on the score type. Scores increased uniformly over the study period. We also found that regardless of distribution used the variances of the quality metrics were similar.

In conclusion, we found that socio-demographic disparities and clinical variables remain important risk factors for emergency department and hospital utilization. Quality of care composite measurements differed considerably. The MMP should continue to monitor changes in disparities over time and research should be conducted on the effect on mortality of reporting composite quality of care measures to providers.

Quality of Care and Healthcare Utilization among Individuals with HIV Infection

By

Joshua Saul Josephs
B.A. University of Rochester, 2005
M.H.S. Johns Hopkins Bloomberg School of Public Health, 2008

Advisor: Patrick S. Sullivan D.V.M. Ph.D.

A Dissertation submitted to the Faculty of the
James T. Laney School of Graduate Studies of Emory University
in partial fulfillment of the requirements for the degree of
Doctor of Philosophy
in Epidemiology
2013

Acknowledgements

Table of Contents

List of Tables

Abbreviations:
HIV: Human Immunodeficiency Virus
AIDS: Acquired Immune Deficiency Syndrome
PLWHA: People living with HIV/AIDS
CD4: Cluster of differentiation 4
DAG: Directed Acyclic Graph
HAART: Highly Active Antiretroviral Therapy
IDU: Injection Drug User
MSM: Men who have sex with men
ED: Emergency Department
MMP: Medical Monitoring Project
SEM: Structural Equation Model
CFI: Comparative Fit Index
TLI: Tucker Lewis Index
RMSEA: Root Mean Square Error of Approximation
HIVRN: HIV Research Network
NA-ACCORD: North American AIDS Cohort Collaboration on Research and Design
NHBS: National HIV Behavioral Surveillance
IOM: Institute of Medicine
HRSA: Health Resources and Services Administration

1.0 Introduction to HIV and HIV care in the United States

Human immunodeficiency virus (HIV) infection is a major problem in the United States afflicting more than one million persons. [1] Since the introduction of antiretroviral therapy, life expectancy for persons living with HIV/AIDS (PLWHA) has increased from ten years to thirty years. [2,3] The assumption of optimal care underlies life expectancy calculations. However, the provision of optimal care is a target that has proven illusory. Many disparities exist in the receipt and quality of HIV-related healthcare in the United States.[4-8] Failure to provide quality care and prophylaxis against opportunistic infections drives excess costs: annual mean costs for HIV-infected persons with CD4 counts greater than 500 cells/mm^3 were $16,614 in 2006. Among those with CD4 counts less than 50 cells/mm^3 mean costs were $40,678 in 2006.[9] This dissertation focuses on three issues related to the quality of care for and healthcare utilization by HIV-infected patients in the United States. The issues are emergency department utilization (ED), hospital utilization, and measurement of quality of care.

1.1 A history of HIV treatment and the state of HIV care in the United States today

Care for, and treatment of patients with HIV has evolved over time. The early epidemic was a period of crisis as investigators and clinicians struggled to understand what was causing the outbreaks of pneumocystis pneumonia and Kaposi's sarcoma.[10,11] Identification of the viral etiology of the acquired immune deficiency syndromes helped spearhead the first prevention efforts.[12] Prevention efforts included screening the blood supply, developing safe clotting factors, and beginning scientific research on therapy. Identification of the virus also allowed drug companies to screen compounds for antiretroviral activity. Because there was no effective therapy to treat the underlying viral infection initially, medical care focused on the treatment of opportunistic infections and palliative care placements. The first major step forward in the medical treatment of HIV occurred in 1987 with the approval of azidothymidine (AZT).

In the ten years following the approval of AZT, the medical treatment for HIV expanded as new drugs were released. The new medications had toxic side effects, and inconvenient dosing schedules that made them difficult to administer. Because of the increasing complexity of HIV therapy, and the wide variety of complications of AIDS, medical care for HIV became concentrated in large academic centers with HIV specialists. The trend for concentration in urban academic centers was, in part, promoted by the Ryan White Comprehensive AIDS Resources Emergency Act (CARE), which granted urban clinics federal funding to provide treatment. In 1996, therapy for HIV underwent a seismic shift; the Food and Drug Administration (FDA) approved protease inhibitors and the first of the non-nucleoside reverse transcriptase inhibitors. The new medications altered the natural history of HIV infection. Almost immediately, studies appeared showing decreased morbidity and mortality for patients on highly active antiretroviral therapy (HAART).[13]

The modern mainstay for treating HIV is antiretroviral therapy[14]. The goals of antiretroviral therapy are two-fold. The first goal is to increase the number of CD4 cells to help the body fight off infection. The second goal is to reduce the amount of virus circulating in the blood in order to protect CD4 cells from death, and reduce the damage to other organs due to viral attack. Modern antiretroviral therapies allow for simple daily dosing regimens including one pill once a day, using a fixed dose combination. Therapy is designed as a combination of medications from different classes in order to prevent the development of resistance. The FDA now approves five different classes of antiretroviral therapy. Therapy is now begun regardless of CD4 cell count. The other mainstay of effective treatment is to prevent opportunistic infections and other sequelae of HIV disease.

Although effective medical therapy for the treatment of HIV is now available in the United States a variety of challenges remain to effective HIV care and treatment. The first challenge is the aging of the individuals infected with HIV. It is estimated that over 50 percent of persons living with HIV are older than 40 years of age.[15] Aging patients reveal previously unrecognized effects of the virus on organs other than the immune system. Beyond the damaging effects of HIV, aging patients require screening for a wide variety of chronic conditions found in the general population including high blood pressure and high cholesterol, and prostate, breast, and colon cancers. The current HIV workforce is well trained in the care of HIV disease, but is not always well trained in providing primary care.

A second challenge is that the current HIV workforce practices primarily in academic urban specialty clinics.[16] The concentration of providers in urban clinics has both positive and negative effects. The positive effects include the ability to see a large number of HIV-infected patients, and to collaborate with other HIV care providers. One negative consequence of the urban concentration is that rural areas are underserved.

A third challenge is the notion that therapy removes all sequelae of disease. Having effective therapy available does not ensure patient compliance, nor does it ensure that patients can advocate for their own health.

A fourth challenge is the rise in the prevalence of HIV in the United States. The prevalence is increasing because of the increased lifespan of infected individuals and the stable incidence rate.[1,17] The rise in the total number of patients infected is straining the capacity of the HIV care system; and the national physician shortage will likely soon result in a shortage of physicians to care for HIV-infected individuals. The caseload for each physician is also likely to rise. Antiretroviral therapy is the mainstay of treatment, and for many patients this therapy is paid for via AIDS Drug Assistance Programs (ADAP). ADAP is a joint program administered by the States and paid for by the States and the federal government. ADAP enrollments are increasing more quickly than the amount of funding.

Other major funders of HIV care include Medicare, Medicaid, and the Ryan White CARE Act. The Ryan White CARE Act deserves special attention because it is one of the few federal acts devoted to a specific disease. Initially passed in 1990, the Ryan White CARE Act has been reauthorized several times since. In addition to providing funding for medications and HIV care, the Act also provides funding for support services. These support services include a wide range of services designed to improve the quality of care for HIV patients. Of particular importance is the treatment of co-existing mental health and substance abuse disorders. Both mental health diagnoses and substance abuse are more common in the HIV-infected population, and both diagnoses lead to worse health outcomes. Other support services include transportation assistance, language interpretation, and comprehensive medical management teams including nurses and social workers. There is now concern that the Ryan White Care Act could be politically vulnerable because of the perception that the Affordable Care Act will allow people living with HIV ready access to health insurance.[18]

In addition to federal and state funding for HIV care, thirty seven percent of patients have private insurance.[19] Having health insurance has been associated with both lower and higher frequencies of healthcare utilization.[5,20] Insurance is often necessary to pay for therapy. The need for health insurance and other HIV care funding mechanisms will likely increase because the latest recommendations from the Department of Health and Human Services (DHHS) call for providing treatment to all HIV-infected persons, regardless of CD4 cell count.[14] Additionally, the Affordable Care Act is changing the way insurance is provided to HIV-infected persons in the United States. The data used in this dissertation are based on information from studies published before the implementation of the Affordable Care Act. Future studies will be able to compare data from this dissertation with data collected by the Medical Monitoring Project (MMP), a CDC surveillance system, after the implementation of the Affordable Care Act.

The Affordable Care Act changes several important rules regarding health insurance coverage in the United States. Medicaid coverage expansion has occurred in an erratic fashion as each state has decided whether or not to expand coverage. Each state currently uses a percentage of the federal poverty level to set cutoffs for Medicaid eligibility. For those states expanding Medicaid the coverage threshold is now 133% of the federal poverty level. Medicaid coverage will expand to all low-income individuals regardless of whether they have children or a disability. Second, insurers must allow young adults to remain on their parents' insurance plans through age 26. Third, persons with HIV previously faced problems obtaining private insurance because insurers had the right to deny coverage to those with pre-existing conditions. Federal law no longer allows the denial of coverage for pre-existing conditions. Fourth, the states and the Federal Government have established high-risk insurance pools to help insure persons with HIV. Fifth, lifetime caps on the amount paid out by insurance plans are no longer allowed.

The delivery of preventive healthcare services is one of the cornerstones of quality care in HIV treatment and prevention. Eventually, all insurance plans will be required to provide preventive services and immunizations recommended by the US Preventive Services Task Force. Preventive services and immunizations will be provided free of co-pays and deductibles. The Affordable Care Act offers many potential improvements; however, challenges remain. These challenges include providing coverage for illegal immigrants who remain without federal health insurance benefits. Additionally, patients who cross back and forth over the Medicaid eligibility program threshold will be covered only a percentage of the time. Purchasing insurance remains a task that is time-consuming and logistically complicated. A recent study also showed that state ADAP managers are confused by their role in the new healthcare system.[21]

Despite the efficacy of current antiretroviral therapy (ART) and the provision of services by Ryan White, all is not well with the state of HIV treatment and detection in the United States. As Wafa M. El-Sadr and coauthors write in “AIDS in America – Forgotten but Not Gone” [22], HIV remains a major health threat in this country. Although overall HIV prevalence in the United States is approximately one third of one percent, the prevalence among certain population subgroups rivals that of sub-Saharan Africa.[1,22] HIV prevalence is concentrated in the “disenfranchised and socially marginalized.”

Ideally, patients follow a systematic cascade to accessing therapy and receive diagnosis, engagement and retention in care, and ultimately therapy for HIV. Although one study found that disparities in receipt of care, viral load, and CD4 count have declined over time, others have not found the same associations.[23] For example, Adeyemi found that non-Hispanic blacks were still twice as likely as whites in 2009 to have viral loads that were not suppressed.[24] Data at the national level are equally discouraging. In 2009, only 82 percent of people believed to have HIV had been diagnosed with the disease.[25] This is particularly problematic because it is now well established that ART lowers the risk of transmission of infection[26]. Of all patients infected with HIV in the United States in 2009, 60 percent were linked to care, 37 percent were retained in care, and 33 percent were receiving ART.[25] Twenty five percent of those infected had a suppressed viral load. Among those who were prescribed ART, 70–86 percent had a suppressed viral load depending on which demographic subgroup they belonged to.[25] Christopoulos et al. describe the evaluation of the detection and treatment cascade as follows, "Fixing the cascade requires implementation sciences because it is necessary to address patient and provider behaviors, to overcome structural barriers to care for vulnerable populations, and to evaluate an evolving healthcare delivery system." [27]

Although questions about all the steps in the diagnosis and treatment cascade cannot be answered in the dissertation, our goal is to contribute meaningful answers to questions that can be asked about patients who are receiving regular HIV care. On July 13, 2010, the Obama Administration released the National HIV/AIDS Strategy. [28]The second and third goals of the Strategy are particularly relevant because they focus on improving health outcomes and reducing health disparities. We seek to address questions related to both health outcomes and health disparities.

The dissertation contains three parts. In the first two parts, measures of healthcare utilization are analyzed. The third part focuses on measurement of quality of care. Emergency department (ED) utilization constitutes the first measure of healthcare utilization. Wilkinson et al. noted that during a six-month period 9.3 percent of those interviewed switched from having a regular source of HIV care to using the ED for HIV disease treatment.[29] Patients with HIV disease may contribute to overcrowding in the emergency department.[30] Both HIV infection and heart failure are diseases that require careful clinical monitoring. Patients with HIV were nearly twice as likely to use the ED as patients with heart failure.[31]

Previous studies of emergency department utilization have used logistic, risk, or rate regression models (See Chapters 2 and 3). Use of logistic, risk, or rate models does not allow assessment of the underlying latent variables such as sociodemographics that explain healthcare utilization. Logistic, risk, and rate regression models only use the variables measured by investigators. Logistic, risk, and rate models then directly relate the observed variable with the outcome. In structural equation modeling (SEM), investigators hypothesize that unmeasured variables represent the true or causal reasons for healthcare utilization. Because we cannot directly measure the latent factors, investigators must use proxies they believe reflect the underlying truth. For example, consider the effect of sociodemographic status on ED utilization. An investigator could measure several variables and calculate a point estimate for each individual variable. However, the investigator has no way to combine the measured variables into an overall effect of sociodemographic status. Structural equation modeling solves this difficulty by allowing the investigator to assess whether several measured variables belong to one latent variable. Furthermore, SEM extends standard regression techniques. According to Goldberger in Pearl causal analysis, "In a structural equation model each equation represents a causal link rather than a mere empirical association" [32] Thus, each arrow in a SEM diagram represents a causal connection between the two variables, and not merely the conditional distribution of one given the other.

The second measure of healthcare utilization among patients with HIV infection is admission to the hospital. Hospital admission contributes to a large percentage of total costs. The percent of total cost attributed to hospital care rises from 6.4 percent among those with CD4 counts greater than 500 cells/mm^3 to 60.8 percent among those with CD4 counts less than 50 cells/mm^3. [9,33] Failure to receive appropriate opportunistic infection prophylaxis, antiretroviral therapy, or vaccination may lead to hospital admissions. Odds, risk, or rate regression techniques have generally been used in previous analyses of risk factors for hospital admissions. To date, the underlying causal latent factors of hospital admissions have not been analyzed.

In the third part of the dissertation, five combination metrics for measuring quality of care are estimated. Each combination metric will have its standard error calculated under three different distributional assumptions. The data source for this project is the HIV Research Network (HIVRN), a geographically diverse, but not nationally representative study of HIV patients in care in the United States. To our knowledge, data on combination metrics for quality of care in HIV in the United States have been published in only three studies.[34-36] Thus, our data can be used to set a baseline for quality improvement within the HIVRN. The combination metrics were calculated using individual quality indicators that were chosen by a committee of several national stakeholders in 2009.[37] The quality indicators cover a wide variety of quality of care areas, including prescribing HAART, opportunistic infection prophylaxis, and screening for other infections.

1.2 Theoretical models of healthcare access and utilization

It is critical to have a theory or model for the purposes of guiding epidemiologic research. Theoretical approaches to modeling and understanding healthcare utilization are important for a number of reasons. In the interest of simplicity, the terms theories and models are used interchangeably.[1] Theories can help guide both the study design and analytic stages. Before the study is conducted, theory can guide the framing of the hypothesis of interest. Study design is influenced in two ways. First, investigators must decide which variables to include on their questionnaires. Second, the investigators must choose which variables to include in analyses. For epidemiologic research, a further breakdown of the variables included in the model is important for defining the exposure of interest and in controlling for confounding. In addition to controlling for confounding, the theory can guide the investigator in choosing which effects to estimate. For example, the investigator must decide whether to estimate direct effects, indirect effects, or both. Theories can also guide the understanding of unmeasured variability. For example, without a theory an investigator might ignore the potential input of the healthcare environment on care-seeking behaviors. Similarly, an investigator might not consider the role of personal decision-making.

[1] Theories generally refer to overaching ideas about what being sick means in the context of society, and personal motivations for seeking care. Models refer to specific sets of factors that drive healthcare utilization. The Health Belief model is the best example of a model and theory combined.

Theoretical models also guide the choice of analysis techniques. The two different analytic techniques in this dissertation answer two different questions posed by Andersen's theory, which is discussed in detail below. The first is to use prevalence ratio regression to understand the public health impact of individual risk factors for healthcare utilization. The second is to use SEM to understand whether the Andersen theory is itself a valid way of conceptualizing healthcare utilization.

A healthcare utilization analysis requires two steps. First, access to care must be defined so that an appropriate study population is selected. Second, the investigator must decide whether to use a causal theory in the analysis. A causal theory makes it easier for the investigator to identify and control for confounding. We are using the Gelberg-Andersen-Aday model as our causal construct. An important consideration is defining access to care. Mkanta et al. defines access as such: "Access to care is the set of factors that affect the potential ability of an individual or group to acquire timely and appropriate use of healthcare services." [38] Andersen, on the other hand, defines healthcare access as follows: "Access to care means how a patient gets entry into care and continues in that process."[39] It is these determinants that we are interested in understanding.

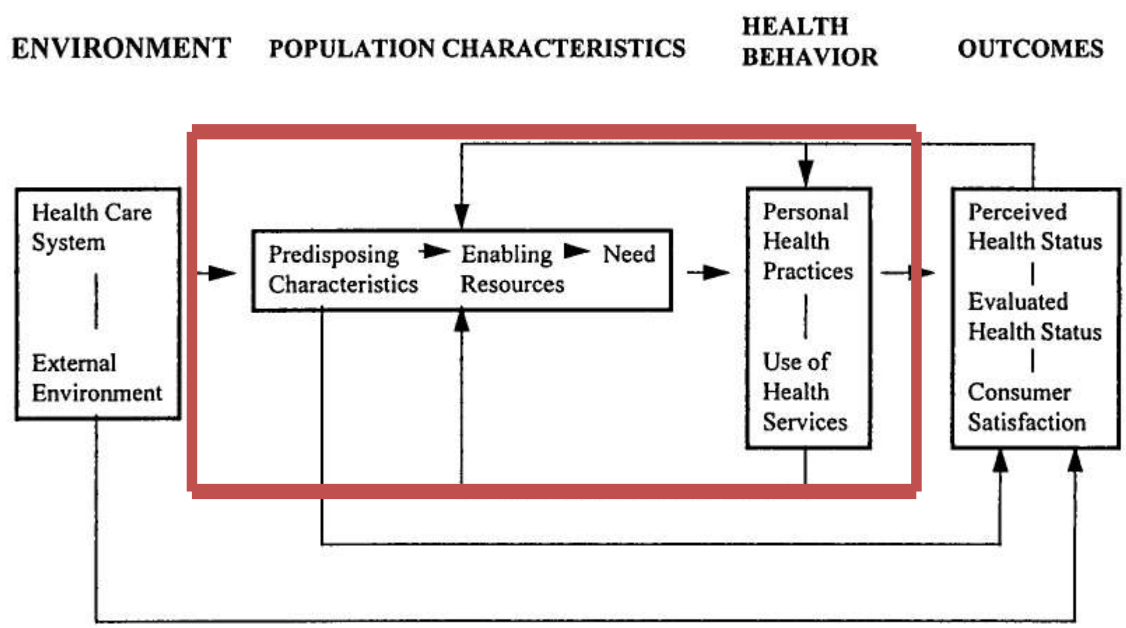
Three main models of healthcare utilization were considered. The models of healthcare utilization contain variables that describe individual-, provider-, and population-level characteristics. This dissertation focuses on the individual level. We did not analyze data on the provider or population level.

The first model is the health belief model. The health belief model defines a sequence of events that must occur for a patient to receive care. With this model, two steps are necessary. First, the patient must analyze the costs and benefits of healthcare utilization. Second, the patients must feel a call to action, or a sense that they need to receive healthcare. The health belief model calculates parameters for the variables from the standpoint of patient beliefs about the desirability and necessity of seeking care. The health belief model does not take into account clinical factors that might be unknown to the patient. Examples of such factors include CD4 count and viral load.

The second model is the biopsychosocial model. This model links biologic, social, and psychological factors to healthcare utilization. The factors are in an ordered hierarchical relationship where change in one level affects the others. Unfortunately, the MMP does not provide measurements to allow estimation of this system of healthcare utilization. For example, the MMP does not measure patients' satisfaction with their healthcare providers. Furthermore, the model does not describe the temporal relationship between the variables.

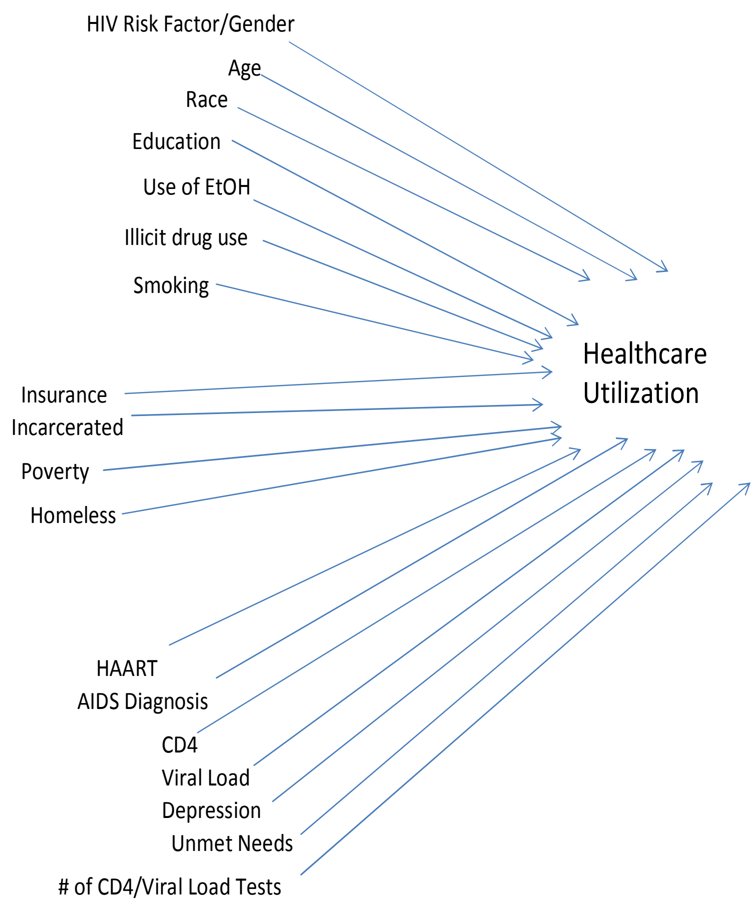
The final model, the Andersen Model of Healthcare Utilization, is used in this dissertation. This model was first developed by Andersen in the late 1960s and has undergone several revisions and reformulations. [39] All three models may include different determinants of healthcare utilization depending on the outcome in question. However, Andersen's research describes his model generically without application to a specific outcome. Andersen's model breaks the measured variables down into three groups. Each of the groups represents an underlying construct. Underlying constructs are variables invented by the investigator. Underlying constructs cause the measured variables. The underlying constructs in Andersen's model are known as predisposing, enabling, and illness-related factors. Possible measured predisposing variables include demographics, social structure, and beliefs. This inclusion of beliefs is incorporated from the health belief theory.[40,41] Enabling variables include individual-level factors such as transportation, marital status, and income. Illness-related variables in our study include CD4 count and viral load. According to Andersen, the predisposing variables alone are not reasons to seek care. Andersen notes that if sociodemographic disparities are not present then receipt of care should be determined by illness-related factors. [42]

Figure 1.1: Andersen model of healthcare utilization



The dissertation focuses on the population characteristics and health behaviors shown in the central boxes surrounded by the red box in Figure 1. Each of the central boxes denotes measures of individual-level characteristics. The instruments used in this dissertation do not assess the external environment or the healthcare system. Furthermore, analyses of consumer satisfaction and self-evaluated health status are beyond the scope of this dissertation. Figure 1 is not a directed acyclic graph. Figure 2 shows the directed acyclic graph (DAG), which results from transforming Figure 1 into a causal diagram.

Figure 1.2: A directed acyclic graph of the measured variables in the Medical Monitoring Project and their effect on healthcare utilization

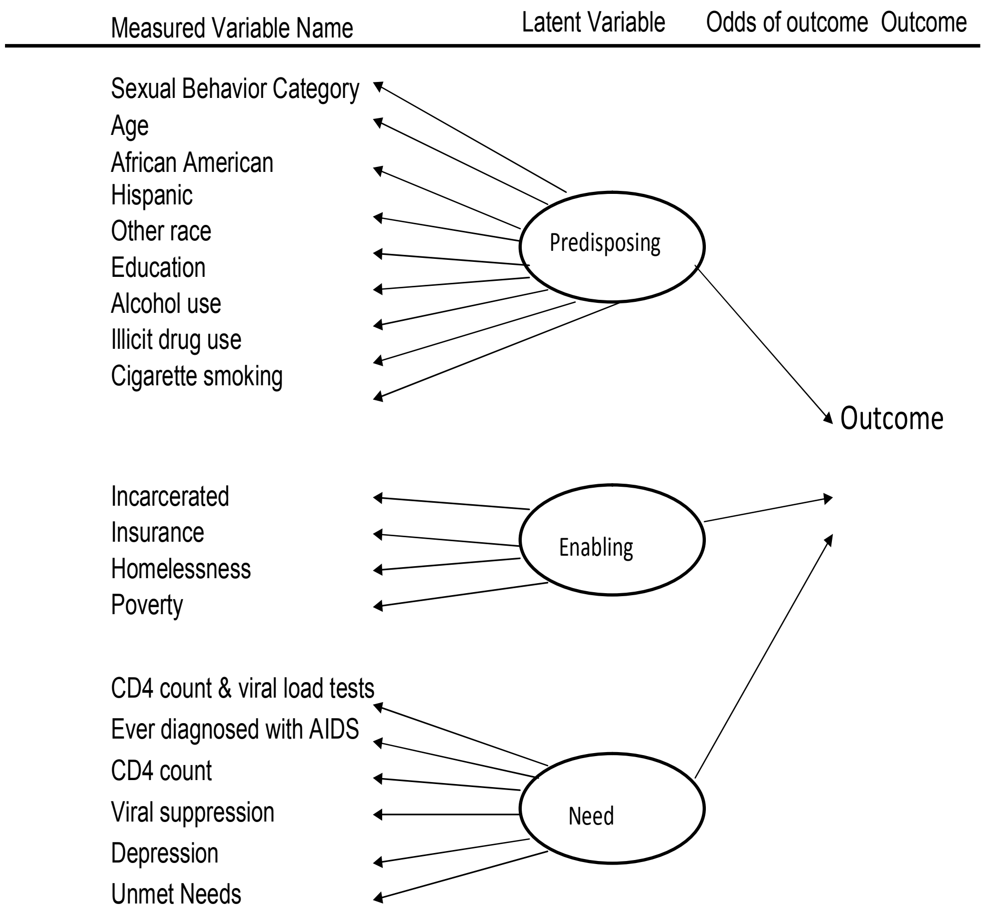


All of the variables in the DAG are causes of the outcome. The independent variables in the DAG are confounders of each other. For simplicity, the DAG does not have arrows demonstrating the confounding relationships. For example, insurance is likely associated with receipt of case management, and this would serve as a confounder of the relationship between case management and insurance.

Figure 2 is organized based on the Andersen model with three groups of variables. The first group contains sexual behavior category, age, race, education, use of alcohol, illicit drug use, and smoking. These are the predisposing variables. Insurance, poverty, homelessness, and incarceration are the enabling variables. The need variables are HAART, AIDS diagnosis, CD4 count, viral load, depression, unmet needs, and primary care visits. Figure 2 contains the variables that have been most commonly assessed in previous studies of emergency department utilization and hospitalization.

Andersen's three groupings of the variables are known as latent factors in structural equation terminology. Structural equation modeling uses the word *loadings* to describe the relationship between a measured variable and a latent factor. A loading is the causal effect an underlying variable has on a variable measured by the investigators. Figure 2 is not a true SEM diagram. It fails to describe the relationship of the latent factors with the observed variables. It also does not describe the relationship of the latent variables with the outcome. The goal of our research is to assess Andersen's model of healthcare utilization. We are loading our measured variables onto the latent factors as described by his work. Other investigators could hypothesize other relationships between the measured and unmeasured factors.[4,5,7,43,44]

Figure 1.3. Structural equation model diagram for the relationship between the measured variables, the latent Factors, and healthcare utilization



The SEM diagram in Figure 3 bears remarkable similarity to the directed acyclic graph in Figure 2. This is not by accident. Structural equation model theory and directed acyclic graphs belong to a unified theory of causal models. Figure 3 contains the latent factors in addition to the measured variables in Figure 2. Circles enclose each of the latent variables. For the emergency department and hospital admissions analyses, we used the structural equation model in Figure 3.

1.3 Introduction to Structural Equation Modeling (SEM)

As described in Section 1.2, structural equation modeling was used in this dissertation to assess Andersen’s model of healthcare utilization. Although SEM has seen wide use in the fields of psychology and psychiatry, few articles in the epidemiology literature have taken advantage of SEM.[45] SEM has many potential uses in the field of epidemiology. One of the primary roles is in data reduction. SEM can help extract the most important risk factors when the investigator is faced with a large number of variables. Structural equation modeling can assist an epidemiologist in overcoming selection bias and confounding. In the dissertation, we combined the ability of SEM to work with many variables with its ability to test theories. Many investigators cite the Andersen model when performing analyses of healthcare utilization. When the model is cited and then standard regression techniques are performed, the investigator is not taking full advantage of the theory. To take full advantage of Andersen's theory requires the investigator to consider Andersen's groupings or latent variables. Only SEM is capable of assessing the relationship between a set of measured variables and latent variables. Furthermore, SEM helps describe whether collections of measured variables belong together. SEM is used here to test an underlying causal structure, specifically the Andersen model of healthcare utilization. [39,42,46]

Structural equation modeling traces its initial origins to the path models developed by biologist Sewall Wright in the 1920s. [47-49] Judea Pearl recently proved that directed acyclic graphs, potential outcomes models, and SEM form one coherent theory. [32,50-52]

Structural equation modeling utilizes likelihood principles of inference. Maximum likelihood estimates are also applied in logistic, rate, or risk models. Maximum likelihood estimation is a general theory that calculates parameters based on the data. A simple example of a parameter is to calculate the probability of seeing a head upon flipping a coin. The parameter in this example is the probability, or p. A technique for estimating this probability would be to conduct n total flips of the coin of which y would be heads. The estimated probability is y divided by n. Y/n is the maximum likelihood estimate of p. The probability is also called an item characteristic function, which is a mathematical relationship that describes the behavior of a variable. In our example, the number of heads is a function of πi, the probability of a head on any given trial.

SEM uses the following notation. The single equation function is $x=\gamma\xi+\lambda$. X is a vector of observed variables, for example, sex, race, and education. The subscript i is added to the X to indicate the different observed variables. ξ_i are the latent factors. γ is a matrix of the loadings for the ξ_i to the x_i. λ is a vector of unique error terms for each of the measured variables. Loading is the SEM terminology for how each latent variable causes the measured variables. A decomposition of the full model examining a single variable is the following (Equation 1): $x_1 = \gamma_1\xi_1 + \lambda_1$. The notation for the formula in the previous sentence is: x_1 is the measured variable sex, γ_1 is the latent factor predisposing, and ξ_1 is the loading or coefficient that describes the relationship between the measured variable and the latent variable. λ_1 is the error term. The right-hand side of equation causes the left-hand side of the equation. In other words, the latent variables cause the measured variables.

The next paragraph details the situation when there are binary measured variables. The first step is to write a likelihood function to estimate the probability for a single binary variable. The probability or likelihood function is written via the logit $\pi_i(y) = \alpha i_0 + E$. Once we have the likelihood function for a single variable, we can extend this function to multiple binary variables. The likelihood function then is $\sum_{i=1}^{p}[\sum_{h=1}^{n}\ln(1-\pi_i(y_h)) + \alpha_{io}\sum_{h=1}^{n}x_{ih} + a_{i1}\sum_{h=1}^{n}x_{ih}y_h]$. [53] A further extension is possible to consider variables that have more than two levels. The subscript s is added to each measured variable if the measured variable contains more than two levels. S will equal the number of levels of the variable. The likelihood then becomes $\sum_{i=1}^{p}[\sum_{h=1}^{n}\ln(\pi_{i0}(y_h)) + \sum_{s=0}^{ci-1}(\alpha_{io}(s)\sum_{h=1}^{n}x_{ih}(s) + a_{i1}(s)\sum_{h=1}^{n}x_{ih}(s)y_h]$. [53] The formulas for binary and categorical data can be combined using maximum likelihood theory. The combination involves taking the integral over the unknown variables. Structural equation model theory can use any variable whose distribution falls within the exponential family. [53]

Factor analysis is used to calculate the loadings for the measured variables onto the latent variables. Factor analysis is the first step in constructing an SEM. A simple example may help clarify how factor analysis works. The primary risk factor for Down syndrome is the age of the mother at the time of conception. Physicians previously thought birth order of the children was a risk factor for Down syndrome. A simple 2x2 table demonstrates an association between Down syndrome and birth order. Stratification into two 2x2 tables based on maternal age removes the Down syndrome birth order association. The directed acyclic graph that applies to this situation is in Figure 4.

Figure 1.4. Directed acyclic graph of maternal age, birth order, and Down syndrome example

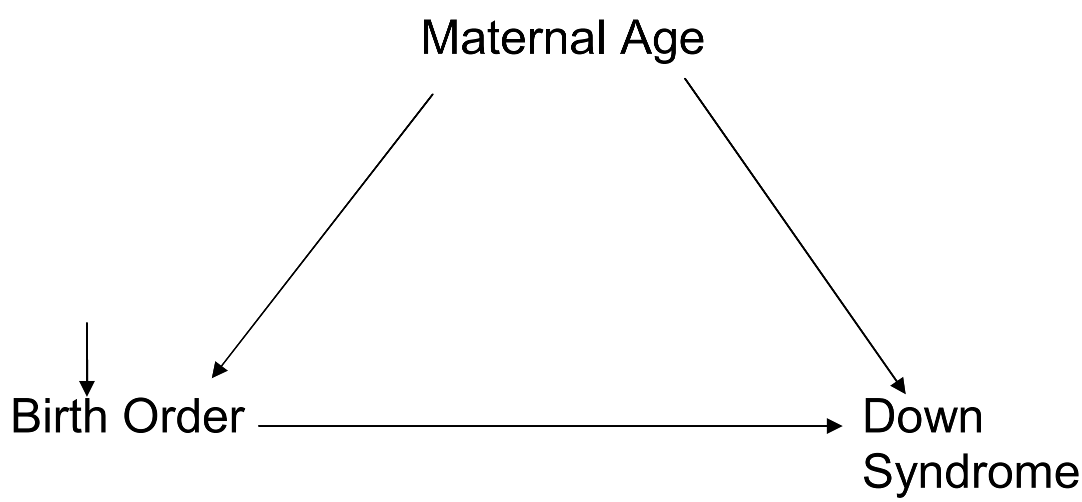


Figure 4 demonstrates a simple confounding situation where there is a backdoor pathway from Down syndrome to birth order via maternal age. A solution to the problem of confounding is stratification on the maternal age variable. Factor analysis works similarly to stratified analysis. Instead of using a known measured variable to provide the strata, the computer attempts to use a latent variable to define the strata.

Some important points distinguish an SEM diagram from a DAG. Arrows connect the latent factors to their measured variables. Factor analysis terms the single-headed arrows residuals. However, we followed Pearl and use arrows to represent causal associations. Dashed lines denote the correlation between the latent variables. The dashed lines are the remaining correlation between the latent variables after controlling for the measured variables. In Figure 3, the arrows that denote measurement error of the observed variables are omitted. For our analyses, measurement error was not a concern except as a nuisance parameter.

Standard regression analyzes the association of specific measured variables with the outcome. In SEM, there are two steps. First, the association between a set of measured variables and a latent variable is estimated. Second, the association between the latent variable and outcome is estimated. SEM uses goodness-of-fit statistics similar to those of standard regression models to determine the adequacy of model fit.

The data used in this dissertation are derived from a complex sample survey design. Survey designs require special statistical software in order to estimate the correct variances and standard errors. MPLUS, a Windows-based statistical package designed specifically for SEM, is the only software that handles complex survey design.

1.4 Issues and considerations in the measurement of quality of care

The number of articles assessing quality of care has exploded since the publication of "To Err is Human: Building A Safer Health System" and "Crossing the Quality Chasm" by the Institute of Medicine. [54,55] The Institute of Medicine publications have served two purposes. First, to alert the public and healthcare providers that nearly one hundred thousand deaths occur each year due to medical errors. The second purpose was to reinforce the importance of measuring quality of care. The increased awareness of quality of care has led to the promulgation of a large number of practice guidelines.

The efforts of a number of stakeholders have brought quality of care measurement in HIV to the forefront. New York State instituted some of the earliest efforts to measure quality of care in 1992. A set of consistent indicators across studies were not used in early efforts to monitor quality of care. There were no published guidelines for determining the numerator and denominator data for quality of care calculations. A variety of factors galvanized efforts to systematize the measurement of quality of care. First, the federal government made the measurement of quality of care a priority for Ryan White grantees. Second, the Agency for Healthcare Research and Quality began a review of available measures of HIV care. Third, the Centers for Medicare and Medicaid Services demonstrated that wide dissemination of quality of care guidelines and concomitant measurements of quality was feasible. In 2010, the Health Resources and Services Administration (HRSA), the HIV Medicine Association of the Infectious Diseases Society of America, and the National Committee on Quality Assurance released the first set of comprehensive guidelines for measuring quality of care in HIV.[56] The guidelines are designed for measuring quality among patients receiving regular HIV care. As part of the release of the National HIV/AIDS Strategy, the Office of National AIDS Policy asked the Institute of Medicine (IOM) to prepare a report on monitoring HIV care in the United States. The IOM identified the HIV Research Network as one of the key data sources for monitoring quality of care.

The goal of the dissertation is to develop composite quality of care metrics for HIV care. A composite metric is a combination of many individual measures of quality of care. It is difficult for patients, providers, and insurers to interpret multiple measures of quality simultaneously. Several definitions of combination metrics exist. Two important definitions are from The National Quality Forum and the Institute of Medicine. The National Quality Forum defines combination metrics as, "a combination of two or more individual measures into a single measure that results in a single score" [57] The Institute of Medicine defines combination metrics as, "the bundling of measures for specific conditions to determine whether all critical aspects of care for a given condition have been achieved for an individual patient thereby enhancing measurement to extend beyond tracking performance on separate measures."[58] The available individual metrics for quality of care do not cover all of the "critical aspects" of care. For the sake of clarity, I will not use the terms *bundled* or *aggregate* because these refer to quality improvement packages.

The American Medical Associations Physicians Consortium makes several recommendations that are discussed in the dissertation. "Recommendation 1: Define the purpose of the measure and the desired outcome for the patient." Committees of the Infectious Diseases Society of America, National Quality Forum, and HRSA have defined the purposes of the measures and desired outcomes. They have already selected the measures we are using. "Recommendation 2: Define the constructs or elements that should be included in the composite." For a list of the indicators proposed by Horberg, see Figure 1.5.

Figure 1.5. Recommended quality of care measures by Horberg et al.

Measure	car
Process of care	
1. Retention in care (seen at least twice annually at least 60 days apart)	
2. CD4 cell count measurement (measured at least twice annually)	
Screening	
3. Gonorrhea/chlamydia screening (at least once)	
4. Syphilis screening (annually)	
5. Injection drug use screening (annually)	
6. High-risk sexual behavior screening (annually)	
7. Tuberculosis screening (at least once)	
8. Hepatitis B screening (at least once)	
9. Hepatitis C screening (at least once)	
Immunization	
10. Influenza immunization (annually)	
11. Pneumococcal immunization (at least once)	
12. Hepatitis B vaccination first dose received (if appropriate)	
13. Hepatitis B vaccination series completed (if appropriate)	
Prophylactic therapy	
14. PCP prophylaxis if CD4 cell count <200 cells/μL	
ART prescription	
15. Appropriately prescribed ART	
Viral control (after at least 6 months post–ART initiation)	
16. Achieving maximal viral control if prescribed ART	
17. Achieving maximal viral control if prescribed ART or treatment plan documentation if maximal viral control not achieved	

We have chosen to include the following seven measures of quality of care: HAART if CD4<350; prophylaxis for pneumocystis pneumonia if CD4<200 and mycobacterium avium intracellulare if CD4<50; lipid screening if on HAART; two or more CD4 measurements in the calendar year; and screening for syphilis, gonorrhea, and chlamydia. These measures were chosen because they were readily available from the HIVRN. One issue in studying the quality of HIV care has been that no study or cohort is capturing data on all of the measures proposed by Horberg. “Recommendation 3: Scoring Methods.” These are discussed in more detail in the analysis section below. Briefly, there are varieties of ways to create composite measures. The preferred one according to Donald Berwick, former head of the Centers for Medicare and Medicaid Services, is an all or none scoring system whereby a score of zero is received unless all quality components are performed. [59] “Recommendation 4: Define the Level of Aggregation.” The level of aggregation refers, for example, to patients, providers, networks of care, or insurers. In our analysis, there are two levels of aggregation. The first level is either across patients or across quality indicators. The HIVRN is the second level of aggregation. Recommendation 5 does not apply to our analysis and is not cited here. "Recommendation 6: Testing and Evaluation." The AMA provides a wide variety of suggestions for testing and evaluation both for test and retest reliability as well as validation against outcomes. Validation against outcomes is excluded from the dissertation.

There are a variety of ways to classify quality measures. A given measure can fall into more than one classification. For example, screening for syphilis is both a screening measure and a process measure. Process measures require actions to be taken. Process measures are distinct from structural measures. A structural measure describes the capability of a physician or patient to perform a process measure. For example, the percentage of laboratories capable of conducting syphilis screening tests is a structural measure. Finally, quality of care can be measured using outcomes measures such as ED utilization or hospital admissions.

In order for a patient to receive quality care, several sequential steps need to take place. First, the healthcare worker must recognize that the patient meets the criteria for a quality care measure. This can be a difficult process since guidelines for quality of care are often complex, and the complexities of an individual patient's situation may not be covered by the guideline. In locations with an electronic medical record, some of the burden of recognizing which patients meet guidelines may be assumed by the computer program, which can alert the clinician to the need for tests or prophylaxis prescription. Once the healthcare worker recognizes that a given quality of care indicator has been triggered, he or she must then act on that indicator. Once an indicator has been acted on, it is often up to the patient to follow through with treatment, or continued laboratory testing. Patient compliance with indicators is not assessed in the dissertation. For example, we record from the medical record whether the patient was prescribed pneumocystis prophylaxis—not whether the patient filled the prescription, nor whether the patient adhered to the medication. Because we do not assess the patient side of compliance with quality indicators, we are grading the clinicians on their performance.

1.5 Structure of the dissertation

Chapters 2–4 contain literature reviews for use of the emergency department, hospital admissions, and quality of care, respectively. Chapters 5–8 contain the manuscripts as well as additional discussion information. Chapter 9 discusses conclusions from my work as well as future directions for research. Chapter 10 discusses sensitivity analyses proposed by the committee as well as those I undertook on my own in preparing the dissertation.

<u>Chapter 2: Use of the Emergency Department</u>

<u>2.1 Introduction</u>

Self-reported use of the ED in the Highly Active Antiretroviral Therapy (HAART) era, defined as after 1996, has been studied several times. The goal of the ED analysis was to determine risk factors for ED utilization. Because structural equation modeling relies on using measured variables to predict the presence of latent factors, we undertook a review of the literature. Our goal was to find what variables had already been associated with ED utilization.

<u>2. 2 Literature review for emergency department utilization</u>

2.2.1 Methods:

Search Strategy:

Three searches were performed. First, “emergency department utilization HIV united states”. Second, “emergency room utilization HIV united states”. Third, “healthcare utilization HIV united states”. For the second search string, we excluded articles found in the first search.

Searches were conducted using PUBMED. Searches were limited to articles published after 1/1/1996. Searches are up to date as of 12/31/2012. Searches were performed on 3/30/2013. All articles produced by the first two searches had their abstracts reviewed to identify potentially relevant articles. Articles from the third search were selected based on relevant titles only. Articles whose abstracts or titles were deemed relevant were then read in full. Details sought from articles included estimates of ED visit proportions or rates, study design information on populations, sample size, and date of recruitment, as well as risk factors for utilization.

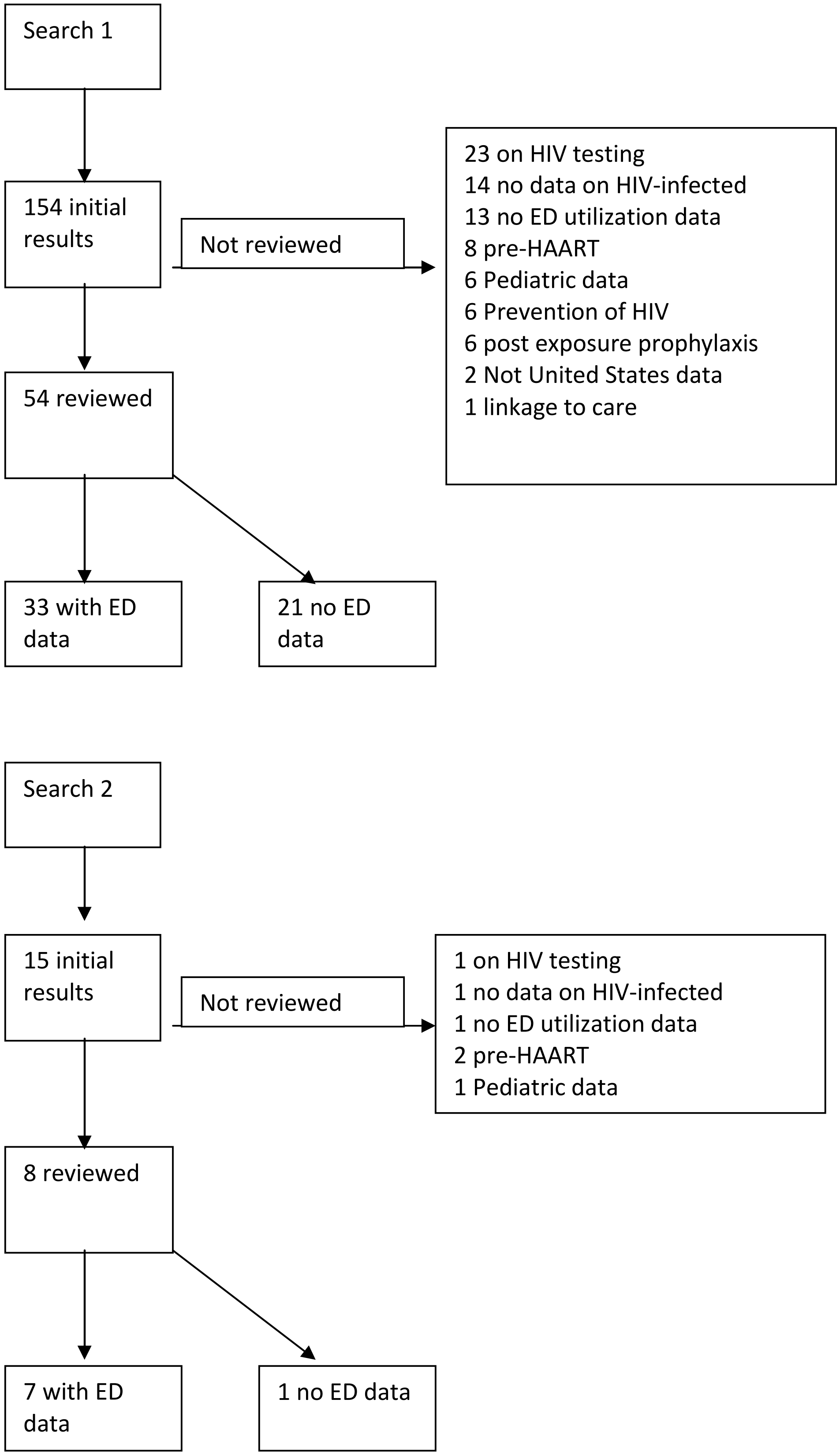
JJ abstracted all articles onto standardized forms. All articles that contained data on any estimate of ED utilization then had their reference lists reviewed for any additional relevant articles. Articles were selected without regard to whether the study design was observational or interventional.

2.2.2 Search Results and Methods:

The first search string generated 136 results. Of these 54 were selected for further review based on review of the abstracts. Of the 54 selected, 33 contained data on ED utilization and 21 did not. Articles deemed not of interest fell into the following categories; HIV testing (23), not broken down by those HIV-infected (14), no data on ED utilization (13), pre HAART era (8), pediatrics (6), prevention of HIV (6), use of post exposure prophylaxis (6), not United States data (2), linkage to care (1).

The second search string generated 15 results. Of these eight were selected for further review. Seven of the eight studies selected from the second search contained data on ED utilization. Articles deemed not of interest fell into the following categories; HIV testing (1), not HIV specific (2), pre HAART era (2), no data on ED use (1), pediatric data (1) The third search string excluded articles already located by the previous two searches leaving 1230 articles. Of the 82 selected for additional review, 13 contained data on ED utilization and 69 did not.

Figure 2.1: Flowchart of article abstraction for emergency department utilization



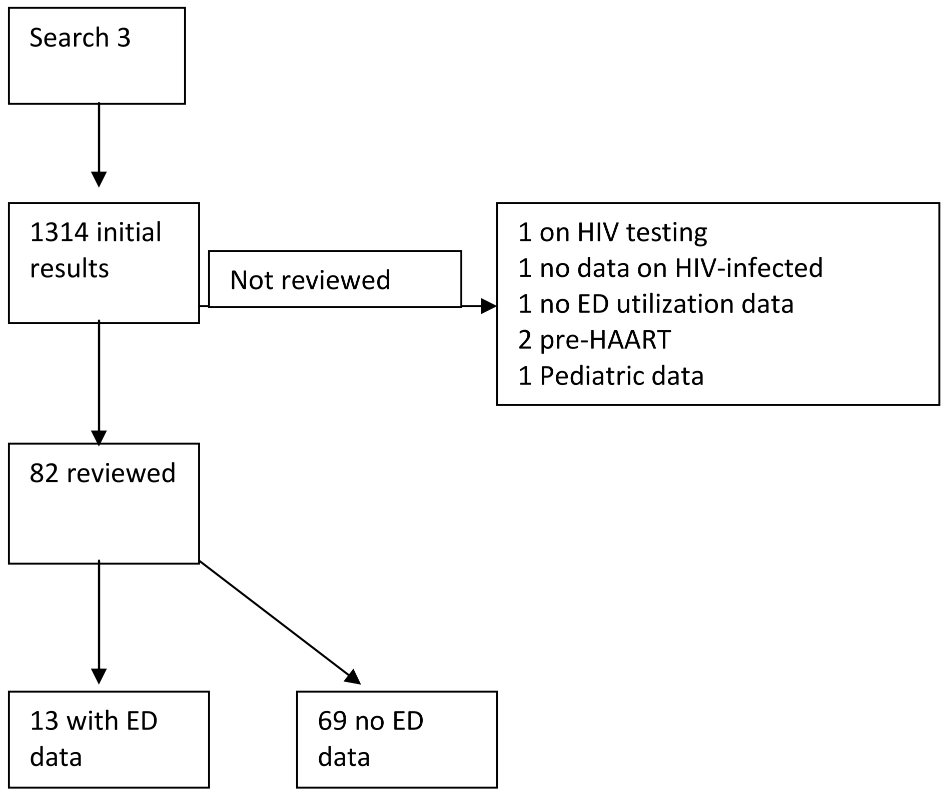


Table 11.1 contains the name of the study's first author, the year(s) that the study was conducted, a brief description of study participants, the number of participants, and the risk, mean number, or rate of visits made by study participants. Table 11.2 contains the name of the first author, the year(s) the study was conducted, the risk factors assessed by the study, the measures of association, and the comparison group for each risk factor. Table 11.2 contains the results from multivariate analysis if it was carried out. If

multivariate analysis was not carried out bivariate analysis is presented. Stratified analysis with only p-values is not presented.

2.2.3 Literature Review Discussion:

2.2.3.1 Frequency and rates of ED utilization

Table 11.1 contains the risks, rates, and mean number of emergency department visits. The literature most frequently has assessed ED visits over the following intervals; the past three months, the past six months, or the past year. The range of frequencies in the last three months was 17.3%-23%.[20,60,61] None of the studies reporting three-month frequencies selected a representative sample of those in care. Barnett et al. evaluated visits to ED in a randomized controlled trial of vouchers redeemable for goods. The goal of the trial was to examine adherence to antiretroviral therapy. All participants received coaching on antiretroviral therapy adherence. [62] Trial participants who were randomized to coaching alone made a mean of 0.13 visits in the past three months. Those who were randomized to vouchers and coaching made a mean of 0.31 visits in the past three months. Smith et al. found that patients made 1.8-2.1 visits in the past three months on average. [63]

The range of frequency of ED use in the last six months was 16%-65.3%. [5,44,64-77] The higher end of the range was commonly encountered in subsets of the population who were either homeless or using illicit drugs.

Frequencies of ED use over twelve months ranged from 17.8% to 69.2%. [78-84] The lower end of the range was found in studies of hospital-based cohorts. [81,83] The higher end of range was found in studies of specific subgroups such as the homeless or injection drug users.[79,82,84] Data from 1997 showed utilization of 36-39% depending on whether or not the patient had AIDS. [80] Data from 2006 had percentages of 17.8 and 20.2 respectively [83] [81] Potentially, there has been a decline in ED utilization over time. However, Bailey et al included only Medicaid beneficiaries, while Venkat and Kolman included persons with all insurance types. The Venkat and Kolman studies may underestimate ED utilization. This is because they only examine ED utilization at one facility. Josephs et al contains data on all visits to the ED not just those to a specific hospital. Using self-reported data 32 percent of individuals made a visit in the six months prior to their interview during 2003. [44] The mean number of visits per year ranged from 0.4 to 2.9 depending on the study. [64,85-90]

The rate of ED utilization varied widely across different subgroups of the population depending on housing status, CD4 count, and hepatitis C virus co-infection.[91-93] Those infected with HIV and hepatitis C virus had the highest rate of 43.9 visits per 100 person years. [92]

2.2.3.2 Sociodemographic risk factors for emergency department utilization

Table 11.2 contains results for the odds, risk, or rate ratios for each study and their association with ED utilization. Fifteen studies examined the odds, risk, or rate ratios of sex on ED utilization. Eight found that women had increased odds, risks or rates of utilization.[5,44,60,67,72,76,83,87,91,92,94-97] [98] The point estimates ranged from 1.24-6.97 across studies with a statistical significant measure of association. No study, regardless of statistical significance, had a point estimate where women were less likely to use the ED than men did.

Twelve studies examined the association of age. Most studies classified age as a continuous variable. [5,44,60,72,83,91,92,94-96,98]Only one of the twelve studies found increased odds of utilization. [5]

Norton et al. and Shapiro et al. found that African Americans had increased rates, or odds of ED use respectively. Subsequent studies have not demonstrated such an association.[5,60,83,92,94,95,97-99]

ED utilization was increased in two out of six studies that examined the effect of education. ED utilization increased among those with a lower level of education.[5,44,63,72,95,98]

Neither study found an association between employment and ED use.[44,72](Josephs et al., Knowlton et al., 2001) One of two studies found decreased odds of ED use amongst those at increasing levels above the Federal poverty line.[72,83]

2.2.3.3 Risk factors for ED use: enabling variables

Four of six studies found an increased odds or rates of ED use among those who reported being insured. [5,20,44,72,73,87] Shapiro et al found that self-reported insurance by Medicaid and Medicare was associated with increased odds of ED utilization compared to private insurance. Josephs et al found increased odds of ED utilization among those who self-reported insurance by Medicare. Both Shapiro and Josephs found no association between having no insurance compared to private insurance. Riley et al examined the effect of being continuously insured and intermittently insured compared to being continuously uninsured over a twelve month period. Riley et al used self-reported insurance coverage. [20] In the first three quarters of the study period those who were continuously insured had higher odds of ED utilization that those who were continuously uninsured. At the final study time-point continuous insurance was not statistically significantly associated with ED utilization. In none of the four time periods was intermittent insurance coverage associated with increased or decreased ED utilization.

Several studies found no association between illicit drug use and increased odds, risks, or rates of ED utilization while other studies found increased ED utilization amongst illicit drug users. [44,60,64,68,72,76,89,92,94,95,100] Some studies evaluated all illicit drug use including marijuana use. It is possible that marijuana users are at no increased risk of ED utilization compared to non-drug users. If marijuana users are not at an increased risk then their inclusion in the drug-using group would reduce the association between illicit drug use and use of the ED. Studies that focused solely on injection drug use also found both statistically significant and statistically insignificant results. [101] [64] [89]

Each of the studies evaluating whether alcohol use was associated with ED utilization used a different measure of alcohol use. The measures of alcohol use included the Alcohol Severity Index, the AUDIT questionnaire, and the NIAAA criteria. [60,72,73,92,94,95,102]Masson used the Alcohol Severity Index, and the Alcohol Severity Index squared and found rates of -0.18 and 0.25 respectively. [95] Norton et al found a rate ratio of 0.80 comparing alcohol users to non-users. [92]

Five of six studies found that homelessness was associated with increased ED utilization. The range of the increased odds across the studies was 1.57-2.54. [70,73,94,95,102,103] The only study, which did not find an association between ED use and being homeless, had an odds ratio for current homelessness of 1.35 with a confidence interval of 0.79-2.33 suggesting an association in the direction of the other studies. [102]

2.2.3.4 *Risk factors for ED use: need variables*

Six studies examined the relationship of CD4 count with ED utilization. Linas et al found that CD4 counts less than 100 had an odds ratio for ED utilization of 2.4. Those with CD4 counts between 100 and 200 had an odds ratio of 1.4 for ED utilization. Linas et al was the only study to find an association between CD4 count and ED utilization. [44,83,91,92] [5,72,87,94,100] It is unclear why the majority of studies did not find an association between CD4 count and ED utilization. Self-reported data may have led to misclassification of CD4 count, which can lead to a bias towards the null. However, since most studies classified CD4 count there is no guarantee that the bias due to misclassification is towards the null. If the majority of ED visits are not related to HIV then CD4 count would not be an important risk factor for ED utilization.

Four studies examined the association of viral load with ED utilization. Two found an association between ED utilization and two did not. [44,83,91,104] The statistically significant findings were in the studies by Linas et al and Venkat et al. Venkat et al. found that viral loads of 1000 to 100,000 and greater than 100,000 had odds ratios of 3.49 and 5.43 respectively.[83] Linas et al found an odds ratio of 0.5 in comparing those participants with viral loads less than 401 to those whose viral loads were greater than 400. Linas et al and Josephs et al are directly comparable since they both examined the effect of viral loads at the threshold of 401. Josephs et al found no association with emergency department utilization with an odds ratio of 1.05. [44]

If HIV disease caused many of the ED visits then it is likely that CD4 counts and antiretroviral therapy would be important predictors of ED utilization. Thus, it is surprising that only two studies, Venkat and Josephs, assessed the effect of HAART on visits with neither study finding an effect. [44,83] Based on the results of the studies examining the association of CD4 count with ED utilization and the results for HAART it may be that immune status is not an important predictor of ED utilization.

Studies have taken a variety of approaches to quantifying the association between mental illness and ED utilization. [72,94,96,105,106] Two studies found increased utilization amongst those persons with mental illness and two did not. Unfortunately, the study with null results did not provide confidence intervals to allow comparison with the data from Kim et. al. which showed an effect of 1.02 per point increase in CES-D score. [94] Meade et al, found no effect of depression as measured by the CES-D score. [97]Being the victim of violence or abuse was associated with increased utilization with odds ratios between 1.11 and 1.74.[94] Finally, Cunningham et al. found increased utilization amongst those taking mental health medications or those who made a mental health visit. [73]

2.3 Conclusions:

For most risk factors or confounders of ED utilization, the association with the outcome remains unclear. This is likely due to difference in selection of the various study samples and classification of the risk factors. ED use frequency remains high especially as measured by self-report. The high frequencies seen in self-reported data may be due to bias in the recall of participants. The high frequencies may in fact be true, due to the capture of all visits the participants are making rather than visits solely to one hospital or healthcare system. For most of the risk factors of ED utilization there was no consensus of their relationship with ED utilization. Thus, there is a need for more research so that studies that wish to assess causality can ascertain which risk factors and confounders ought to be considered during the study design phase. Furthermore, no data exist that display trends in ED utilization over time within one study population.

Table 2.1: Risks, Rates, and Mean Number of ED Visits[2]

Author	Year of Study	Study Population	N	% with >=1 visit	Mean Number of Visits	Rates
Liebschutz[106]	2/1994- 4/1996	Newly enrolled women in care in Boston, MA and Providence, RI Victims of violence Not victims of violence	50	No Data	 2 / 2 years 1 / 2 years	No Data
Masson[95]	1994- 1996	Clinical trial of case management Patients with substance abuse Recruited in EDs and office visits	190	70% / 2 years		
Box[87]	6/1994- 2/1997	Patients at Duke University Assigned to either General Medicine or ID Clinics	214	No Data	1.1 /year	No Data
Keitz[90]	6/1994 2/1997	Same study as Box General Medicine clinic ID Clinic	214	No Data	 1.58 / year 0.71 /year	No Data
Knowlton[72]	6-1995- 12/1996	SAIL subcohort of the ALIVE study Injection drug users in Baltimore, MD ED visits overall ED visits without hospitalization	287	 33% / 6 months 16% / 6 months	No Data	No Data
Smith[63]	4/1996- 3/1997	New York State Medicaid Recipients	1447	No data		No data

[2] This table was compiled from all articles found in the literature review using the following search strings. (1) "emergency department utilization HIV united states" (2) "emergency room utilization HIV united states" (3) "healthcare utilization HIV united states" Articles are listed in chronological order.

		Mean number Stably Housed Doubled Up Homeless			 1.8 / 3 months 2.1 / 3 months 1.8 /3 months	
Small[79]	4/1996- 9/1997	Miami residents targeted for outreach Stratified network sampling		47.5 / 12 months	No data	No data
Shapiro[5]	1996- 1998	HCSUS National Probability sample with three interview stages ED visit without hospital admission in last six months Initial interview First Follow Up	2864	 23 % / 6 months 16% / 6 months	No Data	No Data
Joyce[107]	1996- 1998	HCSUS 0 Mental Health Symptoms 1-2 Symptoms 3-4 Symptoms 5+ Symptoms		 36.6 / 6 months 40.2 / 6 months 37.6 / 6 months 43.5 / 6 months	No data	No data
Palepu[76]	5/1996- 8/1999	Injection drug users in Vancouver, CA HIV (+) at baseline HIV seroconverters HIV (-)	598	No Data	 2.6 / year 2.9 / year 1.4 / year	No data
Mathews[108]	1/1996- 6/2000	Patients at UCSD followed with EuroQol survey	965	40 % / duration of study		
Norton[92]	1996- 2010	Duke University Clinical Cohort HIV mono infected HIV/ HCV co infection	 96 156	No Data	No Data	 7.1 /100 py 43.9 /100 py

Bailey[80]	1997	Patients in the Tennessee Medicaid Program Patients with HIV Patients with AIDS		 39% / year 36% / year	No data	No Data
Palacio[71]	4/1997-3/2000	Women's Interagency HIV Study Urban sites Patients AIDS discontinued from HAART HIV negative patients	1485	 25.8% / 6 months 13.8% / 6 months	No data	No data
Kim[94]	1997-2001	Boston MA patients with Alcohol problems Participants in an adherence RCT	349	No data	No Data	No Data
Liebschutz[109]	1997-2001	Same data as Kim above Looked at effect of violence	349	No data	No Data	No Data
Palepu[101]	1997-2001	Patients in Boston, MA with EtOH abuse ED visits without hospitalization	350	 29% /6 months	No data	No Data
Horberg[88]	1997-2002	Kaiser California Patients Initiating ARV Pharmacist available No pharmacist	1571	No Data	.4-1.7 / year	No Data
Magnus[110]	1/1997-12/1998	Women 13-45 years old New Orleans 12 months of data available	198	No Data	No Data	No Data
Gardner[85]	1997-2003	Denver, CO Initiators of ART Study of Adherence	325	No data	0.5 / year	No Data

Nosyk[86]	1997- 2003	Patients in Vancouver Classified by SES Homeless Low SES High SES	2768	No Data	 2.13 / yr 1.63 / yr 1.27 / yr	No data
Metsch[111]	2/1998- 12/1999	Crack cocaine users in Miami	327	No data	No data	No data
Sullivan[77]	10/1998 8/1999	Those with serious mental illness in Los Angeles	154	22 % / 6 months	No Data	No Data
Kraemer[78]	10-1998- 9/2003	Veterans Administration Cohort Matched to HIV uninfected patients HIV-infected HIV Uninfected	 16048 32096	 41% / 1 year 33% / 1 year	No Data	No Data
Gordon[102]	6/1999- 6/2000	Veterans Affairs Cohort Study 3-sites	881	No data	No data	No data
Cunningham CO[64]	8/1999- 2/2001	Single room hotel occupants Last six months number of ED visits Any drug use vs no drug use IDU vs Non IDU Any EtOH vs None	238	No Data	 1.3 vs 1.8 0.9 vs 1.6 1.3 vs 1.5	No data
Barash[89]	1/1999- 12/2003	CDC Adult Spectrum of Disease Survey Major metro areas Current IDU Former IDU Never IDU	18915	No Data	 2.57 / year 0.91 / year 0.42 / year	No Data

Kidder[70]	5/2000- 12/2003	SHAS project Cross sectional surveillance Went to ED for HIV/AIDS care Homeless Stably housed	7925	 40.7% / 6 months 25.9% / 6 months	No data	No Data
Linas[91]	2000- 2007	Effect of HCV/ HIV coinfection HIV/ HCV Coinfected CD4≤100 Coinfected CD4_101-200 Coinfected CD4 201-350 Coinfected CD4 > 350 HIV-infected Only CD4≤100 HIV-infected Only CD4 101-200 HIV-infected Only CD4 201-350 HIV-infected Only CD4> 350	3143	No data	No data	 32 /1 00 py 25 / 100 py 29/ 100 py 11/ 100 py 28/ 100 py 13/ 100 py 8.6 / 100 py 6.1 / 100 py
Kushel[100]	3/2001- 7/2002	Homeless persons in San Francisco, CA	280	40.1 % / 15 months	No Data	No Data
Leserman[96]	12/2001- 4/2002	Southeast US clinics	611	39.2% / 9 months	No Data	No Data
Cunningham CO[73]	10/2001- 9/2003	Special Projects National Significance Patients targeted for outreach	610	41.7 / 6 months	No Data	No Data
Cunningham WE[66]	2001- 2003	Special Projects National Significance Patients targeted for outreach Urban areas	1286	37.3% / 6 months	No Data	No Data

Barnett [62]	5/2001- 1/2004	Patients on methadone RCT of vouchers for adherence Incentive + coaching Coaching alone	66	No data	 0.31 /3 months 0.13 / 3 months	No Data
Sansom[93]	11/2001- 12/2004	Trial of case management directly observed therapy standard of care	84 82 84	No Data	No Data	17.9 / 100 py 25.5 / 100 py 25.5 / 100 py
Cunningham CO [65]	2002- 2003	Single room occupancy hotels in NYC served by CitiWide Harm Reduction Looking at the effect of homelessness	150	45% / 6 months	No Data	No Data
Kang[75]	2002- 2003	Active injection drug users in Harlem NY. Recruited by outreach workers African Americans African Americans Hispanics Hispanics	220	 14% / 1 month 35% / 6 months 26% /1 month 42% / 6 months	No data	No data
Riley[20]	7/2002- 10/2006	Convenience sample Unstably housed in San Francisco	330	17.3 % / 3 months	No Data	No Data
Meade[97]	2002- 2004	Persons with a history of childhood abuse. Part of an RCT on coping.	268	24% / 4 months	No Data	No Data

Braitstein[69]	6/2003 or 12/2003	Vancouver, CA injection drug users HIV monoinfected HIV/HCV coinfected	707	 22% / 6 months 32% / 6 months	No Data	No data
Josephs [44]	2003	HIV Research Network Convenience sample from clinical cohort	951	32 %/ 6 months	No data	No data
Sohler[68]	2003-2005	Urban outreach centers	970	35.4% / 6 months	No Data	No Data
Patel[61]	10/2003-1/2007	New York City enrolled in either fee for service or special needs planning programs	572	19 % / 3 months	No Data	No Data
Sohler [67]	8/2004-6/2005	Convenience Sample of single occupancy hotels ED visits without hospitalization Men Women	414	 48.2 / 6 months 65.3 / 6 months	No Data	No Data
Ramaswamy[60]	6/2004-8/2007	Patients in NYC receiving methadone therapy Nested in an adherence RCT	77	23% / 3 months	No Data	No data
Wolitski[103]	6/2004-1/2007	Urban locations RCT of regular housing assistance Vs Housing Opportunities for People with AIDS (HOPWA) Baseline SOC Baseline HOPWA 6 month Follow up –SOC	629	 43.1% / 6 months 42.0% / 6 months 34.6% / 6 months	No Data	No Data

		6 month Follow up –HOPWA 12 month Follow up –SOC 12 month Follow up –HOPWA 18 month Follow up –SOC 18 month Follow up –HOPWA		30.3% / 6 months 32.0% / 6 months 30.9% / 6 months 27.1% / 6 months 28.6% / 6 months		
Kolman[81]	2004-2008	Patients receiving care in Durham North Carolina 2004 2005 2006 2007 2008		 20.3 % / year 18.7 % / year 17.8% / year 19.9 % / year 22.0% / year		
Fairbairn[82]	12/2005 4/2008	Vancouver, CA IDU Stably housed Unstably housed	428	 50.5% / 1 year 69.2% / 1 year	No Data	No Data
Venkat[83]	1/2006-12/2006	Single US center All Patients followed	356	20.2% / 1 year	No Data	No Data
Pantalone [84]	2006-2007	Convenience sample MSM in Seattle HIV only HIV/ HCV coinfected	171	 35.1% / 1 year 52.8% / 1 year	No Data	No Data
Pantalone[112]	2006-2007	Same as study above	171			
DiBonaventura[113]	3-4/2008	Cross sectional study in U.S. cities All patients on medication Examined effects of side effects nearly all of which had more ED visits	953	No Data	No Data	

Whetten[114]		Coping with HIV/AIDS in the Southeast Same study as Leserman[96]				

Table 2.2: Odds, Risk, and Rate Ratios for ED Utilization [3]

Study (Study Years)	Risk Factor	OR/ RR (95% CI)	Reference Group
Box[87] (1994-1997)	Female	NS[a]	Male
	Insurance	NS	Unclear
	CD4 Count	*[b]	Continuous
Masson[95]	Age [c]	-0.10 (.11)	Per year
	Education	-0.12 (.10)	Per year
	Men	-0.04 (0.31)	Women
	African Americans	-0.02 (0.23)	White
	Latinos	-0.50 (0.10)	White
	Other	-0.02 (0.07)	White
	Homelessness	0.66 (0.23)	Not homeless
	Drug Use	0.24 (0.15)	No Drug Use
	ASI index of alcohol use	-0.18 (0.15)	Per Unit
	ASI index squared	0.25 (0.09)	Per Unit
	Beck Depression Index	-0.01 (0.12)	
	Physical functioning	0.05 (.09)	
Knowlton[72] (1995-1996)	Female[d]	1.24	Male
	> 12th grade education	0.98	<12th grade education
	Employed	0.99	Unemployed
	> 5000$ income / year	1.05	≤ 5000 income
	≥ 40 years old	0.87	< 40 years old
	AIDS	3.79*	Not being diagnosed with AIDS
	Having limited functional status	2.72*	Having normal functional status
	CD4 < 200	1.57	CD4 ≥ 200
	CES-D ≥ 16	1.41	CES-D <16
	Current Illicit Drug Use	1.30	Former Drug User
	Daily EtOH consumption	0.79	
	Substance Abuse treatment	1.37	No Substance abuse therapy

[3] [3] This table was compiled from all articles found in the literature review using the following search strings. (1) “emergency department utilization HIV united states” (2) “emergency room utilization HIV united states” (3) “healthcare utilization HIV united states” Articles are listed in chronological order. Odds, risk, or rate ratios were abstracted from the papers. Multivariate results only are presented.

	Having a case manager	1.06	Not having a case manager
	Insurance	1.43	
Shapiro[5] (1996-1998) HCSUS	Age 18-34 [e]	1.62 (1.19-2.20)	Age ≥50
	Age 35-49	1.12 (0.86-1.46)	Age ≥50
	Female	1.41 (1.09-1.83)	Male
	Black	1.62 (1.23-2.13)	White
	Latino	1.28 (0.83-1.97)	White
	Other	1.49 (0.96-2.30)	White
	<12 years of Education	1.46 (1.00-2.12)	>16 years of education
	12 years of Education	1.26 (0.91-1.24)	>16 years of education
	13-15 years of education	1.13 (0.80-1.59)	>16 years of education
	IDU HIV Risk Factor	1.21 (0.92-1.59)	MSM HIV Risk Factor
	Heterosexual Risk Factor	0.82 (0.56-1.18)	MSM HIV Risk Factor
	Other Risk Factor	0.77 (0.49-1.20)	MSM HIV Risk Factor
	No Insurance	1.45 (0.96-2.20)	Private Insurance
	Medicaid	1.89 (1.29-2.78)	Private Insurance
	Medicare	2.01 (1.47-2.75)	Private Insurance
	HMO	1.05 (0.69-1.59)	Private Insurance
	Midwest	1.31 (0.73-2.35)	Northeast
	South	0.72 (0.47-1.11)	Northeast
	West	0.98 (0.53-1.45)	Northeast
	CD4 Count 50-200	0.82 (0.59-1.15)	CD4 Count <50
	CD4 Count 200-499	0.78 (0.63-0.97)	CD4 Count <50
	CD4 Count >=500	0.86 (0.55-1.33)	CD4 Count <50
Cunningham (1996-1998)[115] HCSUS	Having at least one competing need	1.6 (1.3-2.0)	Having no competing needs
Katz [116] (1996-1998) HCSUS	Having a case manager	1.30 (0.97-1.73)	No case management
	Sustained contact with case management	1.58 (1.17-2.13)	No case management follow up
Eisenman[105] (1996-1998) HCSUS	Experienced violence and;		
	Male MSM or bisexual	1.74 (1.20-2.52)	No violence
	Heterosexual men	0.60 (0.28-1.27)	No violence
	Women	1.66 (0.96-2.86)	No violence

Penniman[117] (1996-1998) HCSUS	Age 35-44	0.98 (0.59-1.64)	Age 20-34
	Age >44	0.78 (0.46-1.35)	Age 20-34
	Heterosexual Men	0.57 (0.37-0.86)	Gay and bisexual men
	Female	1.06 (0.71-1.58)	Gay and bisexual men
	Black	1.05 (0.65-1.69)	White/ Other
	Hispanic	1.07 (0.76-1.52)	White/ Other
	High School	1.16 (0.75-1.79)	Less than high school
	Some College	0.82 (0.57-1.19)	Less than high school
	College Graduate	0.82 (0.48-1.41)	Less than high school
	Medicare	0.88 (0.52-1.51)	Private Insurance
	Medicaid	1.12 (0.74-1.70)	Private Insurance
	No Insurance	1.05 (0.69-1.61)	Private Insurance
	5,000$-10,000 Income	1.04 (0.70-1.55)	<5000$ Income
	10,001$-25,000	0.87 (0.56-1.35)	<5000$ Income
	>25,000$ Income	0.56 (0.30-1.04)	<5000$ Income
	CD4 Count 50-199	1.02 (0.71-1.47)	CD4 Count <50
	CD4 Count 200-499	0.77 (0.52-1.14)	CD4 Count <50
	CD4 Count >499	0.52 (0.22-1.22)	CD4 Count <50
	Having Any Competing Needs	1.50 (1.17-1.91)	No Competing Needs
Morales[118] (1996-1998) HCSUS	Less Acculturated	1.24 (0.69-2.21)	More acculturated
	Spanish language survey	0.57 (0.15-2.19)	English language survey
	Not a United States Citizen	0.89 (0.31-2.55)	U.S. Citizen
Smith[63] (1996-1997)	Living doubled up	0.16[c,h]*	Stably housed
	Pain Level	-0.005*	Continuous 0-100
	Grade School or less education	.24*	Grade school or more education
Mathews[108] (1996-2000)	Some Mobility problems [f]	2.0 (1.7-2.3)	No problems
	Confined to bed	1.0 (0.6-3.8)	No problems
	Some self care problems	1.9 (1.6-2.2)	No problems
	Unable to care for self	1.2 (0.7-1.9)	No problems
	Some problems with ADL	1.8 (1.5-2.1)	No problems
	Unable to perform ADL	1.9 (1.5-2.6)	No problems
	Moderate Pain	1.6 (1.4-1.9)	No Pain
	Extreme Pain	2.0 (1.6-2.5)	No Pain

	VAS2 Score	0.86 (0.83-0.89)	Per 10 unit change
	pVAS Score	0.79 (0.75-0.82)	Per 10 unit change
	Much the same health status	1.1 (0.9-1.3)	Better health
	Worse health status	1.9 (1.5-2.3)	Better Health
Norton (1996-2010)	Age[g]	0.91 [h]	Per year
	Female	1.75*	Male
	African American	2.97*	White
	CD4 Median	1.0	
	Drug Use	3.02*	No drug use
	EtOH Use	0.80	
	Diabetes	0.97	No diabetes
	Renal Disease	2.03*	No renal disease
	HCV Coinfected	2.07*	HIV monoinfected
Magnus[110] (1997-1998)	>1 contact with Case manager / month	0.79 (0.34- 1.84)	1 or fewer case management contacts
	>1 Transportation Service	3.66 (1.75- 7.62)	1 or fewer transportation services
	>4 contacts or services /month	2.33 (1.19- 4.54)	4 or fewer service contacts
Palacio[71] (1997-2000)	HAART Users	0.75 (0.59-0.95)	HAART naïve
	Discontinued HAART users	0.79 (0.57-1.08)	HAART naive
Kim[94] (1997-2001)	Age[i]	1.0 (0.98- 1.01)	Per year
	Female	1.50 (1.11- 2.03)	Males
	African American	0.99 (0.74- 1.31)	White
	Hispanic	0.81 (0.56- 1.18)	White
	CD4 count	1.07 (0.98- 1.20)	Per 100 increase
	Viral Load	1.00 (0.94- 1.07)	Continuous
	Receipt of ART	0.91 (0.72- 1.15)	Yes
	Intervention RCT arm	1.11 (0.82- 1.51)	Not an RCT participant
	Control RCT Arm	0.88 (0.65- 1.19)	Not an RCT participant
	Alcohol Severity Index	1.13 (0.67- 1.93)	Per point
	Illicit Drug Severity Index	2.29 (0.87- 6.06)	Per point
	CES-D score	1.02 (1.01- 1.03)	
	Homeless	1.95 (1.55-2.45)	Any vs none
Liebschutz[109] (1997-	Victims of Violence	1.65 (1.18-2.30)	Not victims of intrapersonal

2001)			violence
Palepu[101] (1997-2001)	Female	1.2 (0.6-2.2)	Male
	African American	1.0 (0.5-1.9)	Other
	White	1.1 (0.5-2.0)	Other
	IDU	1.2 (0.7-2.3)	Vs none in last 6 months
	Alcohol Dependence Score	1.0 (0.98-1.03)	
	Stable Substance abuse therapy	0.5 (0.3-0.9)	None
	Unstable substance abuse therapy	0.4 (0.1 -1.0)	None
	Alcoholics or Narcotics Anonymous	0.9 (0.5-1.5)	None
	Homeless	2.3 (1.3-4.0)	Vs none in last 6 months
	Self Help	0.9 (0.5-1.5)	
Gordon[102] (1999-2000)	Currently Homeless	1.35 (0.79-2.33)	Never homeless
	Prior Homelessness	0.98 (0.70-1.38)	Never homeless
	Hazardous drinking	1.02 (0.75-1.39)	AUDIT $\leq$6 or fewer than six drinks in a sitting
Cunningham CO[64] (1999-2001)	IDU[j]	-1.10 p=0.10	Non IDU drug use
	Any drug use	-0.57 p=0.23	No drug use
Barash[89] (1999-2003)	Current IDU[k]	2.3 (1.9-2.8)	Never IDU
	Former IDU	1.3 (1.1-1.6)	Never IDU
Kidder[70] (2000-2003)	Homeless	1.57 (1.14-2.15)	Stably Housed
Linas[91] (2000-2007)	HCV coinfection	1.7 (1.4-2.1)	HIV infection only
	Age	1.0 (0.9-1.1)	Per 10 years
	Female	1.3 (1.1-1.6)	Male
	White	0.9 (0.8-1.1)	Non White
	AIDS illness	1.7 (1.3-2.4)	No AIDS defining illness
	Viral Load under 400	0.5 (0.5-0.6)	Viral Load > 400
	CD4< 100	2.4 (1.9-3.0)	CD4 Count > 350
	CD4 101-200	1.4 (1.2-1.8)	CD4 Count > 350
	CD4 201-350	1.0 (1.0-1.3)	CD4 Count > 350
Kushel[100]	CD4 Nadir <200	1.8 (1.1-3.0)	CD4 Nadir $\geq$200
	SF-36 Physical Function Score 35-50	1.2 (0.6-2.3)	SF-36 Physical Function Score >50
	SF-36 Physical Function Score <35	1.7 (0.9-3.4)	SF-36 Physical Function Score >50
	SF-36 Mental Function Score 35-50	1.5 (0.8-2.8)	SF-36 Mental Function Score >50

	SF-36 Mental Function Score <35 Cocaine in last 30 days Methamphetamine Use in last 30 days	1.6 (0.9-3.0) 1.3 (0.7-2.3) 1.9 (1.0-3.7)	SF-36 Mental Function Score >50 No Use No Use
Leserman[96] (2001-2002)	Age Female Less Education Number of traumas Victim of Sexual or Physical Abuse Presence of PTSD	0.98 (0.96 -1.0) 1.72 (1.2-2.46) 0.89 (0.82-0.97) 1.11 (1.03-1.19) 1.90 (1.35-2.67) 1.47 (1.16-1.87)	Per year Men Per 1 unit increase No abuse Per 1 unit increase
Whetten[114]	Younger than 40 [1] Male Non White Race High School Graduate Living in Poverty Trust Care Providers Trust Government God did not create AIDS	–0.009 (0.154) –0.595*** (0.159) 0.124 (0.179) 0.119 (0.190) –0.111 (0.169) –0.0768 (0.0365) –0.0689* (0.0340) 0.0392 (0.0672)	Older than 40 years old Female White Less than High School education Above the Federal Poverty Level 3-15 scale 2-10 scale 1-5 scale
Cunningham CO[73] (2001-2003)	Insured Homeless Fair/ Poor Health Infected >= 3 years Mental Health Visit in Last 6 months Mental Health Medications Ever used EtOH	1.74 (1.10-2.77) 2.23 (1.36-3.67) 2.02 (1.53-2.67) 2.02 (1.11-3.67) 1.47 (1.18-1.84) 1.59 (1.05-2.38) 1.46 (1.02-2.09)	Uninsured Stably Housed Good/ Very Good/ Excellent Health Infected < 3 years No Mental Health Visits No Mental Health Medications Have used EtOH
Meade[97] (2002-2004)	Female African American HIV symptoms Psychiatric Disorder Traumatic stress syndrome Depressive symptoms Perceived stress	1.84 (0.96–3.54) 0.76 (0.40–1.44) 2.30 (1.22–4.35) 1.26 (0.62–2.55) 0.58 (0.28–1.22) 0.87 (0.39–1.93) 1.09 (0.64–1.85)	Male White Per 1 point increase Per 1 point increase Per 1 point increase Per 1 point increase (CES-D) Per 1 point increase

	Poor social support	0.89 (0.60–1.34)	Per 1 point increase
	Any binge drinking	2.92 (1.18–7.24)	No binge drinking
	Any illicit drug use	1.98 (1.02–3.85)	No illicit drug use
Riley[20] (2002-2006)	Continuously insured at 3 months	1.82 (1.06-3.84)	Continuously Uninsured
	Continuously insured at 6 months	2.07 (1.11-4.85)	Continuously Uninsured
	Continuously insured at 9 months	1.90 (1.00-4.55)	Continuously Uninsured
	Continuously insured at 12 months	1.87 (0.94-4.41)	Continuously Uninsured
Josephs[44] (2003)	≥50 years old	0.95 (0.66-1.37)	<50 years old
	Female	1.95 (1.33-2.86)	Males
	Black	1.27 (0.8-1.98)	Whites
	Hispanic	0.94 (0.53-.65)	Whites
	Other	1.38 (0.59-3.23)	Whites
	High School or Junior College	1.07 (0.74-1.54)	< High School
	College or More	0.85 (0.46-1.56)	< High School
	Retired	1.24 (0.71-2.19)	Working
	Disabled	1.27 (0.80-2.04)	Working
	Unemployed	0.92 (0.48-1.77)	Working
	MSM HIV Risk Factor	0.82 (0.52-1.29)	IDU Risk Factor
	Heterosexual HIV Risk Factor	0.67 (0.44-1.02)	IDU Risk Factor
	Other/ Missing HIV Risk Factor	0.51 (0.28-0.92)	IDU Risk Factor
	Medicaid	2.09 (1.20-3.65)	Private
	Medicare	0.97 (0.51-1.87)	Private
	Medicare/Medicaid	1.44 (0.81-2.57)	Private
	None	0.86 (0.41-1.80)	Private
	CD4 Count <50	1.41 (0.64-3.10)	CD4 Count >499
	CD4 Count 50-199	0.92 (0.52-1.60)	CD4 Count >499
	CD4 Count 200-499	0.99 (0.65-1.52)	CD4 Count >499
	CD4 Count Missing	2.65 (0.58-12.11)	CD4 Count >499
	HIV Viral Load >400 copies	1.05 (0.71-1.55)	HIV Viral Load <400
	HIV Viral Load Missing	0.44 (0.10-1.98)	HIV Viral Load <400
	Received Antiretroviral Therapy	0.99 (0.70-1.39)	No HAART
	Pain 2nd quartile	0.95 (0.56-1.61)	1st quartile of pain
	Pain 3rd quartile	2.10 (1.28–3.44)	1st quartile of pain

	Pain 4th quartile	2.36 (1.47–3.81)	1st quartile of pain
	Current Drug use	1.85 (1.20-2.86)	Never drug use
	Former Drug use	1.59 (1.04-2.41)	Never drug use
	EtOH (Heavy/Binge)	1.94 (1.06-3.57)	No drinking
	EtOH (Socially)	1.76 (0.98-3.14)	No drinking
	Primary Care visits (4th quartile)	2.13 (1.38-3.27)	1st quartile
Sohler[68] (2003-2005)	Cocaine Only	1.62 (1.10-2.37)	Neither illicit drug
	Opioids Only	1.52 (0.84-2.70)	Neither illicit drug
	Both	1.85 (1.27-2.67)	Neither illicit drug
Sohler[67] (2004-2005)	Women (after adjustment for sociodemographics)	2.07 (1.27-3.40)	Men
	Women (after adjustment for attitude variables)	1.97 (1.20-3.26)	Men
Schackman[119] (2005-2007)	Integrated methadone maintenance HIV only care	No difference by site type (Data not shown)	
Ramaswamy[60] (2004-2007)	Total Network size [m]	1.02 (0.97-1.07)	
	Number in Network	1.57 (0.77-3.24)	
	Total support	1.01 (0.99-1.04)	
	Female	6.97 (0.90-5.34)	Male
	Age $\geq$ 50	0.88 (0.15-5.23)	Age <50
	African American	0.46 (0.04-4.80)	White
	Latino/Latina	1.45 (0.17-12.66)	White
	Ever incarcerated	8.16 (0.89-75.00)	Never incarcerated
	Crack cocaine use in last thirty days	4.34 (0.80-23.71)	No crack cocaine use
	Hazardous EtOH use	4.69 (0.99-22.21)	
	Health Good/ Very Good/ Excellent	0.15 (0.03-0.76)	Health Poor or fair
Wolitski[103] (2004-2007)	Homeless[n]	2.54 (1.71-3.77)	Not experiencing homelessness
Venkat[83] (2006)	Age	0.99 (0.95-1.03)	Per year
	Female	1.36 (0.63-2.94)	Men
	Non Caucasians	0.74 (0.38-1.42)	Caucasians
	1-2x Federal Poverty Level	0.58 (0.27-1.24)	Below poverty level
	2-3x Federal Poverty Level	0.36 (0.12-1.09)	Below poverty level

	3-4x Federal Poverty Level Years since HIV diagnosis Years on HAART On HAART in 2006 HAART interrupted in 2006 Viral Load Apex 400-1000 Viral Load Apex 1000-100,000 Viral Load Apex >100,000 Viral Load Mean in 2006 400-1000 Viral Load Mean in 2006 1000-100,000 Viral Load Mean in 2006 >100,000 CD4 Nadir 0-200 CD4 Nadir 201-350 CD4 Mean in 2006 0-200 CD4 Mean in 2006 201-350	0.07 (0.01-0.52) 1.05 (0.98-1.11) 1.01 (0.89-1.15) 0.54 (0.17-1.75) 1.66 (0.48-5.72) 0.93 (0.09-9.73) 0.93 (0.30-2.89) 0.81 (0.24-2.74) 0.79 (0.08-7.12) 3.49 (1.26-9.73) 5.43 (1.09-21.21) 1.14 (0.36-3.57) 0.87 (0.33-2.27) 0.61 (0.18-2.07) 0.97 (0.35-2.69)	Below poverty level Viral Load Apex <400 Viral Load Apex <400 Viral Load Apex <400 Viral Load Mean < 400 Viral Load Mean < 400 Viral Load Mean < 400 CD4 Nadir >350 CD4 Nadir >350 CD4 Mean in 2006>350 CD4 Mean in 2006> 350
Pantalone[112] (2006-2007)	Adult abuse led to ED visits by Structural Equation Modeling-no estimate presented		

Chapter 3: Literature Review of Hospital Admission Among Patients with HIV

3.1 Introduction to Hospital Utilization

After the introduction of HAART rates of hospitalization declined rapidly. They have subsequently stabilized.[4,93,120-125] There is a need for updated data on the rate of hospital admissions among patients with HIV. Hospital admission is a major driver in the cost of HIV care as shown by Gebo et al. who found that hospital charges amongst those with CD4 counts less than 50 mm^3 were in excess of $24,000 per year. [9] Understanding hospital utilization is important for resource planning, insurance guidance, and public health interventions to alter problematic health seeking behaviors. Furthermore, hospitalization places the patient at risk for nosocomial infection, iatrogenic error, and is disruptive to quality of life. [126]

3.2 Literature Review for Hospitalization

3.2.1 Search Strategy:

The following two search strings were used (1) " hospitalization HIV, "United States" and NOT pediatrics NOT children NOT youth NOT adolescents". The first search string identified 279 articles. (2) hospital admission HIV "United States" NOT hospitalization HIV "United States" and NOT pediatrics NOT children NOT youth NOT adolescents" and not the above articles yielded 40 titles.

Searches were conducted using PUBMED. Searches were limited to articles published after 1/1/1996. Searches are up to date as of 12/31/2012. Searches were conducted on 6/1/2013. All articles produced by the searches had their abstracts reviewed for any relevant articles. Articles whose abstracts were deemed relevant were then read in full. Details sought from articles included estimates of hospital visit proportions or rates, mean number of visits, study design information on populations, sample size, and dates of recruitment, as well as risk factors for utilization. If any of the details were present then the article was abstracted onto standardized forms by the author. All articles that contained data on the above then had their reference lists reviewed for any additional relevant articles

3.2.2 Search Results and Study Methods:

The first search string generated 279 results. Of these 66 were selected for further review. Of the 66 selected 33 contained data on hospital utilization and 33 did not. Articles deemed not of interest fell into the following categories; not having data on admissions, being related to HIV but not having admission data or having data only on cause specific admissions, being in the pre HAART era, participants not from the United States, being about HIV testing, being about HIV prevention. Two articles could not be located.

The second search string generated 40 results. Of these, one was selected for further review and did not contain information on hospitalization. Articles deemed not of interest fell into the following categories; not having data on admissions, being related to HIV but not having admission data or having data only on cause specific admissions, being in the pre HAART era, participants not being from the United States, and being about HIV testing. Finally, articles that contained data on hospital utilization yielded a further 36 articles of potential interest of which 19 had data.

Figure 3.1: Flowchart of article abstraction for the hospital utilization literature review

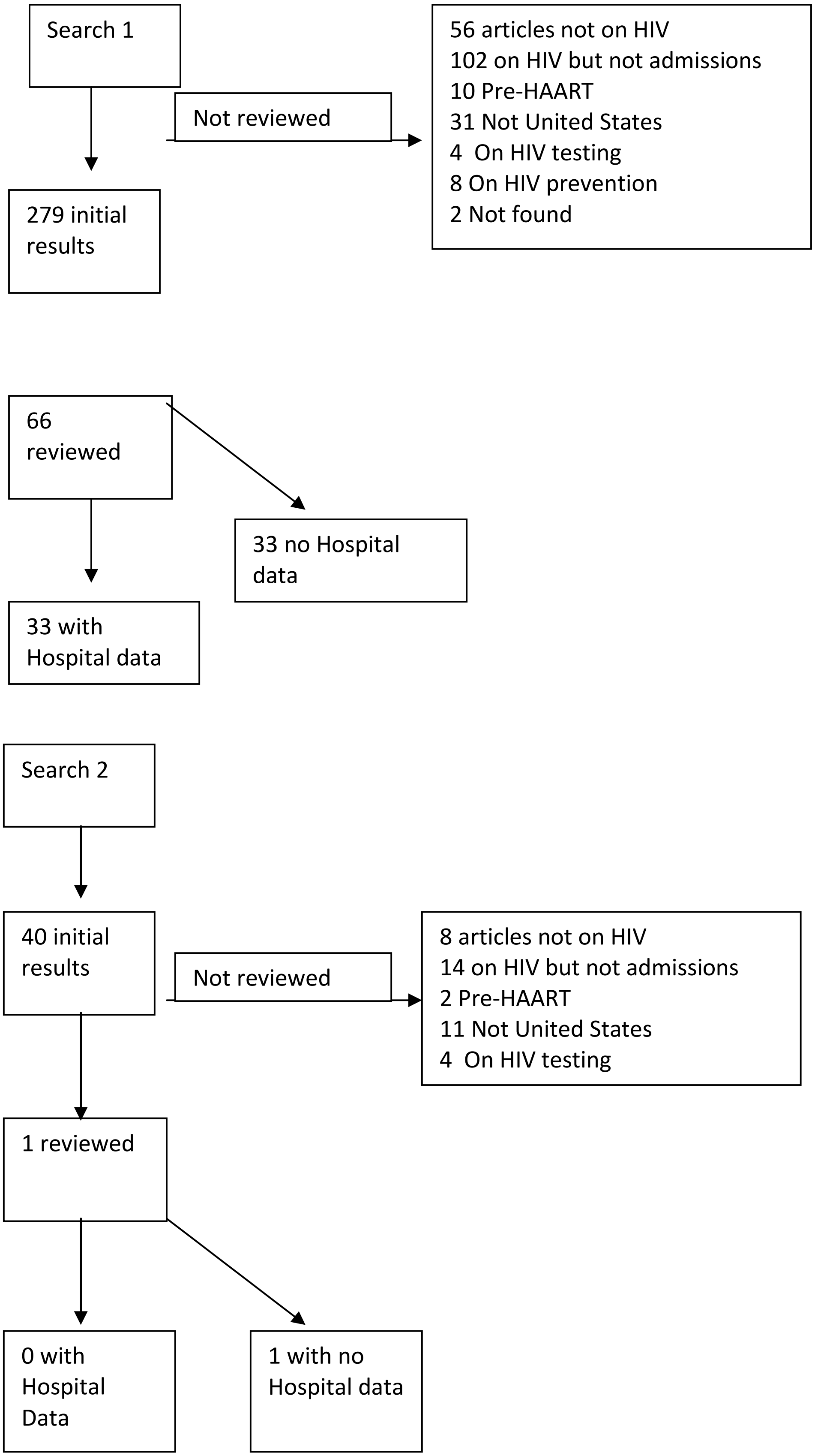


Table 11.3 contains the name of the studies first author, the year(s) that the study was conducted, a brief description of study participants, the number of participants, and the risk, mean number, or rate of visits made by study participants. Table 11.4 contains the name of the first author, the year(s) the study was conducted, the risk factors assessed by the study, the measures of association, and the comparison group for each risk factor. Table 11.4 contains the results from multivariate analysis if it was carried out. If multivariate analysis was not carried out bivariate analysis is presented. If a study performed analyses in more than one year, each year is reported as a separate study in Table 11.4.

3.2.3 Discussion:

3.2.3.1 Frequency and rates of hospital admission:

Studies primarily assessed the risk of hospitalization over three different time intervals; six months, twelve months, and twenty four months. Studies assessing risk over six months found a range of 15.6% to 30% risk of utilization. [5,65,71-73,76] The primary difference between studies with lower estimates and higher estimates was that those with higher estimates were among participants targeted for outreach sampling. [65,127]

Risk in the past twelve months ranged from a high of 55.6% in 1996 among New York State Medicaid enrollees with drug abuse problems to a low of 14.8% amongst an in care cohort in 2007.[4,6,70,78,128-130] Risks were generally higher in those with drug abuse problems and the homeless and lower among cohorts in care.[128] Data from the HIV Research Network showed a decline in hospitalizations over time. 29% of participants had at least one hospitalization in 1998 while 14.8% had a hospitalization in 2007.[4,8,130] Use over twenty-four months was assessed by three studies that found rates of 23.4-64 percent.[95,131,132] The 64 percent rate was found among those with drug abuse problems.[95] The reason for the difference in risk between Sherer et al and Zingmond, both of whom looked at patients in care, is not clear. [131,132]

A large number of studies have looked at the rate of hospitalization over time.[4,8,87,91-93,120-125,133] Between 2002 and 2007 rates fell from a high of 35 per 100 person years to a low of 27 per100 person years in the HIV Research Network.[4] In the HOPS cohort rates fell from 17.7 per 100 person years in 1997-1999 to 11.2 per 100 person years in 2003-2005.[123] Amongst military members rates went from 12.7 per 100 person years in 1999 to a high of 15.4 per 100 person years in 2003 and then fell to 10.2 per 100 person years.[124] The large initial decreases in rate of hospitalization are most likely due to the effect of antiretroviral therapy.

Amongst studies that stratified by gender all found increased hospitalization in women.[87,120,125] Two studies stratified those who were dually infected with HIV and Hepatitis C and found that they had substantially increased rates of utilization over those solely infected with HIV. [91,92]

3.2.3.4 Risk factors for hospital admission: sociodemographics

Age was classified in a variety of systems. Between 2000-2002 and 2003-2005, age in 10-year intervals increased the odds of utilization by 1.15-1.18.[123] Linas et al. also utilized 10-year intervals of age and found an odds ratio of 1.1.[91] Crum-Cianflone et al found no association of age in ten-year intervals with hospitalization. [124] Buchacz et al found no association of age with hospitalization between 1994-1996 and 1997-1999. [123] Three of seven studies that looked at age per year found an association.[76,92,94,95,115,120,125] Finally, several studies used a variety of categorical schemes.[4,5,122,130,134-136] Overall, studies using categorical schemes present both significant associations of age with hospitalization and null results. Being over 50 was associated with increased utilization in three out of six studies. The general trend for increased use among older patients maybe due to the increased burden of co-morbid illness in this population, long term effects of HIV itself, or of HIV therapies.

Thirteen of the twenty studies that examined the association between hospital use and sex found that utilization was increased among women compared to men.[4,5,8,76,91,92,94,95,117,120,122-125,130,135,136] The point estimates ranged from 1.11-2.07. Women may have increased hospital admissions due to obstetrics and gynecologic services.

Eleven studies compared being African American to being White.[4,5,8,76,92,94,95,122-124,130] Three studies, all in the same dataset, found statistically significant increases in utilization among African Americans compared to Whites. The point estimates in the statistically significant studies was small, 1.16-1.30, and potentially statistically significant due to the very large sample size of the HIV Research Network.[4,8,130] No study found increased hospital utilization among Hispanic individuals. [5,94,95,122,123,130]

Four studies investigated whether participants who acquired HIV through injection drug use had increased utilization of the hospital.[5,122,123,130] Three of the four studies found a statistically significant association. Buchacz et al. did not find an association.[123] Buchacz simultaneously included history of substance abuse in their models.[123] Having both substance abuse history and injection drug use in the model may have obscured the ability to detect an association. Fleishman et al compared three groups based on their suspected risk factor for contracting HIV. The first group was men who had sex with men. The second group was men who had sex with men and injected drugs. The third group was heterosexuals who also injected drugs. [130] Both the second and third groups had increased odds of hospital utilization compared to the first group. [130] Several studies compared heterosexuals to men who had sex with men. None of these studies found an association between being heterosexual and hospital utilization. [5,122,123,130]

Eight out of eleven studies demonstrated an association between the use of illicit drugs and hospital admissions.[76,94,95,120,123,133,135] The statistically significant results ranged from 1.32-4.38. In the case of Buchacz et al this association was present only between 2000-2002 and 2003-2005. Three different measures of drug use were used; recent injection drug use, the Addiction Severity Index, and a history of substance abuse. The use of differing measurement instruments made comparisons between the studies difficult.

Alcohol consumption was measured in a wide variety of ways. This made comparisons between studies difficult. Laine et al. found a significant association measuring alcohol use with and without complications. Palepu et al found a significant association using an addiction score.[76,135]

3.2.3.5 Risk factors for hospital admissions: enabling variables

Homelessness was consistently associated with increased odds of hospitalization. [73,76,94,95] The odds ratio estimates ranged from 1.9-2.8. One mechanism for the association between homelessness and hospitalization may be through food insecurity as discussed by Weisser et al. [137]

Studies have examined insurance in a variety of ways. Most studies have compared forms of public insurance with private insurance. Generally, publicly insured patients had higher odds of utilization.[5,20,123,130] Cunningham et al. evaluated the effect of being insured compared to uninsured. They found that the insured had 10.45 times the odds of utilization. Cunningham et al used a special sample of persons targeted for outreach.[73] Riley et al compared being continuously or intermittently insured with being continuously uninsured. The authors found that at 3, 6,9,12 months that continuously insured had increased odds of utilization. The odds ratios fell just shy of statistical significance. [20]

3.2.3.6 Risk factors for hospital admission: need variables

Studies consistently found an association between lower CD4 counts and hospital utilization. [4,5,8,76,91,92,94,100,120,122,123,125,130,132,133,137] Summarizing the point estimates is difficult because a wide variety of classification schemes were used. Gardner, Paul, and Kushel looked at CD4 counts less than 200 compared to greater than 200 and found odds ratios of 1.7, 2.8, and 1.8 respectively all of which were statistically significant.[100,133,122] Fleishman and Yehia, using data from the HIV Research Network, used the categories of 0-50, 51-200, 201-500 compared to greater than five hundred and found nearly identical results with declines from approximately 5 to 2.4 to 1.2 across categories.[4,130] Shapiro et al used similar categories to Fleishman and Yehia. Shapiro et al used 0-49 as the reference group. [5] Shapiro found that all categories had lower odds of admissions than participants whose CD4 counts were between zero and forty-nine.

Seven out of eight studies found that increased viral loads were associated with the use of the hospital.[8,76,91,94,122,130,133] The lack of a consistent comparison group and categorization makes comparisons across studies difficult. However, viral loads of 10,000-100,000 compared to viral loads of greater than 100,000 were associated with odds of hospital of admission of between 0.45 and 0.67.[8,130] These findings suggest that even in the HAART era control of immune dysfunction is an important part of healthcare for persons with HIV/AIDS.

Several studies examined the association between having an AIDS defining event and hospital utilization. Linas, Knowlton and Buchacz all found having ever had an AIDS defining event was associated with use of the hospital.[72,91,123] Buchacz and Linas found that having ever had an AIDS defining event was associated with hospital admissions even though their models also contained current CD4 counts. [91,123] Only Laine et al found no association with having an AIDS defining event, and their definition was limited to AIDS defining events in the study year.[135] The findings of Buchacz and Linas suggest that having ever had an AIDS defining event may be a marker for immune dysfunction beyond that predicted by CD4 count.

Studies have also measured the association between a variety of physical symptoms and increased hospital utilization. Having functional limitations was associated with increased odds of hospitalization. [72] Problems with activities of daily living and pain were associated with increased odds of hospitalization. [108] Cunningham et al demonstrated an associated between fair or poor health status and hospital utilization. [73] Finally, Kushel using the SF-36 physical function score found an association with worse physical health and hospitalization. [100] Only Edelman et al, who assessed a large number of physical symptoms, found no association between most symptoms and hospitalization. [138]

Three of five studies found that hepatitis C co-infection was associated with increased odds of hospitalization.[91,92,124,133,134] In the studies with statistically significant estimates the point estimates ranged from 1.4-1.8. The Gardner study found an association between hepatitis C co-infection in bivariate analysis but it was not significant in multivariate analysis. This may have been due to the study occurring early in the HAART era when the effects of immune dysfunction overwhelmed the effect of hepatitis C co-infection. [133]

3.3 Conclusions for the Hospital Literature Review

Rates and risk of hospital admission have declined since the start of the HAART era. Different cohort and study designs yielded vastly different estimates for the rate of admission. For gender, age, insurance, homelessness, CD4 count, and viral load there were clear patterns of utilization. A summary measure of effect was incalculable for most risk factors due to a lack of a consistent comparison group. The lack of a consistent comparison group made it particularly difficult to judge the effect of alcohol or illicit drug use where a variety of classifications is possible. Disparities in utilization by race were not noted. For the purposes of future analyses of hospital admission if seems important to collect information on at least the above named factors in order to provider for control of confounding.

Table 3.1 Risks, Rates, and Mean Number of Hospital Admissions[4]

Author	Year of Study	Study Population	N	% with >=1 visit	Mean Number of Visits	Rates
Gardner[133]	1993-2000	HERS Study Women in urban areas	885	NR	NR	54.9 / 100 py
Box[87]	1994-1997	Duke University Clinic Patients Men Women	214	NR	NR	 50 / 100 py 60 / 100 py
Buchacz[123]	1994-2005	Participants in the HIV Outpatients Study (HOPS) 1994-1996 1997-1999 2000-2002 2003-2005	7155	NR	NR	 26.4 /100 py 17.7 / 100 py 14.93 / 100 py 11.21 / 100 py
Masson[95]	1994-1996	Patients with substance abuse disorders Trial of case management	190	64% / 24 months	2.4 / 24 months	NR
Liebschutz[106]	1994-1996	Patients in Boston or Rhode Island seeking HIV care Those who suffered abuse Those who did not suffer abuse	50	NR	 2.8 / 24 months 0.8 / 24 months	NR

[4] The risks, rates, and mean number of visits come from the hospital literature review. The following two search strings were used (1) " hospitalization HIV "united states" and NOT pediatrics NOT children NOT youth NOT adolescents". (2) hospital admission HIV "united states" NOT hospitalization HIV "united states" and NOT pediatrics NOT children NOT youth NOT adolescents" Articles with any data on these measures of utilization are included. The articles are listed chronologically and then alphabetically within time.

Gebo[134]	1995- 2000	Johns Hopkins Clinical HIV Cohort 1995 1996 1997 1998 1999 2000	1416 1618 1950 2073 2250 2323	NR	NR	58.8 / 100 py 46.5 / 100 py 41.0 / 100 py 42.6 / 100 py 38.6 / 100 py 46.6 / 100 py
Knowlton[72]	1995- 1996	African American Injection drug users in Baltimore Members of the SAIL/ALIVE cohorts	287	19% / 6 months	NR	NR
Paul [122]	1995- 2001	New York Presbyterian Hospital clinic patients 1995 1997 1999 2001	883 981 1741 1990	NR	NR	94 / 100 py 48 / 100 py 38 / 100 py 25 / 100 py
Kushel[100]	1996- 1997 1999- 2000	Homeless individuals in San Francisco 1996-1997, 1999-2000 (Baseline) 2001-2002 Follow-up	280	9.7% / 3 months 23.1% / 15 months	NR	NR
Gourevitch[128]	1996 -1998	Patients in Methadone maintenance in NYC Linked methadone and outpatient care Methadone therapy only Neither	1161	27.2% / 12 months 31.4% / 12 months 40.1% / 12 months	NR	NR
Katz[116]	1996- 1998	HCSUS Visit percentages were during the follow-up interval	2437		NR	NR

		No contact with case manager Contact with case manager No sustained contact Sustained contact w/ case manager		22.2% 12.7% 23.1% 14.6%		
Mathews[108]	1996-2000	Patients enrolled at UCSD	965	39% / 54 months	NR	NR
Schoenbaum[120]	1996-2000	HERO study-Bronx NY Men Women	384	NR	NR	 53.3 / 100 py 69.6 / 100 py
Shapiro[5]	1996	HCSUS Baseline Second follow up	2864	19 % / 6 months 14 % / 6 months	NR	NR
Smith[63]	1996-1997	New York State Medicaid enrollees Stably Housed Doubled up Homeless	1526	NR	 1.5 / 3 months 1.6 / 3 months 1.3 / 3 months	 NR
Turner[129]	1996-1997	New York State Medicaid enrollees Illicit drug users	11556	55.6 % / 12 months	NR	NR
Floris-Moore[125]	1997-2000	New York City Current and Former injection drug users Men Women	154	NR	NR	 39.1 / 100 py 68.1 / 100 py
Kim[94]	1997-2001	All patients have EtOH abuse Not leaving Boston in next 2 year Eligible for an ART adherence intervention	349	NR	0 (0-10) Median	NR
Palacio[71]	1997-	Women's Interagency HIV Study	1485	15.2 % / 6 months	NR	NR

	2000	Urban Sites				
Palepu	1997-2001	HIV-ALC Study Patients in Boston with Alcohol Abuse	349	30% / 6 months	NR	NR
Paul [121]	1997	The New York Hospital	1880	NR	NR	28.8 / 100 py
Sherer[132]	1997-1998	Patients enrolled in care in Chicago	2646	23.4% / 24 months	NR	NR
Berry[139]	1997-2006	Patients at Johns Hopkins initiating antiretroviral therapy Responders to therapy days 0-45 Non responders days 0-45 Responders days 46-90 Non responders days 46-90	1385	NR	NR	 75.1 / 100 py 78.7 / 100 py 53.3 / 100 py 80 / 100 py
Roberts[140]	1998	Random Sample patients enrolled in care in Chicago	280	29% / 12 months	NR	NR
Fleishman[141]	1998-2000	7 states using the HCUP database 1998 1999 2000	 110355 120439 128699	NR	NR	 61.7 / 100 py 54.1 / 100 py 48.4 / 100 py
Kraemer[78]	1998-2003	Veterans in the VA system Those with an alcohol problem Those without an alcohol problem	16048	 26% / 12 months	 0.84 (0-1) 0.41(0-0)	 NR
Edelman[138]	6/1999-7/2000	Veterans Aging Cohort Study	751	NR	NR	NR
Zingmond[131]	1999-2001	California Urban County Medicaid Program Fee for Service HIV Hospitalization Fee for Service Non HIV	 5943	 10% / 24 months 45% / 24 months	NR	NR

		HMO HIV Hospitalization HMO Non HIV Hospitalization	1085	8% / 24 months 42% / 24 months		
Crum-Cianflone[124]	1999-2007	US military members and beneficiaries 1999 2000 2001 2002 2003 2004 2005 2006 2007	2429	NR	NR	 12.7 /100 py 14.9 /100 py 13.3 /100 py 14.2 /100 py 15.4 /100 py 14.7 /100 py 14.0 /100 py 13.0 /100 py 10.2 /100 py
HIV Research Network[6]	1999	HIV Research Network Cohort Study	5255	16.9% / 12 months	NR	NR
Fleishman[130]	2000-2002	HIV Research Network Cohort Study 2000 2001 2002	 13392 15211 14403	 22.2% / 12 months 20.4% / 12 months 19.7% / 12 months	 NR	 39.7 /100 py 36.14 /100 py 34.83 /100 py
Hellinger[142]	2000-2004	HCUP data for six states 2000 2004	 256,386 334,721	NR	 0.36 0.22	NR
Kidder [70]	2000-2003	Supplement to HIV/AIDS Surveillance Project Homeless Not homeless	7925	 37.2% / 12 months 21.3% / 12 months	NR	NR
Linas[91]	2000-2007	ACTG trials long term cohort CD4 <100 HIV/HCV Coinfected CD4 101-200 HIV/HCV Coinfected	3143	NR	NR	 170 /100 py 70 /100 py

		CD4 201-350 HIV/HCV Coinfected CD4 >350 HIV/HCV Coinfected CD4 <100 HIV Only CD4 101-200 HIV Only CD4 201-350 HIV Only CD4 >350 HIV Only				34 /100 py 8.7 /100 py 90 /100 py 33 /100 py 12 /100 py 7.6 /100 py
Cunningham[73]	2001-2003	Special Projects of National Significance Hard to reach individuals	610	25.6% / 6 months	NR	NR
Himelhoch [143]	2001	4 sites with co-located mental health services 2001 Serious Mental Illness & Injection Drug Use 2001 Injection Drug Use 2001 Serious Mental Illness 2001 Neither Mental Illness nor Drug use	5119	 36% /12 months 29% /12 months 26% /12 months 18% /12 months	NR	NR
Leserman[96]	2001-2002	Same as Pence				
Pence[144]	2001-2002	CHASE Study Southeast US infectious disease clinics	611	26.3% in 9 months	NR	NR
Sansom[93]	2001	Directly Observed Therapy Intense Case Management Standard of Care		NR	NR	29.3 / 100 py 21.9 / 100 py 32.9 / 100 py
Cunningham[65]	6/11/2002-9-22-2003	Living in single room occupancy target by CitiWide intervention group only New York City Interview Data	150	30% / 6 months	NR	NR

Yehia[4]	2002- 2007	HIV Research Network Clinic sites across the US 2002 2003 2004 2005 2006 2007	~15000	 19.3% / 12 months 18.7% / 12 months 17.8% / 12 months 15.9% / 12 months 15.7% / 12 months 14.8 / 12 months	NR	 35 per 100 py 34 per 100 py 32 per 100 py 28 per 100 py 28 per 100 py 27 per 100 py
Riley[20]	6/2002- 9/2006	Homeless and unstably housed individuals in San Francisco	330	10% / 3 months	NR	NR
Hill-Briggs[145]	2005- 2006	Infectious Disease clinic Health related problem solving	111	NR	1.0 (1.7) past year	NR
Norton[92]	7/2006- 3/2007	Duke University Matched design HIV/HCV Infected HIV Monoinfected	 96 165	NR	NR	 18.2 /100 py 6.7 /100 py
Sax[136]	6/2006- 12/2008	Lifelink Insurance Claims Database Had to be on HAART Time period of admission varies 95% Adherent and 1 pill per day 95% Adherent and 2 pills per day 95% Adherent and 3 pills per day <95% Adherent and 1 pill per day <95% Adherent and 2 pills per day <95% Adherent and 3 pills per day	7073	 6.6% 6.6% 7.8% 11.4% 15.2% 12.1%	NR	NR
Weiser[137]	2007- 2010	Marginally housed individuals in San Francisco	347	10.7 % / 3 months	NR	NR

Table 3.2 Risks, Rates, and Odds Ratios for Hospital Admissions [5]

Study (Study Years)	Risk Factor	OR/ RR (95% CI)	Reference Group
Gardner[85] (1993-2000)	Clinical AIDS	3.5 (2.9-4.4)	No AIDS status
	Baseline CD4 <200	1.7 (1.4-1.2)	>199
	Baseline viral load >30,000	1.5 (1.1-2.0)	Viral Load<10,000
	Baseline viral load 10,000-30,000	1.4 (1.0-1.8)	Viral Load <10,000
	HAART received CD4 count <200	0.66 (0.5-0.9)	HAART not received
	HAART received CD4 count >199	1.07 (0.9-1.3)	HAART not received
	Had renal lab abnormalities	1.5 (1.3-1.8)	No renal abnormalities
	Had hypertension	1.7 (1.3-2.0)	No hypertension
	Were HCV antibody positive	1.0 (0.8-1.2)	Not HCV antibody positive
	Recent Injection drug use	1.4 (1.2-1.7)	No recent injection drug use
Masson[95] (1994-1996)	Age	0.06 (0.09)	Per year
	Male	0.22 (0.19)	Female
	African American	- 0.07 (0.17)	White
	Hispanic	- 0.14 (0.29)	White
	Other	0.50 (0.37)	White
	Education	- 0.02 (0.07)	Per year
	Homeless	0.75 (0.16)	
	Illegal Income	- 0.14 (0.07)	
	Employment Income	- 0.06 (0.09)	
	Drug Use Severity	0.24 (0.09)	
	Alcohol Use Severity	0.02 (0.13)	
	BDI score	0.08 (0.06)	
	Physical function score	- 0.01 (0.08)	
Buchacz[123] (1994-1996)	Age (per 10 year increase)	1.03 (0.91-1.16)	
	Female	1.25 (0.86–1.84)	Male
	African American	1.00 (0.75-1.33)	White

[5] Table 11.4 comes from the hospital admissions literature review. Articles are listed chronologically and then alphabetically within time period.

	Hispanic	1.03 (0.70–1.51)	White
	Other/unknown	0.62 (0.26–1.43)	White
	Public Insurance	2.10 (1.65–2.67)	Private Insurance
	IDU	1.00 (0.68–1.47)	MSM
	High Risk Heterosexual	0.78 (0.52–1.15)	MSM
	Other	1.27 (0.70–2.29)	MSM
	Having AIDS	1.77 (1.20–2.61)	Not having AIDS
	Current CD4 count	0.73 (0.67–0.80)	per 100 increase
	Ever smoking	1.16 (0.92–1.46)	Never Smoking
	History of substance use	1.26 (0.95–1.67)	No substance use history
	Amount of Observation Time	1.24 (1.11–1.38)	In years
Buchacz[123] (1997-1999)	Age	1.14 (1.02–1.26)	per 10 year increase
	Female	1.30 (0.98–1.73)	Male
	African American	1.25 (1.00–1.57)	White
	Hispanic	0.90 (0.64–1.26)	White
	Other/unknown	1.12 (0.61–2.04)	White
	Public Insurance	1.95 (1.57–2.43)	Private Insurance
	IDU	1.17 (0.84–1.64)	MSM
	High Risk Heterosexual	1.14 (0.84–1.53)	MSM
	Other	1.65 (0.96–2.84)	MSM
	Having AIDS	1.68 (1.27–2.23)	Not having AIDS
	Current CD4 count	0.82 (0.78–0.87)	per 100 increase
	Ever smoking	1.05 (0.86–1.29)	Never Smoking
	History of substance use	1.16 (0.91–1.48)	No substance use history
	Amount of Observation Time	1.48 (1.35–1.63)	In years
Buchacz[123] (2000-2002)	Age	1.18 (1.07–1.31)	per 10 year increase
	Female	1.57 (1.18–2.09)	Male
	African American	0.98 (0.78–1.24)	White
	Hispanic	0.82 (0.59–1.14)	White
	Other/unknown	1.40 (0.84–2.32)	White
	Public Insurance	1.66 (1.35–2.06)	Private Insurance
	IDU	0.84 (0.60–1.18)	MSM
	High Risk Heterosexual	0.78 (0.58–1.06)	MSM

	Other	1.92 (1.14–3.23)	MSM
	Having AIDS	1.93 (1.49–2.51)	Not having AIDS
	Current CD4 count	0.86 (0.82–0.90)	per 100 increase
	Ever smoking	1.04 (0.85–1.27)	Never Smoking
	History of substance use	1.47 (1.18–1.84)	No substance use history
	Amount of Observation Time	1.37 (1.24–1.52)	In years
Buchacz[123] (2003-2005)	Age	1.15 (1.04–1.28)	per 10 year increase
	Female	1.21 (0.89–1.64)	Male
	African American	1.04 (0.81–1.34)	White
	Hispanic	0.98 (0.78–1.23)	White
	Other/unknown	0.57 (0.26–1.27)	White
	Public Insurance	1.92 (1.52–2.41)	Private Insurance
	IDU	1.00 (0.69–1.45)	MSM
	High Risk Heterosexual	0.91 (0.66–1.25)	MSM
	Other	0.78 (0.37–1.64)	MSM
	Having AIDS	1.15 (0.89–1.49)	Not having AIDS
	Current CD4 count	0.86 (0.82–0.90)	per 100 increase
	Ever smoking	1.12 (0.90–1.39)	Never Smoking
	History of substance use	1.32 (1.04–1.68)	No substance use history
	Amount of Observation Time	1.22 (1.09–1.37)	In years
Gebo[134] (1995-2000)	Female	1.56 (1.32-1.85)	Male
	Age less than 37 years	1.19 (1.01-1.41)	Age over 37 years
	African American	1.30 (1.05-1.61)	White
	CD4 count <50 in 1998	2.20 (1.72-2.83)	CD4 count >200 in 1998
	CD4 count 50-199 in 1998	1.32 (1.07-1.63)	CD4 count >200 in 1998
	Mean viral load <1000	0.22 (0.16-0.30)	Mean viral load >100,000
	Mean viral load 1000-9999	0.30 (0.23-0.39)	Mean viral load >100,000
	Mean viral load 10,000-99,999	0.45 (0.37-0.56	Mean viral load >100,000
	Hepatitis C positive	1.75 (1.47-2.07)	Hepatitis C negative
Eisenman[105] (1996) HCSUS	Violence victims who were gay or bisexual	0.90 (0.52-1.56)	Not victims of violence
	Violence victims who were male heterosexuals	2.74 (0.96-7.85)	Not victims of violence

	Violence victims who were female heterosexuals	1.06 (0.52-2.20)	Not victims of violence
Knowlton[72](1995-1996)	Having clinical AIDS Having functional limitations	4.26 (2.23–8.16) 2.14 (1.02–4.49)	No clinical AIDS diagnosis No functional limitations
Katz[116] (1996-1998)	Contact with a case manager Sustained contact with a case manager	1.13 (0.84-1.54) 1.11 (0.83-1.50)	Case management at baseline Case management throughout
Mathews[108] (1996-2000)	Some mobility problems Confined to bed Some self care problems Unable to was or dress Some problems with usual activities Unable to perform usual activities Moderate Pain Extreme Pain Moderate anxiety Extreme anxiety EuroQol Visual Analogue scale Predicted EuroQol Scale Much the same health Worse health	2.3 (2.0-2.8) 2.9 (2.1-4.0) 2.1 (1.8 -2.4) 2.3 (1.7-3.2) 2.2 (1.9-2.7) 3.5 (2.7-4.5) 1.9 (1.6-2.3) 3.1 (2.4-3.9) 1.1 (0.9-1.3) 1.4 (1.1-1.8) 0.85 (0.82-0.88) 0.79 (0.75-0.82) 1.2 (1.0-1.5) 2.0 (1.6-2.5)	No mobility problems No Mobility problems No self care problems No self care problems No problems with usual activities No problems with usual activities No pain No pain No anxiety No anxiety Per 10 unit change Per 10 unit change Better health Better health
Schoenbaum[120] (1996-2000)	Age Female CD4 count < 200 CD4 count 200-499 Recent Injection Drug Use	1.03 (1.00-1.06) 1.49 (1.03-2.15) 2.29 (1.39-3.65) 1.50 (0.93-2.43) 1.95 (1.02-3.71)	Per Year Male CD4 Count >499 CD4 Count >499 No recent injection drug use
Shapiro[5] (1996)	Age 18-34 Age 35-49	1.14 (0.78-1.67) 0.9 (0.66-1.23)	Age >49 Age >49

	Female	1.12 (0.80-1.58)	Male
	African American	1.11 (0.85-1.46)	White
	Latino	0.72 (0.46-1.13)	White
	Other	1.06 (0.59-1.90)	White
	<12 year of education	1.44 (0.93-2.24)	>15 years of education
	12 years of education	1.36 (0.87-2.12)	>15 years of education
	13-15 years of education	1.33 (0.84-2.10)	>15 years of education
	Injection drug use exposure	1.41 (1.05-1.90)	Men who have sex with men
	Heterosexual exposure	1.13 (0.71-1.82)	Men who have sex with men
	Other	1.35 (0.88-2.06)	Men who have sex with men
	No Insurance	0.77 (0.45-1.33)	Private Insurance
	Medicaid	1.37 (0.86-2.20)	Private Insurance
	Medicare	1.65 (0.98-2.79)	Private insurance
	HMO	0.72 (0.42-1.19)	Private Insurance
	CD4 count >499	0.15 (0.08-0.27)	CD4 count 0-49
	CD4 count 200-499	0.23 (0.17-0.32)	CD4 count 0-49
	CD4 count 50-199	0.33 (0.26-0.46)	CD4 count 0-49
Laine[135] (1996-1997) Same data as Turner	Age 20-29	0.96 (0.30-3.09)	Age <20
	Age 30-39	1.01 (0.32 3.23)	Age <20
	Age 40-49	1.01 (0.32 3.23)	Age <20
	Age >50	0.93 (0.29-2.98)	Age <20
	Female	1.11 (1.02-1.20)	Male
	Rural	1.03 (0.70-1.51)	New York City
	Small City	0.68 (0.45-1.05)	New York City
	Upstate urban	0.87 (0.71-1.06)	New York City
	New York City Suburb	0.99 (0.82-1.19)	New York City
	Clinical AIDS Diagnosis in 1996	1.03 (0.90-1.18)	No Clinical AIDS Diagnosis in 1996
	Inpatient days in 1996 – 1-6	4.77 (3.94-5.77)	Inpatient days in 1996 - 0
	Inpatient days in 1996 – 7-14	4.02 (3.39-4.76)	Inpatient days in 1996 - 0
	Inpatient days in 1996 – 15-32	2.94 (2.52-3.43)	

	Inpatient days in 1996 - >32 Psychiatric Disease in 1996 Chronic Medical Condition in 1996 Acute Infection Regular drug abuse care Regular medical care Both drug abuse and medical care Heroin / Cocaine Abuse in 1996 Unspecified drug dependence Other drug abuse or dependence Acute drug related complication Alcohol use without complication Alcohol use with complication	1.99 (1.73-3.28) 1.04 (0.95-1.14) 1.20 (1.10-1.31) 1.28 (1.15-1.42) 0.85 (0.76-0.96) 0.82 (0.74-0.91) 0.76 (0.67-0.85) 0.98 (0.87-1.09) 0.95 (0.85-1.06) 1.12 (0.93-1.36) 1.30 (1.19-1.43) 1.35 (1.21-1.50) 1.72 (1.45-2.04)	Inpatient days in 1996 - 0 Inpatient days in 1996 - 0 None None None Neither drug abuse nor medical care Neither drug abuse nor medical care Neither drug abuse nor medical care
Turner[129] (1996-1997)	Age 30-39 Age 40-49 Age >49 Female In Methadone Treatment No Drug treatment Has a regular source of medical care Receives HIV specialty care Has a mental health disorder New York Suburbs Upstate Urban areas Small City resident Rural resident 1 chronic disease 2 chronic diseases 3 or more chronic diseases	1.06 (0.91–1.24) 1.06 (0.90–1.24) 0.95 (0.77–1.17) 1.08 (0.99–1.17) 1.69 (1.14–2.55) 1.91 (1.29–2.88) 0.84 (0.78–0.91) 0.82 (0.76–0.90) 1.07 (0.97–1.19) 1.00 (0.83–1.21) 0.91 (0.75–1.11) 0.72 (0.47–1.10) 1.15 (0.79–1.69) 1.23 (1.10–1.37) 1.50 (1.22–1.85 1.79 (1.16–2.87)	Age <30 Age <30 Age <30 Male Patient is drug free Patient is drug free No regular source of care Does not receive HIV specialty care No mental health disorder New York City resident New York City resident New York City resident New York City resident No chronic disease No chronic disease No chronic disease
Kim[94] (1997-2001)	Age Female African American	1.02 (1.00 -1.04) 1.64 (1.41 -2.42) 1.30 (0.87-1.92)	Per year Male White

	Hispanic	0.73 (0.44-1.23)	White
	HAART Use	1.00 (0.72-1.39)	No Use
	Adherence Intervention Control	1.46 (0.99-2.16)	Not on ART
	Adherence Intervention Participant	1.07 (0.73-1.51)	Not on ART
	CD4 Count	1.10 (1.03-1.16)	Per 100 reduction
	Viral Load	1.01 (0.92-1.10)	
	Alcohol Addiction Score	1.54 (0.69-3.44)	Per 1 point increase
	Drug Addiction Score	4.38(1.18-16.33)	Per 1 point increase
	CES-D Depression Score	1.02 (1.01-1.03)	
	Homelessness	1.90 (1.41- 2.57)	Not Homeless
Floris-Moore[125] (1997-2000)	Female	2.07(1.24-3.44)	Male
	Age	1.04 (1.01-1.08)	per year
	CD4 <200	2.46 (1.16-5.18)	CD4 Count <200
	CD4 200-499	2.09 (1.01-4.34)	CD4 Count <200
	HAART	0.56 (0.33-0.93)	No HAART
Palacio[71] (1997-2000)	HAART Recipient	0.67 (0.51–0.88)	HAART naïve
	HAART discontinued	0.99(0.72–1.38)	HAART naive
Palepu[146] (1997-2001)	Age	1.02 (0.99-1.06)	Per year
	Female	1.5 (0.9-2.5)	Male
	White	1.0 (0.6–1.9)	Other
	Black	1.8 (0.9–3.2)	Other
	Homeless	2.3 (1.5–3.6)	Not homeless
	In Jail	0.9 (0.4–1.1)	Not incarcerated
	HAART	1.3 (0.8–1.9)	Not on HAART
	CD4 count	0.999 (0.998–1.00)	Per 1 unit change
	Viral Load	1.11 (1.0–1.2)	
	Substance abuse treatment	1.0 (0.7–1.5)	No treatment
	Injection drug use	1.7 (1.02–2.7)	No use in past 6 months
	Abstinent from EtOH	1.3 (0.9–1.9)	
	Alcohol dependence scale score	1.02 (1.01–1.05)	
Sherer [132](1997-1998)	African American (mean number)	0.20	White
	Hispanic (mean number)	0.16	White
	White (mean number)	0.06	

	CD4 count	Associated with outcome	Data not shown
	No unmet needs	Associated with outcome	Data not shown
Berry[139] (1997-2006)	Female	1.41 (1.14, 1.74)	Male
	African American	1.46 (1.06, 1.99)	Not African American
	IDU HIV Risk Factor	1.43 (1.17, 1.76)	Non IDU Risk Factor
	CD4 count at initiation		
	0-49	2.27 (1.65, 3.13)	>200 cells per microliter
	50-199	1.35 (1.01, 1.81)	>200 cells per microliter
	CD4 increase at 6 months		
	≥101 cells	0.83 (0.67, 1.03)	<101 cells
	Viral Load at initiation		
	4-5 log copies	0.94 (0.68, 1.29)	<4 log copies
	≥5 log copies	1.26 (0.89, 1.79)	<4 log copies
	Virologic responders to therapy		
	Prior 6 months	1.11 (0.84, 1.47)	Days 1–45 after HAART initiation
	Days 46–90	0.74 (0.53, 1.03)	Days 1–45 after HAART initiation
	Days 91–180	0.59 (0.42, 0.82)	Days 1–45 after HAART initiation
	Days 181–365	0.69 (0.49, 0.95)	Days 1–45 after HAART initiation
	Nonresponders over time	1.19 (0.78, 1.81)	Days 1–45 after HAART initiation
	Prior 6 months	1.14 (0.68, 1.90)	Days 1–45 after HAART initiation
	Days 46–90	1.43 (0.89, 2.31)	Days 1–45 after HAART initiation
	Days 91–180	1.11 (0.70, 1.76)	Days 1–45 after HAART initiation
	Days 181–365		
Penniman[117] (1998)	Age 35-44	1.22 (0.79-1.86)	Age 20-34
	Age >44	1.02 (0.76-1.52)	Age 20-34
	Female	1.51 (1.07-2.13)	Homosexual or Bisexual

	Heterosexual Men	1.19 (0.73-1.94)	Men
	High School	1.30 (0.91-1.86)	Homosexual or Bisexual
	Some College	1.32 (0.82-2.15)	Men
	College Graduate	0.86 (0.47-1.58)	Less than high school
	Medicare	2.41 (1.23-4.71)	Less than high school
	Medicaid	1.92 (1.29-2.88)	Less than high school
	No Insurance	1.76 (0.94-3.29)	Private Insurance
	5,000$-10,000 Income	1.05 (0.64-1.73)	Private Insurance
	10,001$-25,000	0.74 (0.41-1.31)	Private Insurance
	>25,000$ Income	1.25 (0.61-2.57)	<5000$ Income
	CD4 Count 50-199	0.66 (0.43-1.01)	<5000$ Income
	CD4 Count 200-499	0.45(0.25-0.81)	<5000$ Income
	CD4 Count >499	0.37 (0.19-0.75)	CD4 Count <50
	Having Any Competing Needs	1.82 (1.31-2.58)	CD4 Count <50
			CD4 Count <50
			No Competing Needs
Edelman[138] (1999-2000)	Fatigue/loss of energy	1.01 (0.78-1.30)	
	Fevers/chills/sweats	0.92 (0.73-1.15)	
	Dizzy/lightheadedness	1.26 (0.99-1.61)	
	Numbness/tingling in hands/feet	1.24 (0.98-1.55)	
	Trouble remembering	0.95 (0.76-1.18)	
	Nausea/vomiting	1.21 (0.94-1.54)	
	Diarrhea/loose bowels	0.86 (0.69-1.06)	
	Sad/depressed	1.18 (0.91-1.53)	
	Nervous/anxious	0.76 (0.58-0.98)	
	Difficulty sleeping	1.08 (0.85-1.36)	
	Skin problems/rash/itching	1.20 (0.97-1.50)	
	Coughing/trouble breathing	1.11 (0.87-1.40)	
	Headaches	0.99 (0.79-1.25)	
	Loss appetite/food taste	1.07 (0.84-1.37)	
	Bloating/pain/gas in stomach	0.97 (0.77-1.21)	
	Muscle aches/joint pains	0.84 (0.67-1.05)	
	Problems with sex	1.02 (0.82-1.26)	

	Change in body composition	1.17 (0.94-1.45)	
	Problems with weight loss/wasting	1.37 (1.10-1.70)	
	Hair loss or changes	0.76 (0.60-0.96)	
Crum-Cianflone[124] (1999-2007)	Age per 10 years	1.08 (0.98–1.19)	
	Female	1.34 (0.99–1.80)	Men
	African Americans	0.88 (0.73–1.06)	White
	Other	1.01 (0.76–1.32)	White
	Chronic Hepatitis B	1.19 (0.82–1.71)	Hepatitis B Negative
	Chronic Hepatitis C	1.46 (1.05–2.03)	Hepatitis C Negative
	Nadir CD4 in prior year	0.92 (0.89–0.95)	Per 50 mm^3
	Proximal CD4 count 350-500	0.71 (0.59–0.86)	Proximal CD4 count
	Proximal CD4 count >500	0.67 (0.56–0.81)	<350
	HAART at Specified CD4 Levels		Proximal CD4 count
	At CD4 <350	0.72 (0.55–0.94)	<350
	At CD4 350–499	0.81 (0.53–1.24)	
	At CD4 ≥500	1.06 (0.79–1.41)	
Linas[91] (2000-2007)	Age	1.1 (1.0–1.3)	per 10 years
	Female	1.5 (1.1–2.1)	Male
	White	0.9 (0.7–1.1)	Other Race
	AIDS Defining Event	2.9 (1.9–4.3)	No AIDS defining Event
	Current Viral Load <400 / mL	0.4 (0.4–0.6)	Viral Load >400 copies/
	Current CD4 Count		mL
	<100	5.2 (3.7–7.3)	
	101-200	2.3 (1.7–3.0)	CD4 Count >350
	201-350	1.4 (1.0–2.0)	CD4 Count >350
	Hepatitis C Infected	1.8 (1.3–2.5)	CD4 Count >350
			Not Hepatitis C infected
Fleishman[130] (2000-2002)	Age 31-49	0.91 (0.82–1.00)	Age 18-30
	Age >50	1.33 (1.19–1.50)	Age 18-30
	Female	1.40 (1.30–1.50)	Male
	African American	1.18 (1.09–1.28)	White
	Hispanic	1.03 (0.94–1.13)	White
	Other	0.90 (0.70–1.15)	White

	Missing	0.65 (0.50–0.84)	White
	Heterosexual	1.08 (1.00–1.18)	MSM
	IDU	1.60 (1.46–1.76)	MSM
	MSM / IDU	1.44 (1.26–1.65)	MSM
	Heterosexual / IDU	1.37 (1.14–1.64)	MSM
	Other	1.22 (1.04–1.43)	MSM
	Missing	1.41 (1.25–1.59)	MSM
	CD4 count <51	5.94 (5.38–6.56)	CD4 count >500
	CD4 count 51-200	2.42 (2.22–2.63)	CD4 count >500
	CD4 count 200-500	1.30 (1.21–1.40)	CD4 count >500
	Viral Load <10,000	0.57 (0.53–0.62)	Viral Load >10,000
	Viral Load 10,000-100,000	0.67 (0.62–0.72)	Viral Load >100,000
	Missing	0.87 (0.71–1.06)	Viral Load >100,000
	HAART	0.94 (0.88–1.01)	No HAART
	HAART data missing	0.82 (0.71–0.96)	No HAART
	Medicaid	1.68 (1.51–1.87)	Private Insurance
	Medicare	1.66 (1.49–1.86)	Private Insurance
	Ryan White/ Uninsured	0.98 (0.87–1.09)	Private Insurance
	Missing	4.74 (4.05–5.54)	Private Insurance
Cunningham[73] (2001-2003)	High School Education or More	1.57 (1.02-2.40)	Compared to less than high school
	Insured	10.45 (1.04–104.70)	No Insurance
	Homeless	2.18 (1.58–3.01)	Not Homeless
	Fair or Poor Health Status	2.64 (1.91–3.64)	Good, very good, or excellent health
	Infected for three or more years	2.03 (1.13–3.64)	Less than three years
	Taking mental health medications	1.87 (1.21–2.91)	Not taking mental health medications
Himelhoch[143] (2001)	Age	1.02 (1.01-1.03)	Per year
	Male	0.63 (0.53–0.74)	Female
	African American	1.35 (1.11-1.67)	Caucasian
	Other Race	1.19 (0.95–1.51)	Caucasian
	CD4 <51	7.86 (6.07-10.2)	CD4 Count >500

	CD4 51-200 CD4 201-500 Viral Load <400 IDU and Mental Health IDU Only Mental Health No IDU/ Mental Health interaction	2.78 (2.22-3.48) 1.26 (1.03-1.56) 0.83 (0.70-0.98) 2.22 (1.64 – 3.01) 1.65 (1.39 -1.96) 1.70 (1.34 -2.15)	CD4 Count >500 CD4 Count >500 Viral Load >400 Compared to Neither Compared to Neither Compared to Neither
Kushel[100] (2001-2002)	African American CD4 count <200 SF 36 Physical Component Score 36-50 SF 36 Physical Component Score <36 SF 36 Mental Component Score 36-50 SF 36 Mental Component Score <36 Crack Cocaine last 30 days Methamphetamine last 30 days	0.7 (0.4-1.4) 1.8 (1.0-3.4) 3.0 (1.0-8.4) 7.7 (2.8-21.6) 1.6 (0.8-3.4) 1.1 (0.5-2.5) 2.1 (1.1-4.2) 1.4 (0.7-2.9)	Not African American CD4 Count> 200 SF-36 Score >50 SF-36 Score >50 SF-36 Score >50 SF-36 Score >50 No Crack cocaine use last 30 days No methamphetamine last 30 days
Leserman[96] (2001-2002)	Clinic in Poor county # of Lifetime Traumas Sexual/ Physical Abuse Post traumatic stress disorder	1.57 (1.09 -2.26) 1.12 (1.04-1.20) 1.78 (1.23-1.59) 1.35 (1.06 – 1.73)	Clinic not in poor county No sexual or physical abuse No post traumatic stress disorder
Paul[122] (2001)	Age > 50 Female African American Hispanic IVDU Heterosexual CD4 count <200 HIV Viral Load > 20,000 copies	1.60 (1.20–2.22) 1.23 (0.93–1.61) 0.81 (0.58–1.12) 0.97 (0.69–1.35) 1.58 (1.12–2.19) 1.22 (0.89–1.67) 2.99 (2.25–3.93) 2.3 (1.73–3.08)	Age < 50 Male White White MSM MSM CD4 count >200 Viral Load < 20,000 copies
Pence [144](2001-2002)	Number of lifetime traumas	1.07 (0.97, 1.18)	

Riley[20] (2002-2006)	Intermittent Insurance at 3 months	2.03 (0.99-.485)	Continuously uninsured
	Continuous Insurance at 3 months	1.78 (1.06-3.91)	Continuously uninsured
	Intermittent Insurance at 6 months	1.42 (0.73-3.39)	Continuously uninsured
	Continuous Insurance at 6 months	1.59 (0.95-3.53)	Continuously uninsured
	Intermittent Insurance at 9 months	1.78 (0.98-4.48)	Continuously uninsured
	Continuous Insurance at 9 months	1.69 (0.99-4.18)	Continuously uninsured
	Intermittent Insurance at 12 months	1.75 (0.92-4.47)	Continuously uninsured
	Continuous Insurance at 12 months	1.53 (0.90-3.79)	Continuously uninsured
Yehia[4] (2002-2007)	Female	1.28 (1.21-1.35)	Male
	Age 31-49	1.08 (1.00-1.77)	Age < 31
	Age > 49	1.37 (1.26-1.50)	Age <31
	African American	1.16 (1.09 -1.24)	White
	Medicaid	2.27 (2.08 -2.48)	Private Insurance
	Medicare	2.18 (1.97-2.40)	Private Insurance
	Medicaid/Medicare	2.31 (2.03-2.63)	Private Insurance
	Ryan White	1.24 (1.13-1.36)	Private Insurance
	CD4<50	5.59(5.15-6.07)	CD4 count >500
	CD4 50-200	2.37 (2.21-2.53)	CD4 count >500
	CD4 200-500	1.32 (1.25-1.40)	CD4 count >500
	Viral Load 400-10,000	1.17 1.10-1.24	
	Viral Load 10K-100K	1.31 (1.24-1.39)	
	Viral Load 100K+	1.96 (1.84-2.10)	
Norton[92] (2006-2007)	Age[6]	0.95 [7]	Per year
	Female	1.83*	Male
	African American	1.64	White
	CD4 Median	0.99	
	Drug Use	2.22*	No drug use
	EtOH Use	0.57	
	Diabetes	1.23	No diabetes
	Renal Disease	2.97*	No renal disease
	HCV Coinfected	1.24	HIV monoinfected

[6] Rate Ratio

[7] *= statistically significant, no confidence intervals presented

Sax[136] (2006-2008)	Age 35-44	0.815 (0.619-1.072)	Age <35
	45-54	0.829 (0.632-1.087)	Age <35
	55-64	1.013 (0.746-1.375)	Age <35
	65+	0.558 (0.065-4.746)	Age <35
	Female	1.249 (1.032-1.510)	Male
	South	1.101 (0.873-1.390)	East
	Midwest	1.130 (0.893-1.429)	East
	West	0.0964 (0.704-1.320)	East
	PPO	1.199 (0.964-1.491)	HMO
	POS	1.271 (0.956-1.692)	HMO
	Indemnity	1.285 (0.871-1.897)	HMO
	Consumer Directed	0.612 (0.364-1.029)	HMO
	Other/Missing	0.871 (0.374-2.026)	HMO
	Medicaid	1.080 (0.674-1.730)	Commercial
	Medicare	2.156 (1.260-3.692)	Commercial
	Self	1.412 (1.044-1.910)	Commercial
	Other	2.336 (0.460-11.862)	Commercial
	Charlson Score 1-2	2.265 (1.609-3.188)	Score <=1
	Score 2-3	2.446 (1.762-3.396)	Score <=1
	Score >3	5.094 (3.759-6.904)	Score <=1
	Treatment Naïve	1.160 (0.972-1.385)	Treatment Experienced
	Adherence of 95% or more	0.572 (0.479-0.682)	No Diagnosis
	Had Mental Disorder Diagnosis	1.388 (1.130-1.705)	No Diagnosis
	Had drug or alcohol diagnosis	1.884 (1.433-2.477)	
Weiser[137] (2007-2010)	Moderate Food Insecurity	1.56 (1.06, 2.30)	No food insecurity
	Severe Food Insecurity	2.16 (1.50, 3.09)	No food insecurity
	CD4 Nadir	1.22 (1.38, 1.07)	Per 100 cells
	Beck Depression Index Score	1.02 (1.01, 1.04)	

Chapter 4. Literature Review of Quality of Care

The literature review on quality of care was not conducted in a systematic manner. Two types of searches were conducted. First, I sought articles with quality of care and HIV as my search terms in PUBMED. Second, I conducted a specific search for each quality measure. In general, I sought articles from large cohort studies, in the United States such as the VA, HIVRN, or the North American AIDS Cohort Collaboration on Research and Design (NA-ACCORD). I also sought systematic reviews wherever possible; however, the systematic reviews available did not deal with quality of care, but rather with disparities.

Three studies report data on combination quality measures. Kazi et al explicitly calculates a combination metric. [35] Kazi et al. constructed a metric assigning a score from zero to ten. These scores represent perfect care to no indicators performed respectively. They found that 32 percent of participants had all or nine out of ten indicators performed properly. 46 percent had 6-8 indicators performed correctly, and the remainder had fewer than six indicators performed correctly. [35] The other available data come from Backus et al. They present sufficient raw data that combination metrics can be calculated from their paper. [34] It was possible to reconstruct two composite metrics from Backus et al. The overall percentage of indicators performed was 81.6%, and the average of the indicators was 80.7%. [34]Kerr et al. also present raw data so that combination metrics can be calculated. The overall percentage was 85.3%, and the indicator average was 89.8%. [147] Because of the relative paucity of combination data, I will, briefly, discuss each of the individual metrics.

Analyzing trends and changes in the prescription of antiretroviral therapy is difficult, because the prescribing guidelines are frequently changed. Nonetheless, studies have used a single definition over time to look at prescribing rates. Many of the studies in the literature on antiretroviral prescribing are focused on analyzing disparities in who receives antiretroviral therapy. Fleishman et al. found that across, age, race, and sex, rates of antiretroviral prescribing rose from approximately 60 percent in 2002 to 80 percent in 2008. [148] In the Veterans Administration system, Backus et al found that 91 percent of patients were prescribed ART. Prescription frequencies varied across sites from 75 to 99 percent. [34] In an evaluation of sites receiving Ryan White funding, Wilson et al found that 81 percent of patients were prescribed antiretrovirals, and the range was 57 to 93 percent. [149] Horberg et al found ranges of 85-87 percent depending on the year in the Kaiser Permanente system. [150] Hanna et al. used data from the North American AIDS Cohort Collaboration on Research and Design (NA-ACCORD) to show that the adjusted rate of antiretroviral prescribing rose from 51% in 2001 to 72% in 2009. Patients in the NA-ACCORD study were HAART naïve at baseline. [151]

Pneumocystis pneumonia (also known as pneumocystis jirovecii) typically occurs when the CD4 count is less than 200. Table 4.1 contains the prescription rates. Infection with pneumocystis was one of the first recognized sequalae of HIV infection. Articles dating back to 1992 contain data on prescription of pneumocystis pneumonia prophylaxis. Two systematic reviews of disparities on the basis of race in prescription of prophylaxis have been published. [152] [153]Three studies present the change in pneumocystis prophylaxis rate over time. Teshale found that the frequency of prophylaxis fell eight percent from a high of 84% in 1994 to 76% in 2003.[154,155] Buchacz found that the frequency of prophylaxis fell from 93.7% in 1994 to 76.7% in 2007. The Healthy People 2010 goal is for 95 percent of patients to be prescribed prophylaxis. Between 2005 and 2007, Horberg et al. found a decline of 2 percent from 71% to 68.9%. [150] Kerr found that at an academic medical center system between 2006 and 2007 prophylaxis rates were 95.1%.[147]It is unclear why the Kaiser Permanente Network had prophylaxis rates twenty five percent less than an academic medical center. In addition to the worrisome decreases in the prescription of pneumocystis prophylaxis, there appears to be vast site-to-site variation in prescription rate. Wilson et al. examined 69 sites and found prescription rates ranging from 25 and 100 percent. [149]

Mycobacterium avium intracellulare is an opportunistic infection that typically occurs when an individuals' CD4 count is less than 50. Table 4.2 contains the frequencies of MAC prophylaxis prescribing. Data from HCSUS showed that only 41% of patients at baseline and 40% percent of patients at follow up were receiving indicated MAC prophylaxis. [156] Buchacz et al found that prophylaxis rates for ranged from 53.2% to 74.3% between 1994 and 2007 in the HOPS cohort. [155] In 2001, the HIVRN found prophylaxis rates of 87.6 %.[157] In 2006, the prophylaxis rate at an academic medical center was 90.9%. However, only 22 patients out of nearly seven hundred were eligible for prophylaxis.[147] By improving CD4 counts antiretroviral therapy has decreased the need for MAC prophylaxis, and patients are discontinuing prophylaxis as their CD4 counts rise above 50 cells/mm^3. [158]

Table 4.3 contains the frequencies of testing for gonorrhea and chlamydia. The first steps in quality improvement are to insure that care providers are aware of treatment and testing guidelines. Sena et al. found that depending on the STI in question only 11 to

25 % of providers were appropriately testing their patients. [159] Berry et al. demonstrates that testing rates at clinic enrollment increased from 4.0%, prior to the guidelines, to 16.5% after the publication of the guidelines. [160] Hamlyn et al. found that screening rates increased from 39 to 52% between 2004 and 2006 in the United Kingdom. [161] Using data from National HIV Behavioral Surveillance (NHBS) system, Tai et al found gonorrhea testing rates of 36% among MSM. [162] The NHBS data are interesting because they examine testing frequency from the patient's point of view rather than the providers. Patients may recall more testing than providers if they received testing at sites other than their primary HIV clinic. Thus, a patient may comply with guidelines, but his or her providers may not be in compliance. Teague et al found that screening frequencies differed widely based on whether patients were evaluated in STD or ID clinics. [163] Because gonorrhea and chlamydia infect more than one anatomic location Hoover et al evaluated the frequency of testing by anatomic location. They found that urethral sites were tested approximately 4 times more frequently than other locations. [164] Lifetime screening prevalences are much higher than yearly or at enrollment frequencies. Page et al. found that 66% of women enrolled in the Johns Hopkins HIV clinic had at least one gonorrhea or chlamydia test. [165]

HIV-infected individuals should also be screened for infection with syphilis. Some of the earliest data comes from Marx et al. who found that 54% of patients were screened. [166] Sheth et al. found that at the Johns Hopkins clinic 75% of patients received annual syphilis screening between 1999 and 2003. [167] Using data from the NHBS Tai et al found syphilis testing rates of 39% among MSM.[162] Medical record abstraction by Hoover et al found testing rates of between 66 and 76 percent between 2004 and 2006.

The higher percentage of patients screened in studies with medical record abstraction may be due to poor recall of STI testing by study participants. The greater percentage of patients tested according to medical records may also represent a failure of providers to communicate what laboratory studies they ordered to their patients.

Articles on lipid screening among HIV-infected patients were rare. Korthuis et al. evaluated lipid screening within six months of beginning protease inhibitor therapy among patients receiving care at the VA. 59% were screened for hyperlipidemia. [168] Koethe et al. evaluated patients at Yale New Haven hospital and found that annual lipid screening rates were greater than 87 percent regardless of year or provider type.[169] More recent data, from 2008 at the VA, demonstrated screening rates ranging between 48% and 83%.

Measurement of CD4 count is an important piece of monitoring disease stage for patients with HIV infection. CD4 count is also an important measure of retention in care. Rebeiro et al. present data from the NA-ACCORD, which show that between 61-82% of patients, depending on the year, received at least two CD4 counts ninety days apart. [170]Hsu et al. reports that 81% of patients, enrolling in care in 2006-2007 in San Francisco, received at least two CD4 count tests during their first year in care.[171] Kerr et al found that between 70% and 84% of patients had at least three tests in a calendar year. The different frequencies in Kerr's analysis were due to different clinic types.[147] Other studies using a variety of CD4 count categories found frequencies of 61%-90% depending on study type, location, and year. [34,150,172]

Table 4.1 Pneumocystis Pneumonia Prophylaxis Prescription Frequencies

Name of Study (Year of Study)	Mean (Range)
Marx [173](1992)	94.00%
Lundgren[99] (1994)	85.00% across all sites
Kaplan[174] (1996)	94.00%
Smith (1996-1997)	50-63.9 depending on housing status
Solomon[175] (1997-1998)	96.00%
Asch (1996) [156]	64.00%
Sullivan[172] (1998)[172]	N/A (60-87)
Asch (1998) [156]	72.00%
Hirschhorn (1999-2001)[176]	66-75%
Gebo[177] (2001)	88.1 (N/A)
Goldstein[178] (2000-2002)	79.00%
Teshale [179]	84-76[8]
Buchacz[155]	93.7-78.6[9]
Wilson[180]	70 (25-100)
Kazi [181]	
Backus	72.00%
Horberg (2005)[150]	71.0%
Horberg (2007)[150]	68.7%
Horberg (2007)[150]	68.9%
Kerr 2006-2007 [147]	95.1%
Grace[182]	83% / 86% depending on location

8 Fall from 1994 to 2003.

9 Fall from 1994 to 2003.

Table 4.2 Mycobacterium Avium Intracellulare Prophylaxis Frequencies

Murphy 1995-1998[183]	43%
Asch [156]1995-1997	41%
Asch 1996 [156]	40%
Asch 1998 [156]	40-41%
Kitahata 1998[184]	21%
Kitahata 1999[184]	49%
Gebo[157] 2001	87%
Sullivan[172]	43%-87%
Buchacz 1994-2007 [155]	53%-74%
Kerr 2006-2007 [147]	90%

Table 4.3 Screening Frequencies for Gonorrhea/Chlamydia and Syphilis

Study Name (Year)	Measure if Not Separate	Gonorrhea and Chlamydia	Syphilis
Marx (1992)	N/A	N/A	54.00%
Berry[185] (1999-6/2003) At Enrollment	N/A	4.00%	N/A
Berry[185] (7/2003-2007) At Enrollment	N/A	16.50%	N/A
Berry[185] (1999-6/2003) Ever Tested	N/A	34.20%	N/A
Berry[185] (7/2003-2007) Ever Tested	N/A	48.10%	N/A
Solomon[186] (1997-1998)			22%-57%
Sheth[167] (1999-2003)	N/A	N/A	75.20%
Farley (2000-2001) [187]	N/A	33%	N/A
Klausner[188] (2001)	N/A	55.00%	56.00%
Ferrand[189] (2005)	N/A	N/A	80.00%[10]
Hamlyn[161] (2006)	39-52%	N/A	N/A
Hoover[164] (2004-2006)	N/A	15.2%-21.3%[11]	66%-76.8%
Page[165] (1996-2006)	3.8% at initial visit	N/A	N/A
Tai[162] (2006)	34%	36% (GC only)	39%
Teague[163] (2006) STD Clinic	41.00%	47.00%	67.00%
Teague[163] (2006) ID Clinic	6.00%	18.00%	34.00%
Backus[34] (2008)	N/A	N/A	54.00%

10 May include some people only tested for Hepatitis C.

11 Range across gonorrhea and chlamydia which were reported separately in the paper.

Table 4.4 Percentage or Rate of CD4 count testing

Author (Year)	% Receiving CD4 count testing
Sullivan[172] (1998)	61-92%
Horberg (2005)[150]	76.2%
Hsu (2006-2009)[171]	95% one test per year average, 3.5 total tests
Horberg (2007)[150]	87.4%
Horberg (2007)[150]	86.3%
Backus[34] (2008)	93.00%

Chapter 5: Emergency Department Paper and Additional Analysis

5.1 Aims of the Emergency Department Analysis

5.1.1 Specific Aim 1

Describe the prevalence of emergency department use in an in-care sample of the United States HIV-infected population in 2009.

5.1.2 Specific Aim 2

Assess the risk factors for emergency department utilization in this population.

Emergency department utilization among HIV-infected persons in the United States

Joshua S. Josephs MHS[1,2], Patrick Sullivan DVM PhD[2], Brent A. Johnson PhD[2], Kelly A. Gebo MD MPH[3], Carlos del Rio MD[1,2], Jacek Skarbinski MD[4]

1 Emory University School of Medicine
2 Emory University Rollins School of Public Health and Laney Graduate School
3 Johns Hopkins University School of Medicine
4 Division of HIV/AIDS Prevention, Centers for Disease Control and Prevention

Funding Information - Funding for the Medical Monitoring Project is provided by a cooperative agreement (PS09-937) from the Centers for Disease Control and Prevention

Disclosure statement - The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention (CDC).

Contributions: JSJ conceived the research question, designed the study, performed the analysis and wrote the paper. JS provided the data, designed the study and wrote the paper, KG, BJ, PS, and CR designed the study, and wrote the paper.

Word Count: Abstract 219, Paper 2676
Tables and Figures: 3

Corresponding Author:
Joshua Josephs
1518 Clifton Way
Room 400

Abstract

Background: Prior studies suggest that HIV-infected persons have increased prevalence and frequency of emergency department (ED) utilization. However, given advances in antiretroviral therapy and the availability of new nationally representative data, we re-assessed the prevalence and risk for ED utilization among HIV-infected persons.

Methods: Using 2009-2011 data from the Medical Monitoring Project, a national probability sample of HIV-infected adults receiving medical care in the United States, we calculated national estimates for the frequency and number of ED visits and assessed risk factors for ED utilization.

Results: In all, 10.4% [95% confidence interval (CI): 9.8-10.9] of HIV-infected adults receiving medical care had at least one ED visit in the past year. In a multivariate logistic regression model, women, homeless persons, those with incomes below the poverty line, those with CD4+ T-lymphocyte counts less than 500 cells/mm^3, those who did not achieve durable viral suppression, and those who were depressed were more likely to have any ED utilization.

Conclusions: The prevalence of ED utilization was lower than previously reported. Socio-demographic factors, lack of HIV treatment (uncontrolled viremia and immunosuppression) and depression were associated with increased ED utilization among HIV-infected persons in care. Efforts focused on reducing disparities, increasing access to HIV treatment, and improving mental health services might contribute to reduced ED utilization among HIV-infected persons.

Introduction

HIV-infected persons have been reported to use more emergency department (ED) services than the general population[190-192]. However, existing estimates are heterogeneous. Previous studies have reported that 17-69% of HIV-infected persons used the emergency department (ED) in the past year compared to approximately 20% of the general population.[70-72,77,78,80,96,101,192] The variability in ED utilization estimates might partially be explained by the characteristics of the sampled populations in these studies. Studies reporting higher ED utilization prevalence were among samples of homeless individuals or those abusing illicit drugs,[79,82,84] while studies reporting lower prevalence estimates were among samples of persons receiving HIV care.[81,83] Additionally, many of these estimates are from early in the antiretroviral therapy (ART) era (years 1996-2003), and thus as ART has improved substantially since 2003, ED utilization might have declined. Furthermore, with the exception of the Healthcare Services and Utilization Study (HCSUS) conducted in 1996, there are no nationally representative data on the population HIV-infected person receiving medical care.[5]

In addition, the existing literature on risk factors for ED utilization among HIV-infected persons is heterogeneous. Certain factors have been associated with ED utilization in some but not all studies; these factors include gender, CD4+ T-lymphocyte cell (CD4) count, viral suppression, and drug use for non-medical purposes. [5,66-68,70,75,79] [44,83,91,92,104] [5,72,87,94,100] These conflicting results may have occurred due to the use of convenience sampling, selection bias, inadequate control of confounding, misclassification of exposures due to self-report, differences in exposure classification and measurement instruments, and changes over time in HIV treatment.

In all, ED utilization among HIV-infected persons is relatively understudied. Care seeking in the ED by HIV-infected individuals likely reflects a mixture of unpreventable or potentially preventable root causes. Some visits might be categorized as unpreventable as they represent true emergencies (e.g. motor vehicle accident with trauma) while others might be potentially preventable and are due to lack of access to outpatient care (e.g. medication refills, treatment of chronic conditions better managed in outpatient setting) or inadequate treatment in the outpatient setting (e.g. a patient who does not receive *Pneumocystis* pneumonia (PCP) prophylaxis who develops PCP). In this era of highly effective treatment and reduced morbidity and mortality among HIV-infected persons, a better understanding of ED use prevalence and risk factors for ED use is needed.

Given gaps in the existing literature on ED utilization among HIV-infected persons, we used data from the Medical Monitoring Project (MMP), which collects nationally representative data on patient experiences using an interview and receipt of clinical care using detailed medical record abstraction, to provide updated estimates of the frequency and number of ED visits made by HIV-infected persons receiving medical care, and assess socio-demographic and clinical risk factors for ED utilization.

Methods

Study design

We used data from the 2009 to 2011 MMP, a HIV surveillance system designed to produce nationally representative estimates of behavioral and clinical characteristics of HIV-infected adults receiving medical care in the United States.[19,193-195] MMP is a complex-sample, cross-sectional survey. For each data collection cycle, first U.S. states and territories were sampled, followed by facilities providing HIV care, and finally HIV-infected adults aged ≥18 years who received at least one medical care visit during January through April of the data collection cycle year at participating facilities. Data were collected via face-to-face interviews and medical record abstractions from June 2009 through May 2013. All sampled states and territories participated in MMP. Facility response rates were 76% (461/603) in 2009, 81% (474/582) in 2010, and 83% (473/570) in 2011. Approximately 50% of persons sampled from these facilities completed an interview and had their medical records abstracted (4,217/9,038 in 2009, 4,474/9,300 in 2010, and 4,503/9,023 in 2011), with 13,190 respondents over three consecutive cycles. Data were weighted based on known probabilities of selection at state or territory, facility, and patient levels. In addition, data were weighted to adjust for non-response using predictors of patient-level response.

Human subjects protection

MMP, as a public health surveillance activity, was determined to be non-research in accordance with the CDC's Guidelines for Defining Public Health Research and Public Health Non-Research. Participating states or territories and facilities obtained local Institutional Review Board (IRB) approval to conduct MMP and informed consent from patients as required locally. [196,197]

Measurement of outcome

ED utilization was defined as reporting one or more self-reported visits in response to the following question in the interview: “During the past 12 months, how many times did you go to an emergency room or urgent care center for HIV medical care?“

Measurement of risk factors from interview data

We collected data on age in years, race/ethnicity, and the highest level of education completed. Poverty status was defined using Department of Health and Human Services poverty level criteria based on self-reported monthly or yearly income and number of dependents in the 12 months prior to interview. [198] Homelessness was defined as having lived in a shelter, on the street, in a single room occupancy hotel, or car in the twelve months prior to the interview. Participants were considered insured if they had insurance, including Medicare or Medicaid, any time in the 12 months prior to interview. Incarceration was defined as having been in jail, detention, or prison for more than twenty four hours in the 12 months prior to interview. Unmet needs were assessed by asking about unmet need for HIV case management services, counseling about how to prevent the spread of HIV, medicines through the AIDS Drug Assistance Program, professional help remembering to take HIV medicines on time or correctly, HIV peer group support, dental care, mental health services, drug or alcohol counseling treatment, public benefits including Supplemental Security Income or Social Security, domestic violence services, shelter or housing services, meal or food services, home health services, transportation assistance, childcare services, interpreter services, or other; a participant who needed, but did not receive a service were considered to have an unmet need. Alcohol use in the 30 days prior to interview was coded according to the National Institute on Alcohol Abuse and Alcoholism criteria based on the sex of the participant, the number of drinks per week, and the maximum number of drinks in one sitting.[199] Drug use for non-medical purposes was coded into mutually exclusive categories of injection drug use, non-injection drug use that was not marijuana use, marijuana only use, and no use of drugs for non-medical purposes. Information on depression in the two weeks prior to interview was collected using the Patient Health Questionaire-8 (PHQ-8).

Measurement of risk factors from medical record abstraction

Using data from the medical record abstraction, we ascertained whether the patient had ever been diagnosed with AIDS. In addition, using data on all CD4 counts and HIV viral load tests in the 12 months prior to interview, we calculated the mean geometric CD4 count which was then categorized into 0-49, 50-199, 200-349, 350-499, and greater than 500 cells/ mm^3 and assessed whether the patient had achieved durable viral suppression defined as having all viral loads listed as undetectable or less than 200 copies/mL. Moreover, we ascertained the number of CD4 count and viral load measurements in the 12 months prior to interview. ART prescription was defined as documentation in the medical record of having been prescribed any ART in the 12 months prior to interview.

Data analysis

Data analysis was conducted using Stata 12 (Stata Corp, College Station, TX) using procedures that accounted for the complex sample survey nature of the data. We conducted chi-squared tests of the association between risk factors and outcome. We conducted bivariate and multivariate logistic regression and calculated the prevalence ratio via the predicted marginal using the adjrr command in Stata 12 to assess the association between risk factors and ED utilization.[200] We chose not to perform variable selection on the basis of our directed acyclic graph, the Andersen-Aday model of healthcare utilization, and a review of the literature which suggested confounding between our risk factors.[39,42] Multivariate logistic regression was conducted for 3753 participants with complete data.

Results:

In all, 10.4% of HIV-infected adults receiving medical care in the United States self-reported at least one ED or urgent care visit in the 12 months prior to interview. Only 2 percent of participants made more than four visits which has previously been defined as frequent ED utilization.[201] The majority of the sample was aged >40 years (75.5%) and non-Hispanic black or Hispanic/Latino (60.6%). Most (89.1%) were prescribed ART, and achieved durable viral suppression (57.7%).

In bivariate analysis, the following factors were significantly associated with increased ED utilization: female gender, African American race, having a high school diploma or equivalent, having an income below the poverty level, being homeless, being incarcerated, having one or more unmet needs, having a geometric mean CD4 count in the prior 12 months of <500 cells/mm^3, having ever been diagnosed with AIDS, failing to achieve durable viral suppression, depression, being a current smoker, and being an injection drug user (Table 2). In multivariate analysis the following factors were independently significantly associated with increased ED utilization: female gender, having an income below the poverty level, being homeless, having two or more unmet needs, having a geometric mean CD4 count in the prior 12 months of <500 cells/mm^3, failing to achieve durable viral suppression, and depression. Moderate and heavy/binge alcohol use was associated with decreased ED utilization in both bivariate and multivariate models.

Discussion

In this first nationally representative analysis of ED utilization among HIV-infected persons since 1996, we found that 10.4% HIV-infected adults receiving medical care in the United States self-reported at least one ED or urgent care visit in the 12 months prior to interview. Female gender, having an income below the poverty level, being homeless, having two or more unmet needs, having a geometric mean CD4 count in the prior 12 months of <500 cells/mm^3, failing to achieve durable viral suppression, and depression were associated with increased ED use.

In this analysis, relatively few persons, only 10.4% of all HIV-infected persons in care, utilized the ED in the past year. The prevalence of ED use in this analysis appears substantially lower than previously reported from non-representative convenience samples (17.7%–69.2%)[5,70-72,77,78,80,96,101] or from the last nationally representative survey among HIV-infected persons (23% in the past 6 months).[5] Several factors may account for the difference between our prevalence estimate and prior estimates. First, our sampling design, which is nationally representative and only includes patients in care is unique. The most comparable estimates come from two single site studies of in-care persons which found prevalences of 20.2% in 2006 and 22.0% in 2008 respectively.[81,83] Other studies used purposive sampling of populations known to have greater healthcare utilization such as the homeless or those using drugs for non-medical purposes.[79,82,84]

Second, HIV care and treatment have improved substantially between 1996 and 2009 which may explain partially why our estimate is one fourth that of Shapiro et al.[5] In our analysis 45% of participants had CD4 counts ≥500 cells/mm^3 while only 9% of HCSUS participants had comparable CD4 counts.[5] Third, our estimate of ED utilization is based on self-reported visits for HIV-related reasons and thus our methods to measure ED utilization might lead to our estimates being either higher or lower than those previously reported. Because we included all emergency department and urgent care visits and not just those at one site or network, we potentially captured a larger number of visits. However, the accuracy of patient's classification of visits for HIV-related reasons is largely unknown. Estimates of the percent of visits due to HIV, based on ED record review, vary widely based on definition and range from 11%-40%.[70,83,92]

In our analysis of risk factors for ED utilization, certain sociodemographic factors, such as female gender, having an income below the federal poverty line, and being homeless, were associated with increased ED utilization. Increased ED use among women has been shown previously in the general population and HIV literature.[5,44,92] The possible reasons for this association include differences in care seeking behavior between men and women, obstetric and gynecologic complaints, intimate partner violence and other differences in morbidity.[106,202] Moreover, homelessness has been consistently implicated in increased ED utilization in both HIV-infected individuals and in the general population. [70,73,94,95,102,103] Potential reasons for this association include lack of food access, inability to access or afford primary care, and that the homeless are frequently the victims of physical and sexual abuse.[137 20] Homelessness among persons living with HIV has been recognized as critical problem and programs such as the Housing Opportunities for Persons with AIDS (HOPWA) to address this issue are ongoing.[203] In addition, consensus clinical care guidelines have been developed to address care for homeless HIV-infected persons. [204] Impoverishment likely influences ED utilization by similar mechanisms to homelessness including food scarcity, inability to afford primary care or medications. Future researchers should consider assessing the interaction between homelessness and poverty to see if these risk factors behave synergistically. Moderate and heavy alcohol use was associated with decreased use of the ED. In a review of healthcare utilization and alcohol use in patients with HIV, Mazr et al found that for ED utilization studies were split between finding no association between ED use and alcohol and those with alcohol use having higher utilization. An explanation for our findings is that individuals who consume alcohol are healthier than those who do not and thus they have decreased healthcare utilization.

HIV clinical factors including lifetime history of AIDS diagnosis, CD4 count in the prior 12 months, and lack of durable viral suppression were all associated with increased ED utilization in bivariate analyses. However, only geometric mean CD4 count in the prior 12 months and durable viral suppression were independently associated with ED utilization in multivariate analyses. Importantly, the data suggest a dose-response curve with the prevalence of ED utilization higher among persons with lower CD4 counts in the prior 12 months. These data suggest that improved HIV care and treatment to achieve viral suppression and immune reconstitution might reduce ED utilization among HIV-infected persons. As already endorsed by HIV treatment guidelines, clinicians should continue to provide ART with the goal of viral suppression. [14,205]

Depression occurs four times more frequently in the HIV-infected population than in the general population and can lead to worse healthcare outcomes.[206-208] While prior studies of the association between depression and ED utilization in HIV-infected individuals have found mixed results, among those with other chronic diseases and in the general population there is a clear and consistent association between depression and increased ED utilization.[72,94,209-211] Depression may increase ED utilization directly as ED visits might be for mental health care or indirectly by altering adherence to ART. However, as we adjusted for viral suppression and CD4 count in the prior 12 months, our analysis suggests that depression is an independent risk factor for ED use. This study highlights the need for mental health services for HIV-infected persons and as already recommended by guidelines providers should be continue to screen for and treat depression. [212]

Limitations

In this analysis, we examined ED use among HIV-infected persons receiving medical care, but only 45% HIV-diagnosed persons are estimated to be retained in medical care [25,213] Thus, this study might under-report ED use among all HIV-infected persons as HIV-infected persons who are not receiving medical care are less likely to use ART and achieve viral suppression and more likely to develop AIDS defining conditions requiring ED use and hospitalization. In addition, although we used strict criteria to control confounding, due to the cross sectional nature of the study, many factors included in the multivariate analysis might have occurred contemporaneously with ED utilization making causal attribution difficult or impossible. Finally, we do not have data on the ED visit diagnosis and so we cannot ascertain whether visits represent appropriate or inappropriate ED utilization.

Conclusions

In this first nationally representative study since 1996, we found a lower frequency of ED utilization than in prior studies. Similar to studies of ED utilization in the general population, female gender, homelessness and depression were significantly associated with increased ED utilization. Moreover, even in the era of once daily ART, CD4 count in the past 12 months and lack of viral suppression were significant predictors of increased ED utilization. Although, overall ED utilization among HIV-infected persons appears to have decreased over time, reducing homelessness, improving treatment for depression, and improving HIV care and treatment might contribute to further reduction in ED utilization among HIV-infected persons.

Table 5.1 Characteristics of HIV-infected adults receiving medical care in the United States by self-reported emergency department (ED) utilization in the 12 months prior to interview, Medical Monitoring Project, United States, 2009-2011

Characteristic	All n (%)	Persons who had not utilized ED n (%)	Persons who had utilized ED n (%)	Chi-square P-value
Age in years				
18-29	960 (7.4)	844 (7.3)	116 (8.2)	0.03
29-39	2099 (15.7)	1841 (15.3)	258 (19.0)	
40-49	4809 (35.9)	4295 (36.1)	514 (34.5)	
≥50	5294 (40.9)	4809 (41.1)	485 (38.3)	
Birth gender				
Male	9470 (67.1)	8580 (73.8)	890 (64.2)	<0.01
Female	3499 (23.8)	3043 (26.2)	456 (35.7)	
Race/ethnicity				
Non Hispanic white	4327 (31.2)	3938 (31.7)	389 (25.6)	<0.01
Non Hispanic black	5393 (40.4)	4742 (39.9)	651 (45.4)	
Hispanic/Latino	2816 (23.8)	2545 (23.7)	271 (24.7)	
Other	616 (4.6)	554 (4.7)	62 (4.3)	
Education				
< High school	2925 (22.0)	2511 (21.1)	414 (30.8)	<0.01
High school diploma or equivalent	3558 (26.5)	3185 (26.6)	373 (25.6)	
> High school	6676 (51.5)	6091 (53.2)	585 (43.6)	
Poverty				
Income below the federal poverty line	6879 (43.8)	6343 (42.2)	536 (58.0)	<0.01
Income above the federal poverty line	5903 (56.2)	5112 (57.8)	791 (42.0)	
Insured				
No	1919 (16.2)	1752 (16.3)	167 (13.9)	0.10
Yes	11223 (83.9)	10021 (83.7)	1202 (86.1)	
Homeless				
No	12044 (91.5)	10880 (92.2)	1164 (84.8)	<0.01
Yes	1116 (8.5)	907 (7.8)	209 (15.2)	
Incarcerated				
No	12473 (94.8)	11228 (95.1)	1245 (91.3)	<0.01
Yes	682 (5.2)	555(4.9)	127 (8.7)	

Number of unmet needs				
0	6777 (52.7)	6227 (54.0)	550 (40.4)	<0.01
1	3133 (24.7)	2817 (24.8)	316 (23.6)	
2 or more	2879 (22.6)	2422 (21.3)	457 (36.0)	
Prescribed ART				
No	1149 (9.0)	1022 (9.0)	127 (8.8)	0.87
Yes	11937 (91.0)	10699(91.0)	1238 (91.2)	
Geometric mean CD4+ T-lymphocyte cell count in prior 12 months in cells/mm^3				
<50	323 (2.4)	207 (1.7)	116 (9.3)	<0.01
50-199	1295 (10.0)	1042 (9.1)	253 (19.1)	
200-349	2168 (16.8)	1923 (16.6)	245 (18.2)	
350-499	2919 (23.6)	2640 (23.8)	279 (22.5)	
500 or more	5857 (47.2)	5455 (48.8)	402 (30.8)	
AIDS status				
No AIDS diagnosis	4026 (31.3)	3730 (32.2)	296 (21.6)	<0.01
AIDS diagnosis	9089 (68.7)	8016 (67.7)	1073 (78.4)	
Durable viral suppression				
No	5236 (39.9)	4468 (38.2)	768 (56.5)	<0.01
Yes	7926 (60.1)	7321 (61.8)	605 (43.4)	
Number of CD4+ T-lymphocyte count and HIV viral load tests				
<3	4073 (30.8)	3618 (30.5)	455 (33.6)	0.08
3 or more	9006 (69.2)	8098 (69.5)	908 (66.4)	
Depression				
Not depressed	10076 (77.8)	9203 (79.3)	873 (62.3)	<0.01
Depressed	2931 (22.2)	2449 (20.7)	482 (37.4)	
Smoking				
Current	5392 (39.5)	4745 (39.1)	647 (43.9)	0.04
Former	2801 (21.4)	2536 (21.5)	265 (20.1)	
Never	4919 (39.1)	4472 (39.4)	447 (36.0)	
Alcohol use				
None	4663 (34.8)	4114 (34.0)	549 (43.0)	<0.01
Moderate	6969 (54.0)	6299 (54.7)	670 (47.1)	
Heavy/binge	1491 (11.1)	1348 (11.3)	143 (9.9)	
Drug use for non-medical purposes				

None	9589 (73.8)	8648 (73.4)	941 (72.0)	
Marijuana only	1012 (7.1)	901 (7.2)	111 (6.7)	0.03
Other non-injection drugs	2178 (16.9)	1932 (16.8)	246 (17.7)	
Injection drug use	322 (2.2)	257 (2.0)	65 (3.6)	

Abbreviations: ART=antiretroviral therapy; AIDS=acquired immunodeficiency syndrome

All percentages are weighted to account for known probabilities of selection at state or territory, facility, and patient levels and adjust for non-response.

Table 5.2 Factors associated with emergency department (ED) utilization in the 12 months prior to interview, Medical Monitoring Project, United States, 2009-2011

Characteristic	ED Utilization n/N (row %)	Bivariate PR (95% CI)	Multivariate PR (95% CI)
Age in years			
18-29	116/960 (12.1)	Reference	Reference
29-39	258/2099 (12.3)	1.10 (0.83-1.45)	1.04 (0.78-1.39
40-49	514/4809 (10.7)	0.86 (0.66-1.12)	0.89 (0.68-1.16)
≥50	485/5294 (9.2)	0.84 (0.65-1.10)	0.96 (0.73-1.27)
Birth gender			
Men	645/9465 (6.8)	Reference	Reference
Women	289/3525 (8.2)	1.50 (1.31-1.73)*	1.43 (1.19-1.71)*
Race			
Non Hispanic White	389/4327 (9.2)	Reference	Reference
Non Hispanic Black	651/5393 (12.1)	1.36 (0.15-1.62)	1.00 (0.82-1.22)
Hispanic	271/2816 (9.6)	1.26 (1.02-1.55)*	0.96 (0.76-1.21)
Other	62/616 (10.0)	1.13 (0.82-1.54)	0.89 (0.62-1.27)
Education			
< High school	414/2925 (14.2)	Reference	Reference
High School diploma or equivalent	373/3558 (10.5)	1.65 (1.38-1.96)*	1.07 (0.90-1.30)
> High school	585/6676 (8.8)	1.14 (0.97-1.34)	0.94 (0.79-1.13)
Poverty			
Below the federal poverty line	536/6879 (7.8)	1.78 (1.53-2.07)*	1.20 (1.01-1.43)*
Above the federal poverty line	791/5903 (13.4)	Reference	Reference
Insured			
No	167/1919 (8.7)	Reference	Reference
Yes	1202/11223 (10.7)	1.19 (0.97-1.47)	1.24 (0.98-1.57)
Homelessness			
No	1164/12044 (9.7)	Reference	Reference
Yes	209/1116 (18.7)	1.93 (1.61-2.32)*	1.28 (1.02-1.61)*
Incarcerated			
No	1245/12473 (10.0)	Reference	Reference
Yes	127/682 (18.6)	1.73 (1.35-2.21)*	1.11 (0.83-1.48)
Number of unmet needs			
0	550/6777 (8.1)	Reference	Reference
1	316/3133 (10.0)	1.24 (1.04-1.48)*	1.10 (0.92-1.32)
2 or more	457/2879 (15.9)	2.01 (1.77-2.41)*	1.43 (1.19-1.72)*

Geometric mean CD4+ T-lymphocyte cell (CD4+) count in prior 12 months in cells/mm^3	116/323 (36.0)	6.50 (5.01-8.43)*	5.35 (4.96-5.77)*
<50	253/1295 (19.5)	3.21 (2.68-3.84)*	2.71 (2.45-3.01)*
50-199	245/2168 (11.3)	1.75 (1.48-2.07)*	1.43 (1.16-1.76)*
200-349	279/2919 (9.6)	1.34 (1.14-1.56)*	1.41 (1.16-1.75)*
350-499	402/5857 (6.9)	Reference	Reference
500 or more			
Lifetime AIDS status			
Any lifetime AIDS diagnosis	296/4023 (7.4)	1.65 (1.40-1.96)*	1.21 (0.98-1.49)
No lifetime AIDS diagnosis	1073/9089 (11.8)	Reference	Reference
Durable viral suppression			
No	768/5326 (14.4)	1.96 (1.71-2.25)*	1.39 (1.20-1.61)*
Yes	605/7926 (7.6)	Reference	Reference
Number of CD4+ T-lymphocyte count and viral load tests			
<3	455/4073 (11.2)	Reference	Reference
3 or more	908/9006 (10.0)	0.88 (0.76-1.02)	1.01 (0.86-1.19)
Depression			
Not depressed	873/10076 (8.7)	Reference	Reference
Depressed	482/2931 (16.4)	2.10 (1.82-2.42)*	1.63 (1.38-1.93)*
Smoking			
Current	647/5392 (12.5)	1.20 (1.03-1.39)*	1.10 (0.89-1.36)
Former	265/2801 (9.5)	1.02 (0.85-1.23)	1.00 (0.84-1.19)
Never	447/4919 (9.1)	Reference	Reference
Alcohol use			
None	549/4663 (11.8)	Reference	Reference
Moderate	670/6969 (9.6)	0.71 (0.61-0.82)*	0.77 (0.65-0.90)*.
Heavy/binge	143/1491 (9.6)	0.72 (0.56-0.92)*	0.74 (0.57-0.97)*
Drug use for non-medical purposes			
None	941/9589 (9.5)	Reference	Reference
Marijuana only	111/1012 (11.0)	0.97 (0.73-1.28)	0.91 (0.67-1.22)
Other non-injection drugs	246/2178 (11.3)	1.07 (0.89-1.27)	0.98 (0.80-1.19)
Injection drug use	65/322 (19.6)	1.76 (1.26-2.34)*	1.23 (0.90-1.81)

Abbreviations: PR=prevalence ratio; CI=confidence interval; AIDS=acquired immunodeficiency syndrome,
All percentages are weighted to account for known probabilities of selection at state or territory, facility, and patient levels and adjust for non-response.
* P <0.05

5.3 Potential Biases and Limitations in the analysis of Emergency Department Utilization

The outcome in this study is the combination of two questions. The first question is on emergency department utilization. The second question is on use of urgent care facilities. The risk factors that lead a patient to seek care at an ED may differ from those that lead a patient to seek care at an urgent care. This dissertation assumes that the reasons for seeking care remain constant across all healthcare outcomes.

Our outcome, self-reported ED utilization is subject to misclassification. Patients may not accurately classify whether their visit to the ED was for HIV reasons or reasons unrelated to HIV. Non-differential misclassification of the outcome would cause there to be a less significant association between the HIV-related exposures, such as CD4 count, and the outcome. The bias would result in visits unrelated to HIV being reported as related to HIV. If a visit was unrelated to HIV then there is no reason to expect that CD4 or viral load, for example, would cause these types of visits. Differential misclassification of the outcome with respect to CD4 count or other illness related variables might also occur. For example, patients whose CD4 counts are above 500 may still attribute ED visits to their HIV infection. If participants attributed their ED visits to HIV-infection when their CD4 counts were above 500 then it would lead to a less significant association between CD4 count and ED utilization being observed than is true. It is not possible to predict the direction of bias when there is differential misclassification. For most exposure variables, there is no plausible explanation for differential reporting of the outcome. However, for those participants with injection drug use behaviors, or alcohol abuse, these states may cause them to differentially remember the reasons for ED utilization. Patients with injection drug use behaviors might be more likely to report that ED visits were due to HIV-reasons. Differential reporting might occur because the patients have been counseled that they contracted HIV via injection drug use. Enrollment in a clinical trial may influence the number of ED visits. The MMP contains data on clinical trial enrollment, but this data is not assessed over the same time as ED visits.

Another possible concern is that we are dealing with visits solely for HIV related care. Shih et al. looked at discharge diagnosis data in the United States for HIV-infected and HIV uninfected populations. Shih et al. determined that HIV related ED visits were far more likely than general population visits to result in admission to hospital, use of radiographic and diagnostic tests, and medications. [191] Hopefully, patients have classified their visits correctly. If the visits reported to the MMP are those related to HIV then this study examines the most important subset of visits. HIV related visits are the most important subset because it uses the most resources and generates the most cost

The issue of selection bias in the study sample is an important one to consider. Selection into the study is a result of receiving primary HIV care. Primary care visits are related to ED utilization. However, this does not cause a structural selection bias as defined by Hernan. [214] Structural selection bias occurs only when both the exposure and the outcome cause selection into the study. In our case visiting the ED does not influence inclusion in the MMP.

There is also an open question about the importance of being in care and its effects on emergency department utilization. Two studies looked at this question including one using a prospective design and found that emergency department visits were not decreased through linkage to a primary care provider.[215,216] This could have been because all of the patients in the study were initially recruited in the emergency department creating a selection bias. Our low prevalence estimate could be the truth that patients in care really do have lower emergency department utilization, or the timing of entry into care does make a difference.

Chapter 6: Assessing the Gelberg-Andersen-Aday Model of Healthcare Utilization: A Comparison of Logistic Regression and Structural Equation Modeling

61 Specific Aims of the Structural Equation Modeling Analysis

6.1.1 Aim 1

Construct a structural equation model that matches the Gelberg-Andersen-Aday model of healthcare utilization

6.1.2 Aim 2

Compare the sensitivity, specificity, and goodness of fit of the logistic regression and structural equation models with respect to determining the outcome.

6.2 Final Structural Equation Model Paper

Structural equation modeling compared to logistic regression for modeling healthcare utilization: an assessment of the Gelberg-Andersen-Aday theory

Joshua S. Josephs MHS[1,2], Patrick Sullivan DVM PhD[2], Brent A. Johnson PhD[2], Kelly A. Gebo MD MPH[3], Carlos del Rio MD[1,2], Jacek Skarbinski MD[4]

1 Emory University School of Medicine
2 Emory University Rollins School of Public Health and Laney Graduate School
3 Johns Hopkins University School of Medicine
4 Division of HIV/AIDS Prevention, Centers for Disease Control and Prevention

Funding Information - Funding for the Medical Monitoring Project is provided by a cooperative agreement (PS09-937) from the Centers for Disease Control and Prevention

Disclosure statement - The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention (CDC).

Contributions: JSJ conceived the research question, designed the study, performed the analysis and wrote the paper. JS provided the data, designed the study and wrote the paper, KG, BJ, PS, and CR designed the study, and wrote the paper.

Word Count: Abstract 284; Paper 3035
Tables and Figures: 7

Corresponding Author:
Joshua Josephs
1518 Clifton Way
Room 400

Abstract
Background: The Gelberg-Andersen-Aday model (GAAM) is frequently cited as a tool for understanding the relationship of socio-demographic and clinical variables with healthcare utilization. The GAAM hypothesizes that the demographic and clinical variables associated with healthcare utilization cluster into three "latent" unmeasured factors: predisposing, enabling, and need. However, this hypothesized clustering has not been formally tested.

Methods: We used data from the Medical Monitoring Project, a national probability sample of HIV-infected adults receiving medical care in January-April 2009 to assess the GAAM. We used structural equation modeling (SEM) to determine if measured variables were associated with the latent factors, whether the latent factors were associated with two healthcare utilization outcomes (emergency department use and hospitalization), and compared the sensitivity and specificity for detecting the outcomes using SEM versus logistic regression.

Results: The association of measured variables with their respective latent factors followed the hypotheses of the GAAM with the exception of smoking, having ever been diagnosed with AIDS, and the number of CD4+ T-lymphocyte cell count and viral load tests in the prior year. Only the need latent factor was associated with emergency department use and hospitalization. In logistic regression predisposing, enabling, and need variables were associated with outcome. Structural equation modeling provided a statistically significant, but small (6.8 percent) improvement in area under the curve for prediction of emergency department use, but no statistically significant difference for prediction of hospitalization.

Conclusions: The measured variables were generally associated with the latent variables as suggested by the GAAM, with some exceptions noted above. Compared to the logistic regression, where individual predisposing or enabling variables such as race and homelessness were associated with utilization, only the need latent factor was associated with either outcome. Although the SEM showed that the GAAM fits the data, using the SEM did not substantially improve outcome classification.

Introduction

Structural equation modeling (SEM) is a powerful statistical tool that can help solve a number of epidemiologic problems, including unmeasured confounding, selection bias, and measurement error, but it has not been adopted widely in the field of epidemiology and healthcare utilization.[45] SEM also serves as a tool to measure latent factors, which are variables that can only be measured indirectly. An example of a latent factor is depression, which is measured by asking patients questions about sleep, appetite, and activities that they previously enjoyed. We use SEM to test the Gelberg-Andersen-Aday model (GAAM), one of the most widely used theories of healthcare utilization; the GAAM uses latent factors to understand causes of healthcare utilization. [39,42]

The GAAM is an evolution of a model first proposed by Andersen in 1968.[39,42,217] The GAAM posits that measured predictors of healthcare utilization group into three latent factors: predisposing (for example, sex), enabling (for example, having health insurance), and need (for example, viral load). The predisposing factor includes sociodemographic variables that are associated with being more or less likely to seek healthcare, but are not reasons in and of themselves to seek care. Enabling variables include insurance and homelessness, which may help or deter care seeking. Need variables are those that directly measure the severity of illness and thus dictate the level of need for medical care. An example of the relationship between a measured variable and a latent factor is CD4+ T-lymphocyte cell (CD4) count, which associates with the need latent factor. Authors of clinical papers on healthcare utilization often cite the GAAM, but do not make an attempt to test the relationship of the measured variables to the hypothesized latent factors, nor do they test the relationship of the latent factors to the outcome.[44,137] SEM provides a tool to assess these previously unexplored relationships as well as to examine whether additional latent factors exist.

In order to assess the GAAM we used data from a sample of patients in care for HIV infection during January- April 2009. Our outcomes were the 1-year prevalence of emergency department (ED) use and hospitalization. Our objective was three-fold. First, we sought to examine the relationship of the measured variables to the latent factors. Second, we analyzed the association between the latent factors and the outcomes. Finally, we sought to demonstrate that SEM would provide better sensitivity and specificity for predicting the outcomes than logistic regression.

Methods

Study design:

We used data from the 2009 Medical Monitoring Project (MMP), an HIV surveillance system designed to produce nationally representative estimates of behavioral and clinical characteristics of HIV-infected adults in the United States. The study design and sampling approach have been previously described. [19,193,194] In 2009, MMP consisted of a population-based survey of patients living with HIV in the United States who are engaged in care. Sampling took place at the state or territory, facility, and patient levels.

Human subjects protection:

MMP was determined to be a non-research, public health surveillance activity used for disease control and policy purposes in accordance with the CDC's Guidelines for Defining Public Health Research and Public Health Non-Research and was approved by

CDC.[196,197] Participating states or territories and facilities obtained local Institutional Review Board (IRB) approval to conduct MMP as required locally.

Outcomes measures:

Participants were asked about emergency department (ED) use, ("During the past 12 months, how many times did you go to an emergency room or urgent care center for HIV medical care?") and hospitalization ("During the past 12 months, how many times were you admitted to a hospital because of an HIV-related illness? (Please don't include visits that were made only to the emergency room.)"). For both ED use and hospitalization, we classified patients into those who made no visits or had no admissions and those who had one or more visits or admissions.

Relationships between the measured variables and the latent factors:

All measured variables were classified into respective latent factors based on literature review.[8,44,67,71,91,218,219] The predisposing latent factor included the following measured variables: sexual transmission risk category (men who have sex with men, men who have sex with women only, women who have sex with men, other), age in years, race, education, heavy or binge alcohol use, cigarette smoking, and drug use for non-medical purposes. Race/ethnicity was categorized into mutually exclusive categories of non-Hispanic white, non-Hispanic black or African American, Hispanic or Latino, and other. Heavy or binge alcohol use was classified based on the National Institute on Alcohol Abuse and Alcoholism (NIAAA) criteria.[199] These criteria define heavy drinking as fourteen or more drinks in a week for men, or more than seven drinks in a week for women. Binge drinking is defined as more than five drinks in a sitting for men, and four drinks in a sitting for women. Drug use for non-medical purposes was classified into mutually exclusive categories of injection drug use, marijuana use only, drug use other than marijuana and injection drugs, and no drug use.

The enabling factor included the following measured variables: health insurance, poverty, incarceration, and homelessness. Health insurance was classified as having had any health insurance in the past twelve months. Poverty was assessed using the Department of Health and Human Services guidelines based on household size and income.[198] Homelessness was based on self-report of living on the street, in a shelter, in a single room occupancy hotel, or in a car. Incarceration included having been put in jail, detention, or prison for longer than twenty-four hours.

The need latent factor included: geometric mean CD4 count in the past year, durable viral suppression, having ever been diagnosed with AIDS, the number of CD4 count and viral load tests in the past year, being depressed, and having at least one or more unmet needs for services. Durable viral suppression was defined as having all viral load test results in the prior year be undetectable or less than 200 copies/mL. Depression was assessed using the Patient Health Questionaire-8 (PHQ) instrument.[220]

Data analysis:

Data analysis was conducted using Stata 12 (Stata Corp, College Station, TX) and MPLUS 6.1 (MPLUS, Los Angeles, CA) using procedures that accounted for the complex sample survey design. The first step in our analysis was to conduct multivariate logistic regression between our measured variables and the outcome. The multivariate logistic regression used all of the predictor variables based on a directed acyclic graphic that suggested confounding between the variables. The second step was to calculate the SEM based on the GAAM so that we could obtain both the associations between the measured variables and the outcome and the association between the measured and latent variables. SEM results are presented both in unstandardized format in the tables, and in standardized format in the figures with standardization by the standard distribution of both the variable and the outcome. The third step was to compare the logistic regression and SEM in two ways. First, we modeled the predicted probability of each outcome for each individual in the dataset using the two methods. Those participants whose predicted probability of the outcome was greater than half were classified as having experienced the outcome, while those whose predicted probability was less than half were classified as not having experienced the outcome. Comparing the true outcomes to the predicted outcomes allowed us to construct sensitivity and specificity values for each model and outcome. We chose to use the 50 percent cut off to allow us to compare our results to those of Kupek, who conducted a similar analysis using simulated data and an obstetrics outcome. In addition to using the 50 percent cut off method, we calculated areas under the receiver-operator curve (ROC), or equivalently, C-statistics, for each method and outcome. Finally, the areas under the curve were compared using the ROCCOMP command in Stata to assess whether they were statistically different. [221]

Results

Most patients were aged >40 years (75.5%) and were non-Hispanic black, or Hispanic or Latino (76%). Table 1 contains the row and column percentages for users of the ED and the hospital. For all HIV-infected persons in care, 10.8 percent made an ED visit; the average number of ED visits was 0.29, the median number of visits was 0, and the range was 0-40 visits. Among our sample, 7.4 percent were admitted to the hospital at least once; the average number of visits was 0.14, the median number of visits was 0, and the range was 0-15 visits. In multivariate models, increased odds of ED use were associated with other sexual transmission category versus men who have sex with men, non-Hispanic black race, homelessness, failure to achieve durable viral suppression, and depression. Decreased odds of ED use were associated with the men who have sex with women only sexual transmission category and higher geometric mean CD4 count (Table 2).

Structural equation modeling results for ED use are presented in Table 2 and Figure 1. Table 2 describes the associations between the measured variables and the latent factors as raw coefficients, Figure 1 describes the association between measured variables and latent factors as standardized coefficients. All measured variables were significantly associated with their respective latent factors except smoking (coefficient 0.073; 95% confidence interval (CI) -0.152,0.161) and lifetime AIDS diagnosis (coefficient 0.099; CI -0.134,0.332). In the SEM model, only the need latent factor was significantly associated with increased ED use (odds ratio 3.643; CI 1.677,7.918).

Logistic regression results indicated that the following factors were associated with increased odds of hospitalization: being in the other sexual transmission category compared to men who have sex with men, homelessness, depression, having ever been diagnosed with AIDS, and failure to achieve durable viral suppression. Every 100-unit increase in CD4 count was associated with decreased odds of hospitalization.

Structural equation modeling results for the hospitalization outcome are presented in Table 3 and Figure 2. Table 3 describes the associations between the measured variables and the latent factors as raw coefficients, Figure 2 describes the association between measured variables and latent factors as standardized coefficients. All measured variables assigned to the predisposing factor were significantly associated with the latent factor except smoking (coefficient 0.074; CI -0.016,0.164). All enabling measured variables were significantly associated with the expected enabling factor. Among the measured variables assigned to the need factor all were significantly associated except ever having been diagnosed with AIDS (coefficient 0.161; CI -0.139,0.461) and the number of CD4 and viral load tests in the prior year (coefficient -0.347; CI -0.712,0.017). In the SEM model, only the need latent factor was significantly associated with increased ED use (Odds ratio 4.350; CI 1.521,12.436).

The sensitivity of the logistic regression for ED use using the 50 percent cut-off was 0.5%, the specificity 99.9%. The SEM sensitivity and specificity using the 50 percent cut-off were 82.6% and 35.4% respectively. Figure 3 show the plot of the sensitivity vs. 1-specificity. The area under the curve was 0.695 (CI 0.669-0.721) for the logistic regression model and 0.764 (CI 0.742-0.785) for the structural equation model. The sensitivity of the logistic regression for hospitalization was 1%, the specificity 99.8% percent. The SEM sensitivity and specificity were 84.8% and 48.9% respectively. Figures 4 shows the plot of the sensitivity vs. 1-specificity. The area under the curve was 0.748 (CI 0.717-0.776) for the logistic regression model and 0.770 (CI 0.743-0.797) for the structural equation model.

Discussion

For the structural equation models, only the need latent variable was associated with ED use and hospitalization. Risk factors, using logistic regression, for ED use and hospitalization included socio-demographic factors and clinical factors associated with control of HIV infection as well as depression. Comparisons between the two modeling techniques using the 50% cutoff found greater sensitivity for the SEM and greater specificity for the logistic regression. Areas under the curve were greater for the SEM for both modeling techniques, but only of statistical significance for the ED outcome, and in neither case was the difference substantial.

We found that the relationship between the measured variables and the latent factors generally supported the GAAM with the exception of smoking, lifetime AIDS diagnosis, and number of CD4 count and viral load tests. There are at least three general reasons why smoking, lifetime AIDS diagnosis, and number of CD4 count and viral load tests were not associated with the latent factors as described by the GAAM. First, the measured variable could truly not be associated with the respective latent factor at all, or it could be associated with a latent factor not in the model. Second, the measured variable could be associated with a different latent factor in the model. Finally, it could be that other measured variables in the latent factor are more important and overwhelm the association, or that other configurations of measured variables with respective latent factors might be possible. Because smoking can have an independent effect on mortality in this population we hypothesize that smoking should be associated with the need latent factor, an association that can be tested by future researchers. The lack of association between lifetime AIDS diagnosis and the need latent factor may be due to our inclusion of current CD4 count and durable viral suppression in the model, which might have offset the effect of lifetime AIDS diagnosis. The use of current immune markers in the SEM may also explain the lack of association between the number of CD4 count and viral loads tests and the need latent factor.

Following our assessment of the relationships of the measured variables to the latent factors, we turned our attention to the association of the latent factors with the outcome. Using SEM, only the need latent factor was associated with the ED use and hospitalization outcomes. In the logistic regression models, most measured variables associated with the outcomes were related to clinical need. The effect estimates from the logistic regression model for CD4 count, durable viral suppression, and depression were stronger than the findings for the socio-demographic variables. Although the logistic regression found associations between socio-demographic variables such as sexual behavior and race with ED use and hospitalization, we did not find an association between the predisposing latent factor and the outcome in our SEM. The lack of an association may have been due to misclassification of the predisposing latent factor by including smoking, drug use, and alcohol use. Homelessness was strongly associated with both outcomes in logistic regression, but the enabling latent factor was not associated with either outcome in SEM. It is possible that combining homelessness with other enabling variables is incorrect, and that homelessness operates through an alternative path.

In addition to the differences with respect to the variables related to the outcome, the models had vastly differing sensitivity and specificity for detecting ED use and hospitalizations. For both outcomes, the specificity of the logistic regression was greater than the SEM, while the sensitivity was greater for the SEM. Our choice of the 50% cut off was based on theoretical work on this topic that uses this cut-off as a starting point for model comparison.[222] The differing sensitivity and specificity values result from the predicted probability of the outcome produced by each model. The logistic regression almost never produces a predicted probability greater than fifty percent, while the SEM frequently produced predicted probabilities this high. Other cutpoints can be tested to determine if they make substantial differences in sensitivity or specificity.

Our test of the GAAM demonstrated that with exception of smoking, having ever been diagnosed with AIDS, and the number of CD4 count and viral load tests in a year, the measured variables were assigned to the latent factors as predicted by the theory. Future researchers can test whether alternative arrangements of the measured variables or alternative measured variables not studied here provide a better fit to the data. We are somewhat surprised that the predisposing and enabling latent factors were not associated with ED use and hospitalization, given that many of the individual factors were associated with ED and hospitalization in the logistic regression. It is possible that the predisposing and enabling factors do not give sufficient weight to the variables associated with the outcome in the logistic regression. While it is unknown whether the GAAM applies to other diseases, it seems from our work that other researchers can rely on the GAAM to help provide theoretical guidance about variable measurement and control of confounding.

Unlike the sensitivity and specificity values, the area under the curve metrics did not display substantial differences between the modeling techniques. Modeling of the ED outcome revealed that the area under the curve was significantly higher for the SEM than for logistic regression as evidenced by the lack of overlap between the confidence intervals, but the absolute difference was not substantial, representing just a six percent increase in performance. The SEM provided a higher area under the curve than the logistic regression model in hospitalization, but the absolute difference was small and likely practically unimportant. The reasons that the areas under the curve were similar even though the two modeling strategies have differing sensitivity and specificity values is that the area under the curve is calculated using all possible cut off values. Thus, for predicted probability cutoffs less than fifty percent the logistic regression provides better specificity than the SEM, while for predicted probability cutoffs greater than fifty percent the SEM provides better sensitivity than the logistic regression. Because the performance of the logistic regression and SEM are nearly opposite, when totaled they achieve very similar performance.

Our study is not without limitations. The coefficients relating the measured variables to the latent factors do not have simple interpretations. Due to the large number of categorical variables in our model, MPLUS did not report many of the standard goodness of fit tests. There is no single reason to choose between SEM and logistic regression, and the choice of modeling technique will depend on the investigator. We designed our GAAM according to Stein's conception, but there is no single standard arrangement of measured variables to latent factors to test as the gold-standard GAAM. Other investigators could design alternative Gelberg-based models to test using SEM. The relationship between the latent factors and public health action is unclear because the latent factor is a combination of many measured variables.

In conclusion, we found that the measured variables generally fit the GAAM with a few exceptions. We only found an association between the need latent factor and our outcomes, in contrast to logistic regression, where both socio-demographic and clinical variables were associated with the outcome. Using receiver-operating curves the SEM slightly outperformed logistic regression in predicting hospitalization and ED use, but at a fifty percent cutoff the two modeling strategies produced widely differing sensitivity and specificity values.

Table 6.1 Characteristics of HIV-infected adults receiving medical care in the United States by self-reported emergency department (ED) use and hospitalization, Medical Monitoring Project, 2009

Variable name	% of all participants in each group	Column % % in each group among those who visited the ED	Column % in each group among those who did not visit the ED	Column % % in each group among those who visited the hospital	Column % in each group among those who did not visit the hospital
Age in years					
18-29	315 (7.4)	35 (7.6)	280 (7.4)	20 (5.9)	295 (7.5)
29-39	721 (17.2)	94 (20.6)	627 (16.7)	64 (21.2)	656 (16.8)
40-49	1642 (39.3)	197(40.7)	1445 (39.1)	132 (40.1)	1510 (39.1)
≥50	1528 (36.2)	141 (31.1)	1387 (36.8)	93 (32.0)	1435 (36.5)
Sexual transmission category					
Men who have sex with men	1944 (46.7)	190 (39.7)	1754 (47.5)	123 (38.9)	1822 (47.2)
Men who have sex with women only	1027 (23.6)	110 (21.6)	917 (23.8)	77 (24.0)	948 (23.5)
Women who have sex with women or men	1108 (26.4)	144 (32.2)	964 (26.7)	93 (30.1)	1015 (26.1)
Other	127 (3.3)	23 (6.4)	104 (3.0)	16 (7.1)	111 (3.1)
Race					
Non Hispanic white	1395 (34.6)	127 (26.9)	1268 (35.6)	89 (29.5)	1305 (35.1)
Non Hispanic black or African American	1738 (41.4)	224 (47.8)	1514 (40.7)	139 (42.3)	1599 (41.4)
Hispanic or Latino	872 (19.2)	90 (19.6)	782 (19.0)	69 (23.9)	804 (18.7)
Other	199 (4.8)	26 (5.7)	173 (4.7)	12 (3.7)	186 (5.0)
Education					
< High school	979 (22.6)	149 (31.8)	830 (21.4)	106 (33.6)	875 (21.7)
High school diploma or equivalent	1159 (26.8)	126 (25.0)	1033 (27.1)	82 (24.5)	1073 (27.0)
> High school	2067 (50.6)	192 (43.3)	1875 (51.5)	121 (41.9)	1947 (51.4)
Poverty					
Below the federal poverty line	1860 (43.8)	264 (57.8)	1596 (42.1)	176 (41.4)	1684 (57.4)
Above the federal poverty line	2213 (56.2)	189 (42.2)	2024 (57.4)	122 (58.6)	2091 (42.6)

Table 6.1 continued. Characteristics of HIV-infected adults receiving medical care in the United States by self-reported emergency department (ED) use and hospitalization, Medical Monitoring Project, 2009

Insured					
No	603 (14.6)	57 (12.6)	546 (14.7)	32 (11.7)	571 (14.8)
Yes	3595 (85.4)	410 (87.4)	3185 (85.2)	277 (88.3)	3318 (85.2)
Homelessness					
No	3818 (91.0)	390 (82.9)	3428 (92.0)	249 (79.9)	3568 (91.9)
Yes	388 (9.0)	77 (17.1)	311 (8.0)	60 (20.1)	328 (8.1)
Incarcerated					
No	3968 (94.4)	423 (90.2)	3545 (94.9)	277 (88.6)	3690 (94.8)
Yes	235 (5.6)	44 (9.8)	191 (5.1)	32 (11.4)	203 (5.2)
Number of unmet needs					
0	2178 (52.5)	198 (42.2)	1980 (53.8)	128 (43.4)	2050 (53.3)
1	984 (24.4)	106 (23.4)	878 (24.4)	70 (23.7)	912 (24.3)
2 or more	934 (23.2)	151 (34.4)	783 (21.8)	101 (32.9)	833 (22.4)
Prescribed ART[12]					
No	459 (10.9)	50 (10.9)	409 (10.9)	20 (6.6)	440 (11.2)
Yes	3729 (89.1)	413 (89.1)	3316 (89.1)	287 (93.3)	3440 (88.8)
Geometric mean CD4+ T-lymphocyte cell count					
<50	113 (2.6)	40 (8.3)	73 (1.9)	34 (11.1)	79 (1.9)
50-199	425 (9.5)	85 (18.7)	340 (8.8)	84 (27.7)	340 (8.3)
200-349	738 (17.8)	75 (16.4)	663 (18.7)	60 (18.1)	679 (18.5)
350-499	1004 (23.8)	108 (25.7)	896 (24.6)	53 (21.1)	952 (25.1)
500 or more	1765 (46.5)	135 (30.9)	1630 (46.0)	66 (21.9)	1697 (46.1)
Lifetime AIDS status					
No lifetime AIDS diagnosis	1307 (32.4)	109 (23.8)	1198 (33.4)	42 (13.7)	1264 (33.9)
Any lifetime AIDS diagnosis	2888 (67.6)	356(76.2)	2532 (66.6)	266 (86.3)	2622 (66.1)

[12] ART: antiretroviral therapy

Table 6.1 continued. Characteristics of HIV-infected adults receiving medical care in the United States by self-reported emergency department (ED) use and hospitalization, Medical Monitoring Project, 2009

Durable viral suppression					
No	1777 (42.3)	266 (56.8)	1511 (40.6)	197 (36.6)	1580 (59.4)
Yes	2429 (57.7)	201 (43.2)	2228 (59.4)	112 (63.4)	2316 (40.6)
# of CD4 count and viral load tests					
<3	1255 (30.0)	152 (32.5)	1103 (30.1)	93 (29.4)	1161 (30.5)
3 or more	2931 (70.0)	311 (67.5)	2620 (69.8)	214 (70.7)	2717 (69.6)
Depression					
Not depressed	3183 (76.3)	291 (60.7)	2892 (78.2)	117 (58.5)	2992 (77.7)
Depressed	977 (23.7)	171 (39.3)	806 (21.8)	189 (41.5)	861 (22.3)
Smoking					
Current	1775 (42.4)	228 (48.3)	1396 (41.7)	158 (30.8)	1453 (37.7)
Former	868 (20.4)	81 (17.3)	787 (20.8)	52 (17.7)	816 (20.6)
Never	1552 (37.3)	156 (34.4)	1547 (37.6)	98 (51.6)	1617 (41.7)
Alcohol use					
None	1467 (33.8)	175 (37.6)	1292 (33.3)	111 (36.6)	1355 (33.6)
Moderate	2228 (54.5)	227(49.3)	2001 (55.0)	155 (49.4)	2074 (54.9)
Heavy/binge	502 (11.8)	63 (13.1)	439 (11.6)	43 (14.1)	458 (11.6)
Drug use for non-medical purposes					
None	3030 (72.4)	307 (67.3)	2723 (72.9)	202 (66.6)	2826 (72.3)
Marijuana only	505 (12.3)	63 (13.1)	442 (12.2)	41 (13.9)	464 (12.2)
Other non-injection drugs	553 (13.2)	74 (16.1)	479 (12.9)	48 (16.7)	505 (13.0)
Injection drug use	100 (2.1)	19 (3.4)	81 (2.0)	14 (3.3)	86 (2.0)

Table 6.2. Coefficients for the association between the measured variables and latent factors, odds ratios for the association between the latent factors and emergency department (ED) use, and odds ratios for the association between the measured variables and ED use

Variable name	Latent factor name	Coefficient for the association of the measured variable with the latent factor Beta, (95% confidence interval)	Odds ratio for the latent factor and ED use	Logistic regression multivariate odds ratios and 95% confidence intervals ED use aOR[13] (95% CI)
<u>Age in years</u>				
18-29				1.12 (0.75-1.65)
29-39	Predisposing	-0.081(-.148,-0.014)*	1.156 (0.885, 1.500)	1.18 (0.81-1.73)
40-49				1.19 (0.93-1.53)
≥50				Reference
<u>Sexual transmission category</u>				
Men who have sex with men				Reference
Men who have sex with women only	Predisposing	1.00 (Fixed)		0.72 (0.53-0.99)*
Women who have sex with men				1.14 (0.88-1.48)
Other				1.94 (1.14-3.29)*
<u>Race</u>				
Non Hispanic white				Reference
Non Hispanic black or African American	Predisposing	-0.693 (-0.954,-0.432)*		1.36 (1.03-1.79)*
Hispanic or Latino		0.498 (0.218,0.778)*		1.07 (0.73-1.56)
Other		0.286 (-0.031,0.604)		1.33 (0.84-2.09)

[13] aOR=adjusted odds ratio, *=statistically significant at the p=0.05 level

Table 6.2. Coefficients for the association between the measured variables and latent factors, odds ratios for the association between the latent factors and emergency department (ED) use, and odds ratios for the association between the measured variables and ED use

Education < High school High school diploma or equivalent > High school	Predisposing	-0.998 (-1.221,-0.775)*		1.13 (0.87-1.47) 0.98 (0.74-1.30) Reference
Smoking Current Former Never	Predisposing	0.073 (-0.152,0.161)		1.02 (0.77-1.36) 1.11 (0.76-1.63) Reference
Alcohol use None Moderate Heavy/binge	Predisposing	-0.305 (-0.370,-0.240)*		Reference 0.75 (0.55-1.02) 0.75 (0.54-1.04)
Drug use for non-medical purposes None Marijuana only Other non-injection drugs Injection drug use	Predisposing	0.213 (0.121-0.305)*		Reference 1.25 (0.86-1.81) 1.24 (0.88-1.75) 1.34 (0.64-2.82)
Poverty Below the federal poverty line Above the federal poverty line	Enabling	1.00 (Fixed)	0.995 (0.812,1.244)	1.28 (0.98-1.66) Reference
Insured No Yes	Enabling	-0.125 (-0.213,-0.037)*		Reference 1.37 (0.94-1.97)
Homelessness No Yes	Enabling	0.472 (0.250,0.693)*		Reference 1.60 (1.09-2.34)*

Table 6.2. Coefficients for the association between the measured variables and latent factors, odds ratios for the association between the latent factors and emergency department (ED) use, and odds ratios for the association between the measured variables and ED use

Incarcerated No Yes	Enabling	0.514 (0.293,0.735)*		Reference 1.12 (0.74-1.68)
Number of unmet needs 0 1 2 or more	Need	2.387 (1.632,3.142)*	3.643 (1.677,7.918)	Reference 1.04 (0.74-1.44) 1.32 (0.96-1.82)
Geometric mean CD4+ T-lymphocyte cell count per 100 unit change	Need	1.00 (Fixed)		0.87 (0.83-0.95)
Lifetime AIDS status Any lifetime AIDS diagnosis No lifetime AIDS diagnosis	Need	0.099(-0.134,0.332)		1.09 (0.76-1.58) Reference
Durable viral suppression No Yes	Need	1.134 (0.826,1.441)*		1.29 (1.00-1.65) Reference
# of CD4 count and viral load tests <3 3 or more	Need	-0.320 (-0.030,0.671)		Reference 1.04 (0.83-1.30)
Depression Not depressed Depressed	Need	2.237 (1.629,2.844)*		Reference 1.78 (1.34-2.37)*

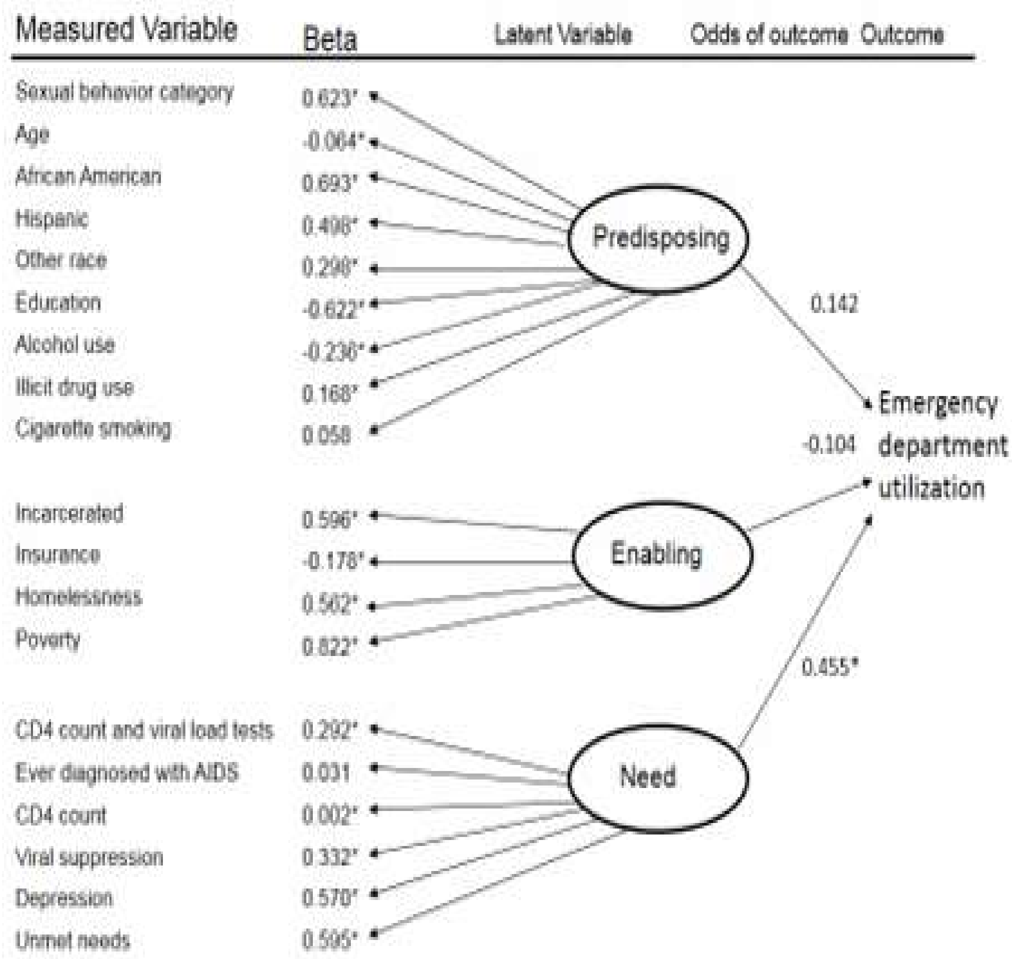
Table 6.3. Coefficients for the association between the measured variables and latent factors, odds ratios for the association between the latent factors and hospitalization, and odds ratios for the association between the measured variables and hospitalization

Variable name	Latent factor name	Coefficient for the association of the measured variable with the latent factor Beta, (95% confidence interval)	Odds ratio for the latent factor and hospitalization	Logistic regression multivariate odds ratios and 95% confidence intervals hospitalization
Age in years 18-29 29-39 40-49 ≥50	Predisposing	-0.080 (-0.147,-0.013)*	1.037 (0.752,1.431)	 0.73 (0.43-1.22) 1.26 (0.84-1.89) 1.16 (0.84-1.60) Reference
Sexual transmission category Men who have sex with men Men who have sex with women only Women who have sex with men Other	Predisposing	1.00 (Fixed)		 Reference 0.81 (0.49-1.35) 1.21 (0.84-1.74) 2.11 (1.04-4.28)*
Race Non-Hispanic white Non-Hispanic black or African American Hispanic or Latino Other	Predisposing	 -0.687(-0.948, -0.426)* 0.501 (0.221,0.781)* 0.292 (-0.027,0.611)		 Reference 0.91 (0.62-1.38) 1.08 (0.63-1.83) 0.56 (0.24-1.28)
Education < High school High school diploma or equivalent > High school	Predisposing	-1.003 (-1.236,-0.770)*		 1.16 (0.78-1.72) 0.90 (0.68-1.19) Reference

Smoking Current Former Never	Predisposing	0.074 (-0.016,0.164)		1.28 (0.99-1.65) 1.24 (0.81-1.88) Reference
Alcohol use None Moderate Heavy/binge	Predisposing	-0.304 (-0.371,-0.237)*		Reference 0.81 (0.55-1.20) 0.84 (0.48-1.45)
Drug use for non-medical purposes None Marijuana only Other non-injection drugs Injection drug use	Predisposing	0.213 (0.121,0.305)*		Reference 1.31 (0.79-2.16) 1.07 (0.60-1.91) 0.98 (0.47-2.06)
Poverty Below the federal poverty line Above the federal poverty line	Enabling	1.00 (Fixed)	1.066 (0.840,1.350)	1.22 (0.90-1.64) Reference
Insured No Yes	Enabling	-0.126 (-0.216,-0.035)*		Reference 1.11 (0.76-1.65)
Homelessness No Yes	Enabling	0.481 (0.256,0.706)*		Reference 1.99 (1.20-3.27)*
Incarcerated No Yes	Enabling	0.524 (.0291,0.757)*		Reference 1.17 (0.76-1.80)
Number of unmet needs 0 1 2 or more	Need	2.704 (2.123,3.282)*	4.350 (1.521,12.436)	Reference 0.93 (0.66-1.30) 1.09 (0.78-1.52)
Geometric mean CD4+ T-lymphocyte cell count per 100				0.82 (0.74-

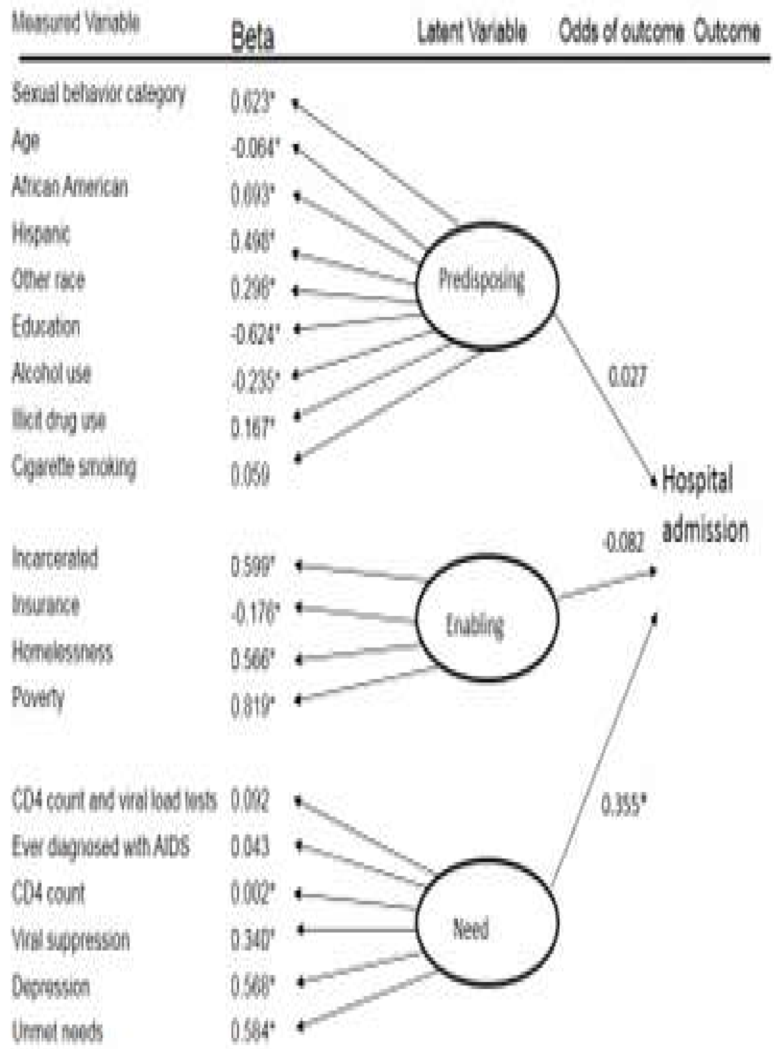
unit change	Need	1.0 (Fixed)		0.92)*
Lifetime AIDS status Any lifetime AIDS diagnosis No lifetime AIDS diagnosis	Need	0.161 (-0.139,0.461)		2.13 (1.25-3.63)* Reference
Durable viral suppression No Yes	Need	1.358 (0.991,1.724)*		1.69 (1.18-2.40)* Reference
# of CD4 count and viral load tests <3 3 or more	Need	-0.347 (-0.712,0.017)		Reference 1.14 (0.87-1.50)
Depression Not depressed Depressed	Need	2.588 (1.784,3.392)*		Reference 1.73 (1.12-2.68)*

Figure 1: Diagram of the structural equation model for emergency department use[14]



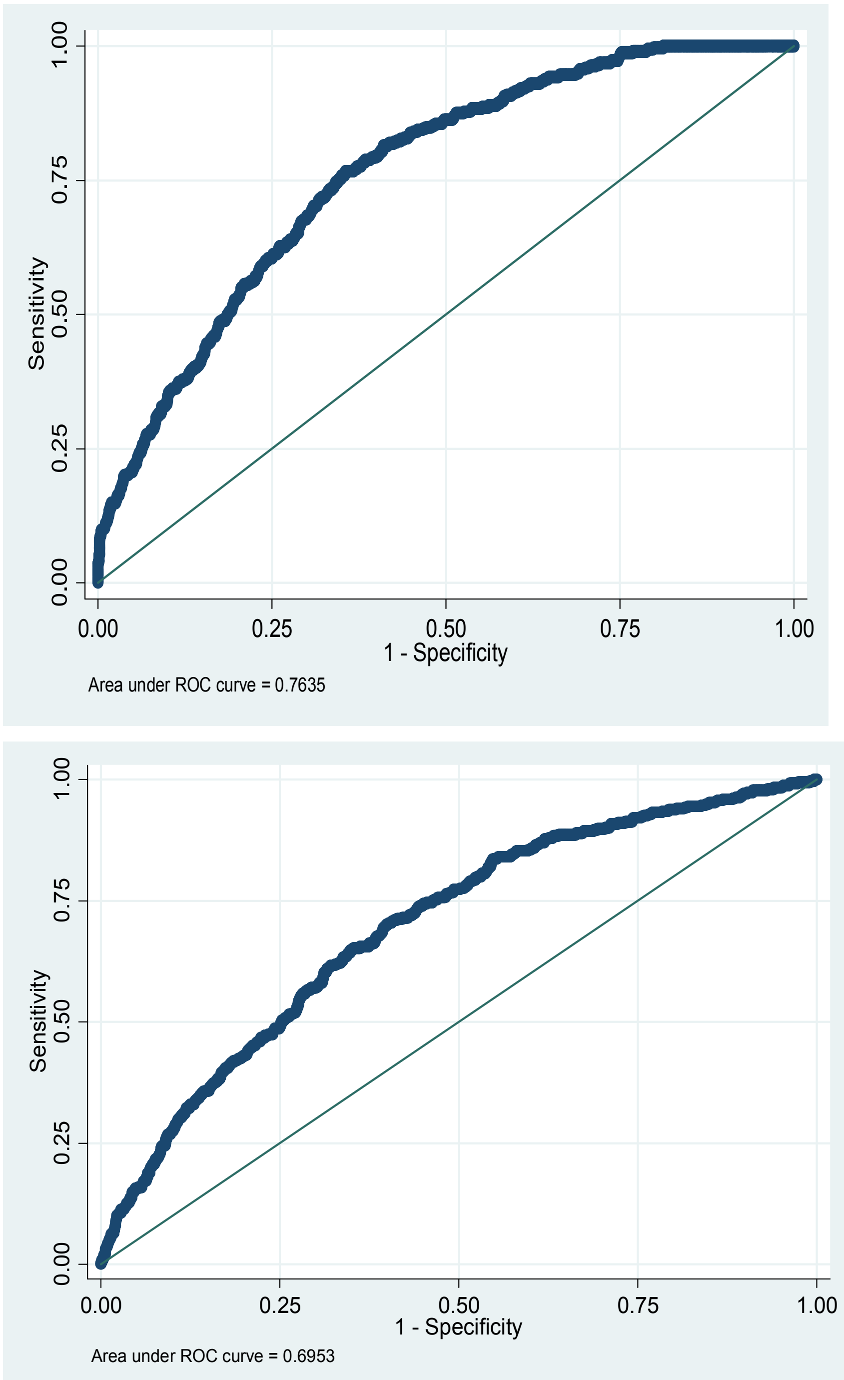
[14] Beta is the standardized coefficient measuring the association between the latent variable and measured variable. The standardization is based on the distribution of the variable and of the outcome. The latent variable are enclosed in circles. Asterisks indicate that the association is statistically significant at p=0.05 level.

Figure 2: Diagram of the structural equation model for hospital admissions[15]



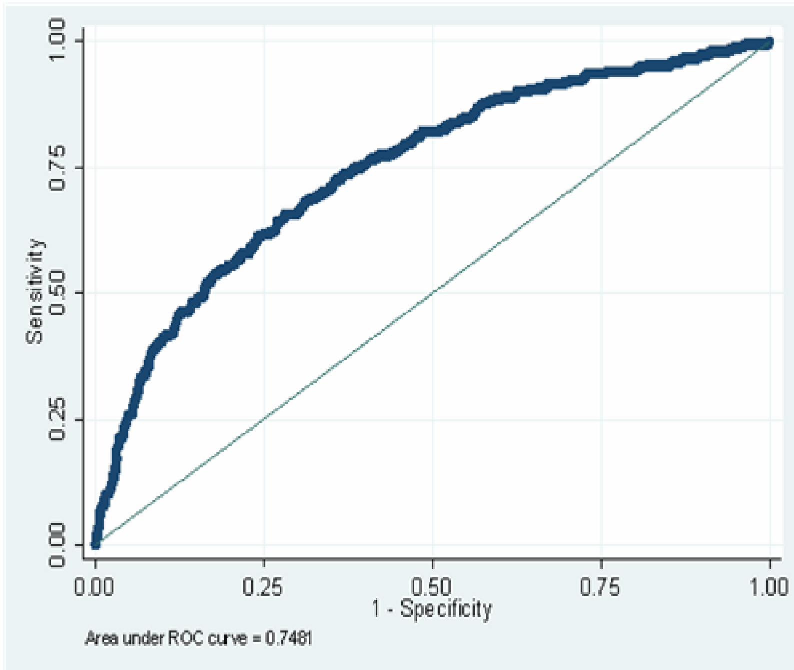
[15] Beta is the standardized coefficient measuring the association between the latent variable and measured variable. The standardization is based on the distribution of the variable and of the outcome. The latent variable are enclosed in circles. Asterisks indicate that the association is statistically significant at p=0.05 level.

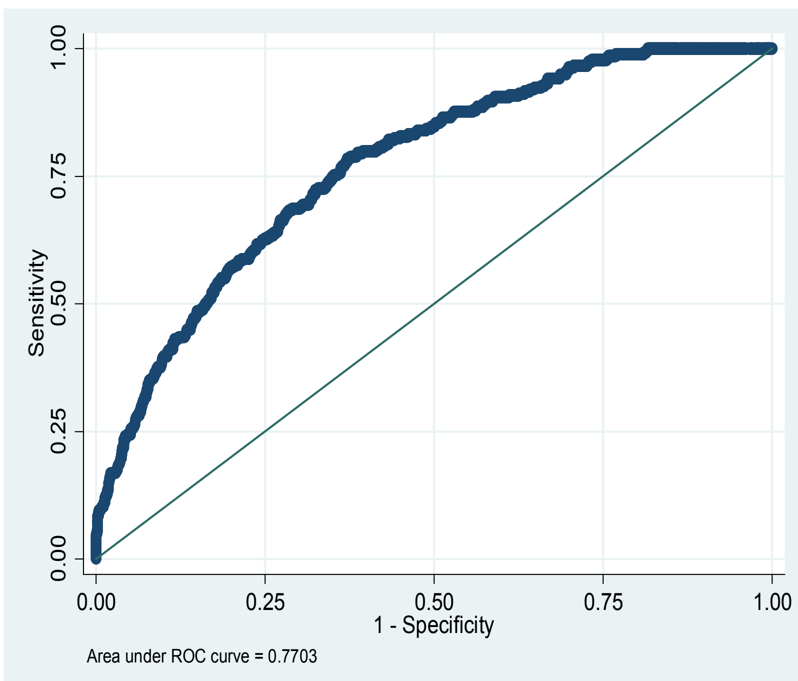
Figure 3: Plot of the receiver operating curves for the logistic regression model (left) and the structural equation model (right) of emergency department use[16]



[16] Both the logistic regression model and the SEM were derived by including all measured variables previously shown in the literature to be confounders of each other and the association of interest.

Figure 4: Plot of the receiver operating curves for the logistic regression model (left) and the structural equation model (right) of hospitalization[17]





[17] Both the logistic regression model and the SEM were derived by including all measured variables previously shown in the literature to be confounders of each other and the association of interest.

6.3 Biases and Limitations of the Structural Equation Model Paper

The biggest problem in creating the structural equation model paper is the large number of possible decision points when constructing the model. We chose to use a model that was designed around a simple conception of the Gelberg model; however, much more complicated designs are possible. In particular, we chose to restrict our model such that each measured variable could only contribute to one latent variable. More than likely some variables such as the use of alcohol or drug use for non-medical purposes likely contribute to more than one latent variable. Furthermore, it is possible that there are pathways that allow for direct and indirect effects that we chose not to analyze. For example, depression probably has a direct effect on healthcare utilization, but also influences viral suppression which itself has an effect on healthcare utilization. Finally, in terms of structuring the model we did not look at interaction. While this was an explicit decision on our part, it reflects the difficulty of drawing interaction into directed acyclic graphs. It is likely that synergistic effects exist among at least some of our variables, such as alcohol use and mental illness. The addition of effect modification may have improved the fit of the models.

A second issue was the method we used for determining the goodness of fit of the models. We chose to only use a 50 percent cutoff since this is the standard in the literature, but there are more advanced methods for choosing between respective models if the goal is to determine the best model for prediction research. Secondly, it was difficult to determine the exact importance of the difference between the two models. The SEM outperformed the logistic regression model for both outcomes by only a slight percentage, so the choice to use the SEM depends in part on how strongly the investigator believes in the Andersen-Aday theory, and how well conceptualized our version of the SEM is.

There are advantages to SEM that we chose not to take advantage of and should be subject to future research. Primarily, this is in the form of assessment of variable misclassification, and the ability to undertake extensive sensitivity analysis of confounding. It is quite likely that there are unmeasured confounders of the socio-demographic variables in our study that we did not measure in the MMP.

Structural equation modeling does not provide any guarantees of model accuracy, it only serves to help identify potential latent factors. Like other modeling techniques, if variables are added to an SEM the accuracy and predictive validity of the model will improve. The SEM literature groups bias and random error under the generic term error. All models in the dissertation assume that the error terms are uncorrelated. An example of correlated error terms occurs in settings of social desirability bias. For example, a participant under reports both alcohol and illicit drug use in order to please the investigator. In such a situation, the error terms are correlated.

Chapter 7: Measuring the Quality of Care for HIV-Infected Patients in Care

7.1 Specific Aims of the Quality of Care Analysis

7.1.1 Aim 1

Calculate five quality of care composite metrics using data from the HIVRN

7.1.2 Aim 2

Calculate the variance of the five quality metrics under the assumption of three different statistical distributions.

7.2 Final Quality of Care Paper

Composite measures for measuring quality of care in HIV-infected individuals

Joshua S. Josephs[1,2], Carlos Del Rio[1,2], Jacek Skarbinski[1], Brent Johnson[1] Kelly A. Gebo[4], Patrick Sullivan[1,]P. Todd Korthuis[3]
1: Department of Epidemiology, Rollins School of Public Health and Laney Graduate School, Emory University
2: Emory University School of Medicine MD/PhD Program
3: Department of Medicine, Division of General Internal Medicine, Oregon Health and Science University
4: Department of Medicine, Division of Infectious Disease, Johns Hopkins University School of Medicine
5: Clinical Outcomes Team, Division of HIV/AIDS Prevention, Centers for Disease Control

Sponsorship:
Supported by the Agency for Healthcare Research and Quality (HHSA290201100007C) and the Health Resources and Services Administration (HHSH250201200008C).
Disclaimer:
The views expressed in this paper are those of the authors. No official endorsement by DHHS, the National Institutes of Health, or the Agency for Healthcare Research and Quality is intended or should be inferred.

Abstract word count: 280
Word Count: 3291

Tables:6
Figures: 1

Corresponding author:
Joshua Josephs
Rm 467
Grace Crum Rollins Bldg
585-278-2053
jsjosep@emory.edu

Background: Improving the quality of care (QOC) for patients living with HIV/AIDS is a goal of the US HIV/AIDS Strategy; however, methods for measuring quality, assessing predictors of QOC, and change in quality over time have not been previously assessed.

Methods: Seven HIV Research Network sites contributed data from 2005-2010. We combined indicators on sexually transmitted infection testing, lipid screening, receipt of PCP and MAC prophylaxis, monitoring of CD4 count, and receipt of ART to construct five composite measures of quality. We used random effects models to identify associations between quality of care and gender, race, age, insurance, and HIV risk factor.

Results: In 2005, 35% of 6,899 patients were female, 56% Black, 24% Hispanic,13% uninsured, with median age 43 (range 17-95) years. Patients reported men who have sex with men (28%), injection drug use (28%), and heterosexual (38%) HIV risk behaviors. Composite quality measures varied from 20-70 percent depending on the method of estimation. Standard error estimates were similar for all of the composite measures except the indicator average. In adjusted analyses, overall QOC was lower for injection drug users (IDU), heterosexuals, and others vs. men who have sex with men, for CD4 counts of 51-200, 201-350, 351-500, and over 500 compared to CD4 counts less than 50. Quality of care was higher for those age over 45 years, females, Blacks and Latinos vs. whites, those with Medicaid, and Medicare, and other insurance vs. private insurance.

Conclusions: HIV QOC improved in participating HIV clinics from 2005 through 2010, but was dependent on measuring method, and disparities in QOC persist. Targeted interventions to increase provider adherence to preventive healthcare could further improve the overall QOC for HIV-infected patients, particularly among IDU.

Introduction

Reliable metrics to assess quality of care (QOC) are critical for reducing morbidity and mortality, improving physician performance, guiding patient choice of providers, and determining physician reimbursement. In the setting of human immunodeficiency virus (HIV) infection, the United States 2010 National HIV/AIDS Strategy promotes providing high quality care, but does not discuss methods of measurement. The Office of National AIDS Policy contracted with the Institute of Medicine to produce reports on quality measurement in the setting of HIV clinical care, but these reports only discuss individual quality indicators, not composite measures. [223,224] The National Quality Forum defines a composite measure as, "a combination of two or more individual measures into a single measure that results in a single score". [57] Composite quality measures provide several advantages over individual measures including: ease of interpretation and calculation with smaller sample sizes.

Little is known about composite measures for the quality of care received by HIV-infected individuals. Although a large number of studies report multiple quality indicators, only four report composite measures. [34-36,149,150,167-169,172,175,176,225] The studies reporting a mean percentage of indicators performed found performance around eighty percent, while Kazi et. al. found that only 32 percent of participants received 9/10 or 10/10 quality measures. [35] Due to the differences in quality depending on which measure was used in these studies, our goal was to explore the quality of care received by HIV-infected patients using several measures simultaneously.

Reeves et. al., reviewed five composite quality measures that may be useful in monitoring trends in quality of care: a 100% measure, a 70% measure, the overall average, the per patient average, and the indicator average.[226] Each of the five measures has differences in interpretation and statistical properties that may guide the choice of one measure over another. We had four objectives: to examine whether the five composite measures produced similar estimates of the quality of care, to estimate the trends in quality over time, to estimate the standard errors under differing statistical assumptions, and to assess the relationship between individual correlates and quality of care.

Methods

Population and Study Design:

The IOM has identified the HIV Research Network (HIVRN) as one source of data for monitoring trends in quality of care. The HIVRN is a research collaboration that includes 11 sites providing longitudinal HIV care to adult patients in 11 US cities. Sites collect demographic, laboratory, inpatient, and outpatient utilization data, strip these data of identifying characteristics, and submit them to a coordinating center, where they are reviewed and combined. Adult patients (≥18 years of age) who enrolled at an HIVRN site between 2005 and 2010 and who had at least one outpatient visit and CD4 count in any calendar year between 2005 and 2010 were eligible for inclusion. Ethical review boards at each site and at the coordinating center have approved the collection and use of these data. Seven sites were included in our analysis. These sites were included because they reported all quality indicators of interest in all years, and were able to conduct manual chart reviews to validate the presence or absence of quality indicators as part of the current study. All composite measures are calculated including data from all seven sites.

Quality Indicators:

We used guidance from the American Medical Association's physician consortium recommendations to guide our choice of indicators, to understand how to construct our composites, and to consider over which levels to aggregate our data. We chose to include the following quality indicators: prescription of anti-retroviral therapy, CD4 count measurement, pneumocystis jirovecii prophylaxis, mycobacterium avium intracellulare prophylaxis, testing for hyperlipidemia, and screening for syphilis, gonorrhea, and chlamydia. These are a selection from the indicators proposed by Horberg et al. with the addition of screening for hyperlipidemia.[56] Each indicator has two criteria; the pass criteria for when a participant successfully receives a measure, and an eligibility criteria to define when participants need a given quality measure. Table 1 contains these criteria. An example of the eligibility criteria for receipt of anti-retroviral therapy is having a CD4 count less than 350 in the year (the standard of care during the study period). The pass criteria would be receiving anti-retroviral therapy during that year. We aggregated over two levels of data, that of the individual and that of the site to create overall estimates for the HIVRN.

Composite Measures:

The following quality of care composite measures were created: (1) An all-or-none measure, coded as a one if the patient received all of the quality indicators for which the patient was eligible and a zero otherwise. (2) A seventy percent threshold which codes the patient as a one if at least seventy percent of the measures for which the patient was eligible had been performed and a zero otherwise. (3) An overall quality score, the sum of the total number of times care was correctly performed divided by the sum of the total number of times patients were eligible for care. For example, if 100 patients were eligible for 1000 quality indicators and patients received 900 of these indicators, the overall average is 900/1000, or 90%. This composite measure is used by the Centers for Medicare Services in the Hospital Compare project. (4) An indicator average, where the percentage of times each indicator was performed was averaged across all indicators. (5) A patient average, calculated by finding the percent of indicators performed for each patient and averaging over the total number of patients. Reeves et. al. define the first two scores as criterion referenced, because there is a threshold for performance. The other scoring systems are defined as absolute because there is no standard threshold. [226]

Standard Error Measurement and Intraclass Correlation:

We calculated three measures of the standard error. First, we calculated the standard error based on the normal approximation. It is appropriate to use a normal approximation given our large sample size. Second, we calculated the standard error based on the binomial distribution. Finally, we calculated the standard error based on the bootstrap using 500 replications. Not all standard errors can be appropriately calculated for all composite measures.

Our dataset consists of patients clustered within practice sites. Because patients within a given site may be more similar than patients between practice sites, we calculated the intraclass correlation coefficient for the patient average measure. The intraclass correlation coefficient measures the amount of variability within a site as a proportion of the total variability. Data analysis was conducted using Stata 12 (Stata Corp, College Station, TX)

Participant characteristics were assessed, including patient age, gender, race/ethnicity (white, black, Hispanic, other), HIV risk behavior (MSM, IDU, heterosexual, other), first CD4 count measured during the calendar year (≤ 50, 51-200, 201-350, 351-500, ≥ 500 cells/mm3), and insurance status (private, Medicaid, Medicare or dual Medicaid/Medicare, uninsured or Ryan White—because participating HIVRN clinics received Ryan White Care Act funding to provide care for under-insured patients, and other or unknown insurance status).

We used multivariable linear random effects modeling to identify variations in overall QOC adjusted for gender, race, age, insurance type, HIV risk behaviors, and site with time as a random effect. We also calculated odds ratios with random effects for variations in quality of care using the all or none metric and the seventy percent metric.

Results:

Between 6899 and 8533 patients were enrolled at these sites in 2005 and 2010 respectively. Patients triggered a total of 30675 and 38151 indicators in 2005 and 2010, respectively. The majority of patients (65.6%) were male and African American (56.3%). Thirty-nine percent of patients acquired HIV through heterosexual transmission. (Table 2)

The all-or-none threshold had the lowest averages between 2005-2010 with a range of 9.9% to 13.8% while the indicator average had the highest averages with a range of 71.5% to 74.8%, the seventy percent average from 43.4%-58.5%, the overall average from 62.8%-70.3%, and the patient average from 61%.4-69.6% (Figure 1, Table 3) The trends over time were statistically significant for all composite measures.

The standard errors were one third of a percent to three percent except for the indicator average method (Table 5). Table 5 contains data for 2010, similar results were found for other years. The overall average method had the lowest standard errors while the indicator average method had the highest. The standard errors were between 0.66 and 2.49 across the sites with the exception of the indicator average which as expected was higher, ranging from 5.54-13.9.

The intraclass correlation coefficient for the patient average was 5% with a 95% confidence interval of 0%-12% suggesting that only a small amount of variation was attributable to the correlation of observations by practice site.

In adjusted analyses, overall QOC was lower for IDU (β -5.00, 95% confidence interval -5.66, -4.35), heterosexuals (β -3.44, 95% CI 4.08-2.79), and other risk behaviors (β -7.02, 95% CI 5.90) vs. men who have sex with men, for CD4 counts of 51-200 (β -1.72, 95% CI -2.81, -0.62), 201-350 (β -5.03, 95% CI -6.08, -3.99), 351-500 (β -6.05, 95% CI -7.09, -5.01), and over 500 (β -6.82, 95% CI -7.82, -5.81) compared to CD4 counts less than 50. Quality of care was higher for those age over 45 (β 0.02, 95% CI 0.01-0.04), females vs. males (β 5.08, 95% CI 4.54, 2.63), Blacks (β 1.76, 95% CI 1.11, 2.42) and Latinos (β 2.18, 95% CI 1.39, 2.96) vs. Whites, those with Medicaid (β 2.61, 95% CI 1.95, 3.27), and Medicare (β 2.49, 95% CI 1.74, 3.24), and other insurance (β 8.52, 95% CI -12.79,19.27) vs. private insurance.

Discussion

Different measures of quality of care produced different pictures of the state of quality received by patients in the HIVRN. As anticipated, dichotomous measures (100% of quality indicators received and 70% of quality indicators received) produced lower estimates than the continuous composite measures. The continuous composite measures-overall average, patient average, and indicator average produced results that were within five percent of each other in all years. The similarity of the continuous measures suggests a ceiling effect for the quality of care being received. Regardless of measure, scores improved over time, and had similar standard errors except for the indicator average. Our improvement over time is consistent with the results found by Chow et al, and raises questions about how much of the improvement over time found in their study was due to secular trends since no systematic quality improvement effort was underway at HIVRN clinics during this time period.[227]

The all-or-none composite measure had the lowest score of all measures due to the ease with which failure occurs on this measure. It is worrisome that over 75% of patients failed to receive all of the measures for which they were eligible. Although the all-or-none measure is a strict standard, it represents a theoretical ideal of quality of care. Calculating the all-or-none measures assumes that all quality indicators are equally important with regard to clinical outcomes. It could be that healthcare providers prioritize individual quality indicators based on perceived importance. For example, receipt of ART is likely to be much more strongly linked to improved survival and improved quality of life compared with lipid screening. Additional research is needed to determine the relative importance of quality indicators that contribute to composite measure of healthcare quality. An additional concern with the use of the all-or-none standard is that it may also lead to fatigue and frustration on the part of providers who feel that the goal is unreachable.

A substantially higher percentage of patients met the seventy percent threshold than met the all-or-none score. This suggests that the seventy percent threshold might serve as a compromise whereby it remains criterion referenced, but is more readily achievable. The only similar study in the literature, using a criterion referenced measure, found that thirty-two percent of participants had ninety percent of their indicators completed.[35] Kazi et al.'s estimate was between our all-or-none score and our seventy percent score suggesting a pattern of improved scores with decreasing failure thresholds.[35] The improvement between the all-or-none score and the seventy percent threshold suggests that quality may obey the Pareto principle where a large increase in effort may be necessary to gain the final twenty percent improvement in quality. Whether a large investment in improved quality of care is warranted depends in part on the benefit achieved via such an effort. It is currently unknown which threshold would produce the greatest mortality or hospitalization reduction. The lack of mortality and other outcomes data means that individual provider and clinics must rely on their clinical judgment for setting their own quality improvement goals.

The continuous composite measures produced scores, which were greater than the criterion referenced measures because there is no failure threshold. There was no obvious reason to prefer one continuous scoring measure to another. Estimates of continuous composite measures from the literature were around eighty percent, and are likely greater than our estimates for two reasons.[34,225] First, most of the data comes from the Veterans Administration (VA) where a comprehensive electronic medical record permits the collection of data from all clinical encounters not just those at HIV clinics. Second, the VA data includes hepatitis screening and vaccination indicators whose completion rates were greater than 80 percent, thus raising their composite averages.

We highlight a few important differences, advantages, and disadvantages between the composite measures and refer the reader to Table 5 of Reeves et. al. for more information. One important difference is that the composites combine information differently. For example, the indicator average weights all indicators equally, the patient average weights all patients equally, and those patients triggering the most indicators weight the overall average most heavily. The overall average and the patient average have the advantage of looking at each opportunity to perform care or the care of the patient taken as a whole respectively. The indicator average is useful because it weights all indicators equally, and thus is not dominated by the most commonly trigged indicators. In contrast, both the overall average and patient average suffer because they are dominated by the most commonly performed indicators. Finally, the all-or-none and 70% scores suffer from being effected by the total number of indicators included, since as the total number included rises the chance of reaching the threshold falls, even with equal probability of completion on each indicator.

There are two issues to consider when calculating the standard errors for composite quality measures. First, the underlying distribution is unknown so, where possible, we fit more than one distribution. For all of the measures, the distribution used made little difference in the standard error estimate except for the indicator average. We also attempted to use the standard error estimates to choose a preferred quality measure because lower standard errors suggest greater estimate stability. The patient average and overall average had standard errors approximately half of the criterion- referenced measures, but since all the standard errors were less than three percent we do not feel this is a meaningful method for choosing a quality measure. The indicator average variance was higher than that of the other composite measures, but we anticipated this because the sample size for the indicator average is the number of indicators not the number of participants.

We have assumed that all of the individual quality indicators are created equal, and have not made a judgment about which indicators provide the best reduction in morbidity and mortality. To that end, we have not used any weighting schemes, which might place more emphasis on a given indicator over another. We have made this choice because none of the published literature, to our knowledge, provides data on what weights might be used. It is possible to imagine that certain indicators, for example, measurement of CD4 count or provision of anti-retroviral therapy, might be more important in preventing morbidity or mortality.

In light of the National HIV/AIDS Strategy goal of improving HIV quality of care, we present a variety of ways to summarize this data for reporting purposes. We hypothesize that it will be necessary to continue to monitor these measures of over time to examine changes in quality of care. This will be particularly important if QOC composites are used for benchmarking because guideline recommendations change rapidly in the setting of HIV. For example, we chose to rate receipt of antiretroviral therapy based on the CD4 threshold of 350, while the current guideline calls for initiating therapy at 500 cells/mm^3. As the Department of Health and Human Services makes decisions about quality of care in patients with HIV, they will have to consider which composite measure to use since the measures yield different pictures of the current quality climate. Furthermore, analysis of quality data by Ohl et. al. found that differing case mix standards led to different conclusion about quality of care further complicating the public reporting picture.[228] The growth of patient centered medical homes may improve the quality of care HIV-infected patients receive. This might occur as care coordination between providers is improved. Tracking of quality of care over time is also necessary as use of electronic medical records becomes more consistent. Electronic medical records hold promise for improving quality of care by providing reminders to perform quality indicators, and by allowing for automated auditing of patient records.

Demographic and insurance variables showed a consistent association with quality across the different measurement methods. However, for CD4 count, increasing CD4 counts were associated with lower quality in the linear and 70 percent measures, but with higher completion rates on the all or none score. One explanation is that as CD4 count increases the number of measures a patient is eligible for decreases which increase the probability of receiving all needed measures.

HIV QOC remains suboptimal for IDU compared with MSM, consistent with the majority of previous studies demonstrating decreased quality of care for IDU.[34,225,229-231] One potential explanation is that care of IDU is more complex than MSM due to the IDU engaging in substance abuse behaviors. Likewise, heterosexual patients received suboptimal HIV QOC. HIV QOC was greater for those of minority race/ethnicity compared with whites, and those with public insurance compared with private, suggesting target populations are receiving high QOC in these safety net clinics.

Limitations:

Our data come from a sample of clinics in only one network of HIV providers in the United States. While these providers cover a wide geographic area, the data is not nationally representative and likely over-estimates the quality of care in practices lacking sophisticated data collection systems. It is possible that providers are aware of performance measurement and are reporting indicators that have not actually been performed. In addition, we do not have data on performance of all national consensus HIV quality indicators, but we selected quality indicators from an array of quality domains which have been reported in previous studies. Quality indicators such as gonorrhea/chlamydia screening may have been omitted from the clinic medical record, if performed outside of the participating clinics. Further research is required to establish methods for choosing which of the composite measures calculated here are optimal for clinical or quality improvement purposes. The choice of composite measure governs the message being sent to providers or quality improvement officers.

Conclusions:

We have demonstrated five quality composite measures using data from HIV-infected individuals. The all-or-none method and 70% score produced lower scores than the continuous criterion methods. We found that among the continuous scoring methods little difference existed. Standard error estimates were less than three percent for all composite measures except the indicator average. Differences in QOC on the basis of HIV risk behaviors, CD4 count, and insurance status suggest that the complexity of patient care is not fully captured by our composite measures. Further research is necessary to examine whether improvement in clinical outcomes results from these measurements and to understand the utility of using weighting schemes in determining which indicators to include in composite measures.

Table 7.1. HIV quality of care indicator definitions used by the HIV Research Network between 2005 and 2010.

Quality Indicator	"Pass" Criteria	Eligibility Criteria
Medications		
ART	Receipt of ART in CY	CD4 nadir $\leq$ 350 cells/mL^3 ever
PCP prophylaxis	Receipt of dapsone, tmp/smx, atovaquone, pentamidine in CY	CD4 count $\leq$ 200 cells/mL^3 in CY
MAC prophylaxis	Receipt of clarithromycin, azithromycin, or rifabutin in CY	CD4 count $\leq$ 50 cells/mL^3 in CY
Screening		
Hyperlipidemia	Lipid test in CY	On ART
Syphilis	Syphilis test in CY	All
Gonorrhea/Chlamydia	Gonorrhea or Chlamydia test in CY	All
Monitoring		
CD4	$\geq$ 2 CD4 counts performed in CY, at least 90 days apart	All

ART = Antiretroviral therapy; CY = Calendar year
PCP= pneumocystis jirovecii prophylaxis; MAC= mycobacterium avium intracellulare prophylaxis

Table 7.2. Patient level characteristics from the HIV Research Network by year

Year N	2005 6,601	2006 6,744	2007 6,841	2008 7,807	2009 8,002	2010 8,030
Mean age, yr (SD)	44.3 (9.4)	44.9 (9.6)	45.6 (9.7)	45.9 (9.9)	46.4 (10.1)	46.9 (10.4)
Female (%)	34.9	34.7	34.0	34.0	34.1	33.0
Race/ethnicity (%)						
White	19.0	19.2	19.3	18.0	17.4	18.3
African American	55.6	55.7	55.9	56.2	56.8	56.5
Hispanic	24.0	23.5	23.3	24.2	24.1	23.4
Other	1.4	1.7	1.5	1.6	1.6	1.7
HIV Risk Exposure (%)						
MSM	27.8	29.4	30.2	29.4	30.0	31.7
IDU	28.3	26.9	26.4	25.4	24.0	22.9
Heterosexual	38.8	39.1	39.5	40.2	41.0	40.4
Other	5.1	4.6	3.9	5.0	5.0	4.9
CD4 Category (cells/mL3)						
<= 50	7.0	6.3	5.8	5.2	4.9	4.0
51-200	15.7	15.0	14.1	15.1	13.7	13.2
201-350	22.5	21.1	21.2	21.8	20.8	20.0
351-500	21.9	22.1	21.3	21.7	22.6	21.6
>500	33.0	35.4	37.6	36.1	38.0	41.2
Health insurance (%)						
Private	13.7	15.9	18.0	17.9	19.0	23.4
Medicaid	57.0	52.7	51.8	53.0	50.6	46.9
Medicare/Dual	15.3	18.4	18.8	16.9	18.4	18.9
Uninsured/Ryan White	13.3	12.7	11.3	12.0	11.7	10.7
Other/Unknown	0.7	0.4	0.1	0.1	0.3	0.04

MSM = Men who have sex with men; IDU = injection drug users; yr= years

Table 7.3. Percent quality indicators achieved for all years and test of trend over time for each individual measure

	2005	2006	2007	2008	2009	2010	P (trend) *
N	6,601	6,744	6,841	7,807	8,002	8,030	
ART	85.6	86.8	89.8	89.2	92.5	91.7	<.001
PCP prophylaxis	92.9	82.5	93.6	88.9	89.1	88.4	.250
MAC prophylaxis	88.6	84.3	87.4	82.4	82.7	79.4	<.001
> 2 CD4 measurements	80.9	82.9	84.8	84.4	84.6	79.9	.540
Lipid screening	71.0	71.3	74.4	74.6	77.6	77.7	<.001
Syphilis screening	60.5	56.5	60.3	62.3	62.4	74.3	<.001
Gonorrhea or chlamydia screening	21.0	22.4	26.6	28.8	31.0	32.4	<.001

ART=Antiretroviral therapy; PCP=pneumocystis jirovecii prophylaxis; MAC=mycobacterium avium intracellulare prophylaxis
*Two-tailed Cochran-Armitage p-value

Table 7.4. Composite quality measures by year with test of trend from seven sites in the HIV Research Network

Indicator	2005	2006	2007	2008	2009	2010	Trend test*
All or none	9.89	9.77	13.42	14.99	16.58	19.79	0.00
70 percent	43.40	40.87	46.15	48.65	51.76	58.52	0.00
Patient average	61.70	61.41	64.93	65.88	67.65	69.60	0.00
Overall average	63.26	62.79	66.32	67.05	68.69	70.36	0.00
Indicator average	71.5	69.22	73.85	72.95	74.28	74.8	0.05

*Two-tailed Cochran-Armitage p-value

Figure 1: Graph of the five composite measures by year between 2005 and 2010

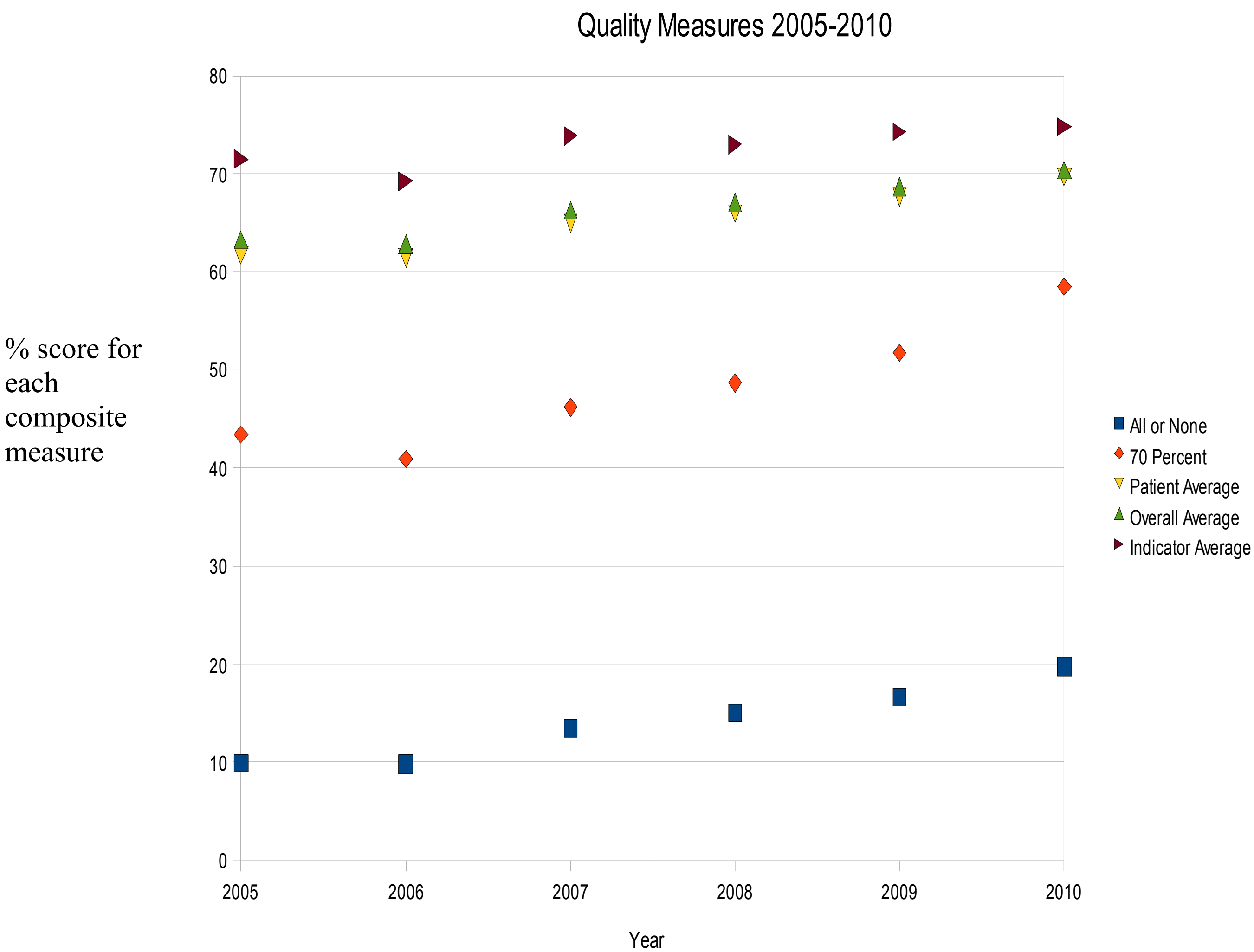


Table 7.5: Mean, range of scores by site, and range of standard errors across site, for 2010 from seven HIV Research Network (n=8,490)

	All-or-none Score	70% score	Patient average	Overall average	Indicator average
Mean (%)	19.79	58.52	69.60	70.36	73.44
Range (%)	1.69-30.71	7.34-69.28	35.68	37.19-76.97	52.12-80.62
Gaussian standard error	0.66-2.21	0.87-2.50	0.37-1.81	0.50-1.67	NA
Binomial standard error	0.92-2.22	0.88-2.49	NA	NA[18]	NA
Bootstrap Standard error	0.66-2.21	0.85-2.50	0.37-1.60	0.36-1.59	5.54-13.91

[18] NA denotes a standard error that could not be calculated.

Table 7.6. Multivariate model of the association between the patient average, all or none score and seventy percent score and predictor variables with controlling for site and year as a random effect.

	Linear model of patient average Beta (95% CI)	All or none score odds ratio (95% CI)	Seventy percent odds ratio (95% CI)
Age <45	Reference	Reference	Reference
Age ≥45	0.02 (-0.01-0.04)	0.99 (0.98-0.99)*	1.00 (1.00-1.00)*
Gender			
Male	1.0 (Ref)	1.0 (Ref)	1.0 (Ref)
Female	5.08 (4.54-5.63)*	2.43 (2.26-2.61)*	1.42 (1.35-1.49)*
Race/Ethnicity			
White	1.0 (Ref)	1.0 (Ref)	1.0 (Ref)
Black	1.76 (1.11-2.42)*	1.25 (1.15-1.37)*	1.10 (1.04-1.17)*
Latino	2.18 (1.39-2.96)*	1.16 (1.04-1.30)*	1.16 (1.09-1.26)*
Other/Unknown	-1.34 (-3.15- 0.46)	0.75 (0.57-0.99)*	0.86 (0.73-1.02)
HIV risk behavior			
MSM	1.0 (Ref)	1.0 (Ref)	1.0 (Ref)
IDU	-5.00 (-5.66, -4.35)*	0.74 (0.68-0.81)*	0.66 (0.63-0.70)*
Heterosexual	-3.44 (-4.08, -2.79)*	0.77 (0.71-0.85)*	0.75 (0.70-0.79)*
Other	-7.02 (-8.14, -5.90)*	0.57 (0.49-0.67)*	0.59 (0.54-0.66)*
CD4 category (cells/mL3)			
≤ 50	1.0 (Ref)	1.0 (Ref)	1.0 (Ref)
51-200	-1.72 (-2.81, -0.62)*	1.09 (0.93-1.29)*	0.42 (0.38-0.47)*
201-350	-5.03 (-6.08, -3.99)*	1.36 (1.16-1.59)*	0.55 (0.50-0.60)*
351-500	-6.05 (-7.09, -5.01)*	1.61 (1.38-1.88)*	0.52 (0.47-0.57)*
≥ 500	-6.82 (-7.82, -5.81)*	1.89 (1.63-2.20)*	0.51 (0.47-0.56)*
Insurance			
Private	1.0 (Ref)	1.0 (Ref)	1.0 (Ref)
Medicaid	2.61 (1.95, 3.27)*	1.23 (1.13-1.33)*	1.22 (1.18-1.29)*
Medicare/Dual	2.49(1.74, 3.24)*	1.15 (1.04-1.26)*	1.19 (1.16-1.17)*
Uninsured/Ryan White	-0.39 (-1.23, 0.44)	1.08 (0.97-1.20)	0.98 (0.91-1.06)
Other/Unknown	-8.52 (-12.79,-19.27)*	0.21 (0.07-0.67)*	0.38 (0.23-0.63)*

MSM=men who have sex with men; IDU=injection drug user

Participating Sites
Alameda County Medical Center, Oakland, California (Howard Edelstein, M.D.)
Children's Hospital of Philadelphia, Philadelphia, Pennsylvania (Richard Rutstein, M.D.)
Community Health Network, Rochester, New York (Roberto Corales, D.O.)
Drexel University, Philadelphia, Pennsylvania (Jeffrey Jacobson, M.D., Sara Allen, C.R.N.P.)
Fenway Health, Boston, Massachusetts (Stephen Boswell, M.D.)
Johns Hopkins University, Baltimore, Maryland (Kelly Gebo, M.D., Richard Moore, M.D., Allison Agwu M.D.)
Montefiore Medical Group, Bronx, New York (Robert Beil, M.D.)
Montefiore Medical Center, Bronx, New York (Lawrence Hanau, M.D.)
Oregon Health and Science University, Portland, Oregon (P. Todd Korthuis, M.D.)
Parkland Health and Hospital System, Dallas, Texas (Ank Nijhawan, M.D., Muhammad Akbar, M.D.)
St. Jude's Children's Hospital and University of Tennessee, Memphis, Tennessee (Aditya Gaur, M.D.)
St. Luke's Roosevelt Hospital Center, New York, New York (Victoria Sharp, M.D., Stephen Arpadi, M.D.)
Tampa General Health Care, Tampa, Florida (Charurut Somboonwit, M.D.)
University of California, San Diego, California (W. Christopher Mathews, M.D.)
Wayne State University, Detroit, Michigan (Jonathan Cohn, M.D.)

Sponsoring Agencies
Agency for Healthcare Research and Quality, Rockville, Maryland (Fred Hellinger, Ph.D., John Fleishman, Ph.D., Irene Fraser, Ph.D.)
Health Resources and Services Administration, Rockville, Maryland (Robert Mills, Ph.D., Faye Malitz, M.S.)
Data Coordinating Center
Johns Hopkins University (Richard Moore, M.D., Jeanne Keruly, C.R.N.P., Kelly Gebo, M.D., Cindy Voss, M.A.)

7.3 Potential Biases and Limitations

The HIVRN is not a nationally representative sample of patients infected with HIV and thus we cannot generalize our findings on quality of care. Those patients who are not receiving regular HIV care are also not included in this analysis. The HIVRN consists of several independent clinical locations. Our analysis aggregates over these sites obscuring any important differences in quality that might vary by location. In addition to aggregating over several sites, one can criticize the choice of sites included in the analysis. All are relatively large volume HIV care providers, and while many HIV-infected persons receive care from these type of providers, other provider types do exist. Because our providers were large volume practices their resources permit potentially better performance on quality of care than small volume practices through the use of clinician education and computer monitoring systems among other quality improvement initiatives. This might lead to an overestimate of the actual care being provided nationally by HIV providers. Another potential bias is that care providers are gaming the system and saying that indicators have been performed when in fact when they have not. Without independent audits of the medical record as well as the use of the actors posing as patients it is difficult to determine if this occurring. Finally, our estimate does not necessarily represent the care that patients are actually receiving since we have not measured how compliant patients are with the recommendations of their physicians.

It is possible to criticize the quality measures we have chosen to include. For example, lipid screening is not included in the original Horberg guidelines. Additionally, the individual quality measures are not of equal importance in determining outcomes. For example, measuring CD4 count as part of effectiveness of antiretroviral therapy is likely more lifesaving than lipid or STI screening.

There is no statistical method to decide which of the five quality metrics is the best. This is left to the clinical judgment of the investigators. It is possible that one or several of the indicators provides useful information and feedback to clinicians. The meaning of the relative difference in the variance estimates with respect to choosing a single quality measure to report is unclear. Since all of the measures are relatively easy to calculate whether a single measure needs to be chosen on the basis of any criteria is not clear.

Chapter 8. Conclusions

8.1 Review of Primary Results

Emergency department utilization, at 10.4% was substantially less than previously reported. Factors associated with increased ED prevalence included female sex; poverty; homelessness; being depressed; failing to achieve durable viral suppression; CD4 counts of 0-50, 50-200, 350-500; and having unmet service needs. Moderate alcohol consumption was associated with decreased ED utilization compared to no alcohol use.

Our expectation was that utilization risks and rates would be less than anticipated from our review of the literature due to our defining visits only as those related to HIV/AIDS. In spite of this narrow classification of the outcome, our results demonstrated that even in 2009-2011 controlling the progression and severity of HIV disease are critical factors in altering patterns of healthcare utilization in this group. The strength of the association between disease severity factors and utilization was surprising for two reasons. First, all patients in the MMP are in care. Second, guidelines for antiretroviral therapy prescribing have counseled for treatment before CD4 counts have declined below 500 cells/mm^3.[14]

Structural equation modeling results for the ED analysis were as follows. Among the variables assigned to the predisposing factor all were statistically significantly associated except smoking. All measured variables assigned to the enabling factor were statistically significantly associated with the factor. Among the measured variables assigned to the need factor all were statistically significantly associated except ever having been diagnosed with AIDS. Only the need latent factor was associated with increased ED utilization. Our SEM results show the predisposing latent variable was not associated with the outcome. The relatively minor importance of the predisposing variable in the SEM is likely, in part, due to the outcomes we have chosen. It is possible that once someone is sufficiently ill to need care in the ED that the predisposing factor is of lesser import. It is also interesting to note that the enabling factor was not associated with ED utilization. As with the predisposing latent variable, the association between the enabling factor and ED utilization may be overwhelmed by the need factor. When examining the prevalence ratios for the enabling variables none is greater than 1.35 suggesting only a small magnitude of association for these variables.

The logistic regression model provided a lower area under the curve than the SEM for both the hospital and emergency department outcomes. This may have occurred due to the improved classification of the exposures by the SEM thus reducing bias in our variables. The difference in receiver operating curves was quite small, at only 6 percent for the ED outcome. Interestingly, when using a 50 percent cutoff, the SEM and logistic models produced opposite pictures of sensitivity and specificity.

We found that using different scoring methods produced differing pictures of the quality of care patients in the HIVRN were receiving. When criterion referenced scoring methods were used the quality of care was not high with scores between 20 and 40 percent. When absolute scoring methods were used scores were approximately 70 percent regardless of method. The standard error estimates were similar for all of the composite measures and statistical distribution assumptions. Only the indicator average method had variances in excess of 5 percent. The variance was greatest for the indicator average method because the small sample size, the number of indicators, instead of the number of patients or opportunities for care used in the other composite measures. We also found that all measures of quality improved over time, and that having a history of injection drug use behavior is a risk factor for lower quality of care.

8.2 Brief Review of Limitations

The risk factors under study were contemporaneous with the outcome and our ability to make causal conclusions is limited. Recent literature using DAGs has shown that it is possible to make causal conclusions using cross sectional data provided that the measured variable is a good proxy for the risk factor prior to the outcome. [232] Unfortunately, many of our variables are potentially influenced by ED or hospital admission, including CD4 count, viral loads, and use of alcohol and illicit drugs. Particular complexity resulted from our measures of viral load and CD4 count, which were composites across a whole year, taking into account time both before and after the outcome. In spite of these difficulties, it is interesting to note that the direction of the associations were as would be predicted based on the clinical significance of these variables.

Although we have described all patients in the Medical Monitoring Project as being in care, patients frequently transition into and out of care. This includes approximately ten percent of patients who sought primary HIV care in the ED in one study.[29] Additionally, only 45 percent of patients with diagnosed HIV are retained in care, and estimates of ED and hospital utilization among those not in care are typically 2-3 times higher than for those patients who are in care.

The structural equation model and the logistic regression models serve differing purposes and require differing interpretations even though they use the same data. The logistic regression produces the important risk factors for public health action. The SEM, on the other hand, provides guidance on the structure of theories of healthcare utilization.

Our quality of care analysis is primarily hampered by our lack of outcome data for use in validating our quality of care measure. A second limitation is the data source which is limited to large volume HIV care providers. These providers may have vastly different results that smaller group practices.

<u>8.3 Dissertation in Context, Innovation and Significance</u>

Since beginning the dissertation research, there has been only one study published on ED utilization. Research on both emergency department and hospital utilization in the setting of HIV is hampered by sampling problems. Large cohort studies and the MMP are focused on people who are receiving primary HIV care who are likely to be the healthiest. While our work provides national estimates for the first time in over a decade there also remains a continued need for sampling patients who are not linked nor retained in care. The dissertation is also the first publication on ED and hospital utilization in a nationally representative sample in over ten years. The two studies with nationally representative data on ED utilization are now outdated. The ACSUS study was conducted in 1992 during the pre HAART era. [233] The HCSUS study was conducted in 1996-1998 during the introduction of antiretroviral therapy. [5]

There continues to be debate in the epidemiology literature on the utility of structural equation modeling. Advocates of SEM continue to note the potential to provide answers for complex situations such as mediation analysis. The detractors continue to note difficulties in applying structural equation models since they do not act as a panacea.

[234] At Emory University, at least two other dissertation projects in the Epidemiology program are using SEM.

SEM permits testing of the underlying construct proposed by Andersen's theory. Andersen's theory has never been tested via SEM before. Furthermore, structural equation modeling will allow the testing of the underlying construct of healthcare utilization as proposed by Andersen in a unique way compared to current logistic regression approaches. Finally, SEM will permit examination of the differences in model fit between this technique and the current standard technique of logistic regression. The dissertation also furthers the introduction of SEM into the epidemiologic literature. Between 2002 and 2008, only 24 articles using SEM were published in six of the major epidemiology journals. [45]

We are the first study to comprehensively compare five different quality metrics. We also are the first study to examine reliability and variance measures for these metrics. We provide the first data to answer questions posed by the Institute of Medicine concerning measurement of quality of care in the HIV-infected population.

8.4 Directions for future research

We cannot make comparisons between our results and those individuals who are not regularly receiving HIV care. Studies are needed to understand the disparities in patients who are not linked or retained in care. Furthermore, since patients transition into and out of care frequently and seek care at more than one clinical location, longitudinal research where patients are followed with regard to where they seek care could help elucidate the role of the ED as a "primary care provider" for HIV-infected patients. [29,235] Further research should also examine what are the determinants that led to failure to improve CD4 counts and viral loads in patients in care. It is possible that patients who are in care are on only partially effective therapy, are not compliant with their antiretrovirals, or are not receiving other necessary vaccinations or prophylaxis. It is also possible that patients who have been infected for a long time no longer have fully therapeutic treatment options due to viral resistance to medication. At least two important questions regarding ED utilization have not been answered by our study. The first is that frequent ED users, those who make more than four visits a year, and who account for 18% of all visits in the general population, were not specifically examined in this study.[201] The frequent ED users may represent a systematically different type of ED patient than the general ED user who makes fewer visits per year. The second unanswered question is whether ED visits made by MMP participants are preventable. Without detailed data on the reasons for the ED visit as would be obtained by chart review, we were unable to answer this question.

A number of variables were of marginal statistical significance in our ED model. The role of these variables deserves further study. The effect of insurance, in particular, should be monitored in light of changes being made to the healthcare system as part of the Affordable Care Act.

Another future research direction is to examine other pieces of the healthcare system from Andersen's model. These include the assessment of patient satisfaction, provider availability, and case-load. In addition to incorporating other elements on Andersen's model, there are other healthcare utilization measures that could serve as tests for the Andersen model. Furthermore, we assigned the measured variables to the latent variables strictly according to Andersen's guidance, and other possible arrangements should be tested to see if they provide a better fit to the data. The clinical quality metrics measured by the dissertation could also be incorporated into analyses of healthcare utilization to assess the effects of quality on outcomes.

For the purposes of using SEM in epidemiologic research, further work is needed on goodness of fit statistics. Because of the large number of measured variables, there was no available goodness of fit statistic for our model. As epidemiology moves increasing into the world of massive datasets, SEM procedures will need to keep up with the ability to handle these data types to be relevant. In addition to difficulties with the goodness of fit statistics, many SEM procedures offer a choice of maximization routine. Each of the maximization procedures offers a variety of pros and cons, but more research is necessary especially when the research includes categorical variables to describe the statistical biases that result from these choices.

There are a variety of areas for future research on quality of care. Our data on quality of care contains repeat observations on the individuals and sites, and there are a wide variety of additional statistical techniques that can be employed in the analyses of this type of data. Furthermore, there are both individual and provider level determinants of quality of care, investigation techniques using multi-level models will be necessary in order to understand the relative contributions of the individual and the provider. Our analysis did not explicitly account for changes over time in either the guidelines or reporting of these measures, which is also a potential point of investigation. The quality indicators that we have included in our composite measures are only a subset of those published by Horberg et al. and it would be useful to demonstrate that the composite measures are easily calculated using the full measure set. Finally, in order for the composite metrics to be useful two events need to occur. The first is pilot testing on reporting these metrics back to clinicians and clinical facilities in order to insure that they are accepted and translated into practice change. The second is to test weighting schemes to examine how to relate the composite measures to outcomes.

8.5 Final Conclusions

The risk factors for emergency department utilization were primarily variables related to immune functions as well as being a women, homelessness and depression. Structural equation modeling demonstrated good fit of the Andersen model to the data, but did not provide improved fit over logistic regression. Finally, criterion referenced scoring systems produced quality of care scores much lower than absolute scoring systems. Gaps remain in providing high quality care to individuals with HIV particularly on the basis of HIV risk behavior.

Appendix 1: Technical Issues In Modeling Healthcare Outcomes

There were three primary decision points in building the analytic framework for the dissertation. First, we decided to construct the structural equation models strictly based on Andersen's theory of healthcare utilization. The second decision was to dichotomize the outcome of ED and hospital utilization. Third, we decided to use prevalence ratios instead of odds ratios in modeling the outcome. This section will explore the results of each of these modeling decisions.

10.1 Results of the Exploratory Factor Analysis

In addition to a theoretical approach to constructing a latent variable model, it is also possible to take an empirical approach. The empiric approach uses exploratory factor analysis to determine how many latent factors there are, and which measured variables are associated with which latent factors. Thus, the exploratory factor analysis makes fewer assumptions about the underlying causal structure. We chose to examine goodness of fit statistics for models with as few as one factor to as many as seven factors. There are three goodness of fit statistics we examined. Two are indices of comparative fit; the Tucker-Lewis Index (TLI), and the Comparative Fit Index (CFI). The Root Mean Square Error of Approximation (RMSEA) is an absolute index of fit.

I present the results of two exploratory factor analyses. The first contains the results of all the variables in the final models included in the manuscripts except that the number of primary care visits made in the first quarter of 2009 is substituted for the number of CD4/viral load tests in the last year. The reason for presenting this model is that it converged for all the possible factors. A model using the variables from the model in the manuscripts did not converge for the three or five factor models. The results of the goodness of fit analysis are in table 11.19. The single factor model has a CFI and TLI of .407 and .323 respectively. The single factor model has a RMSEA greater than the standard cutoff of 0.05. Taken together the goodness of fit tests indicate that a one-factor model is misspecified. The two and three factor models are also misspecified with either an RMSEA greater than 0.05 or CFI and TLI of less than 0.95. Once there are five latent factors, depending on the cutoff, the model fits the data well. Six or seven latent factors provide only a limited increase in the fit of the model. Using the model including all the variables from the main manuscripts there is a similar pattern of rapidly increasing goodness of fit scores, which then level off with six or seven factors. Unfortunately, because the three factor model does not converge we cannot determine whether the change from primary care visits to number of CD4 count and viral load tests provides better fit.

The flaw with EFA is two fold. First, the measured variables may not associate in a logical way with the latent variables. Second, the CFI and TLI are very sensitive to the number of latent factors in the model. This partly explains why the CFI and TLI values increase so rapidly between a one and five factor model even when the variables in the model remain constant.

10.2 Additional Emergency Department Utilization Results

A number of different sensitivity analyses were conducted in order to examine assumptions regarding the way in which variables were coded in the analysis. We initially explored using sexual behavior in our models. The difficulty with these results was the other sexual behavior category which often had a significant association with the outcome, but whose results were difficult to interepret because of the large number of different individuals included in that category. Results from the model with sexual behavior risk groups can be found in Table 11.10.

We compared the results of models, which included CD4 count as a continuous variable to models with CD4 classified according to categories. The categories were 0-49, 50-199, 200-349, 350-499, and greater than 500. The prevalence ratios and ninety-five percent confidence intervals for the continuous variable was 0.91 (0.87-0.95) The continuous variable coding assumes that each one hundred-cell increase in CD4 count leads to the same amount of change in ED utilization. The categorization of CD4 count does not display the same linear trend. There is a plateau in the association between CD4 count and ED utilization once CD4 count is greater than 200. While the association between CD4 count and ED utilization plateaued, there was no category that had prevalence equal to the reference category of greater than 500 cells.

The logistic regression model has the following form: ED Use = β1(MSW only) + β2(Any WSM) + β3(Other HIV Risk Factor) + β4(Age 29-39) + β5(Age39-49) +β6(Age49+) + β7(African American) + β8(Hispanic) + β9(Other) + β10(High school graduate) + β11(Impoverished) + β12(Incarcerated) + β13(Homeless) + β14(Uninsured) + β16(CD4 count) + β17(Ever being diagnosed with AIDS) + β18(All viral loads in 2009 less than 200) + β19(Being depressed) + β20(Current Smoking) + β21(Former Smoking) + β22(Heavy/Binge drinking) + β23(Moderate drinking) + β24(Marijuana use only) + β25(Other non-injection drug use) + β26(Injection drug use) + β27(1 unmet need) + β28(2 or more unmet needs) + β29(three or more CD4/ Viral load tests in the year).

Comparison of prevalence ratio regression to logistic regression for the association of the risk factors with hospital utilization revealed the following. Table 11.11 contains the logistic regression results. The prevalence ratio model and logistic model led to the same variables being of statistical significance. In general, prevalence ratio modeling led lower estimates and to narrower confidence intervals than logistic regression. The logistic regression estimates were within ten percent of the prevalence ratio estimates because our outcome occurred ten percent of the time. Greater divergence between the two models would be observed if the outcome occurred more frequently. We obtained our prevalence ratios using predictive marginal and did not use any of the other possible techniques for directly obtaining risk ratios from modeling the log likelihood instead of the logit. [220-223]

We pursued several additional modeling options for the outcome variable in addition to prevalence ratios. Logistic regression and prevalence ratio models require dichotomizing the outcome variable. Converting a continuous variable to a dichotomous one leads to a loss of information. ED visits are both overdispersed and have excess zeros. For simplicity, the first models used the Poisson and negative binomial distributions. The second set of models run used the zero-inflated Poisson and zero inflated negative binomial distributions. In the setting of survey data there is no likelihood ratio test to compare the Poisson and negative binomial models. There is also no likelihood ratio test to compare the standard Poisson and negative binomial models with the zero inflated forms. Finally, we conducted ordinal and multinomial logistic regression on the number of ED visits. ED visits were classified into those participants who made no visits, one visit, two visits, and three or more visits.

Results from Poisson modeling (Table 11.12) demonstrated that increased rates of visits were seen among the uninsured, the homeless, and those who had ever having been diagnosed with AIDS. Those who drank moderate amounts of alcohol and for every 100-cell increase in CD4 cell count had decreased rates of visits. These Poisson model results are generally in line with those from the logistic regression. The risk factors with increased utilization match those previously identified from the literature. Results from the negative binomial regression (Table 11.13) found that being in an other sexual transmission category, being impoverished, homelessness, failing to achieve durable viral suppression, being depressed and having two or more unmet needs was associated with ED utilization. Those who drank moderate amounts of alcohol and for every 100-cell increase in CD4 count had decreased rates of visits. The negative binomial model results are in line with the prevalence ratio regression results. The negative binomial results share similar effect sizes with the Poisson model.

Results from zero inflated models consist of two parts. The first part is rate ratios among participants with one or more visits to the emergency department. The second part contains odds ratios comparing those who visited the ED to those who did not. Two zero-inflated models were calculated. The first using the Poisson distribution and the second using the negative binomial distribution. Poisson rate ratios (Table 11.14) demonstrated increased ED utilization among, the homeless, and those who had ever been diagnosed with AIDS. Decreased ED rate ratios were seen for Hispanics compared to Whites, those who drank moderate amounts of alcohol, non-injection drug users compared to non-illicit drug users. The Poisson odds ratio (Table 10.15) demonstrated decreased ED utilization among Blacks compared to whites, among those who were depressed, marijuana and non-injection drug users compared to non-illicit drug users. Odds ratios were increased per 100 CD4 cell increase. The reason for the increase in odds of ED utilization per 100 CD4 cell increase is unclear and is in the opposite of the usual association.

Negative binomial rate ratios (Table 10.14) demonstrated increased ED utilization among those who were race other than White, Black or Hispanic, the homeless, and those who had ever been diagnosed with AIDS. Moderate and hazardous/binge drinkers and for every 100 cell increase in CD4 count had decreased ED visit rates. The odds ratio portion of the model was unstable and thus these estimates are not presented.

The ordinal model and multinomial models divided emergency department utilization into four groups. People were classified as not using the ED in the last year, making one ED visit, two ED visits, or three or more ED visits. Ordinal logistic regression (Table 11.16) demonstrated increased odds of ED utilization among Blacks, those with other sexual transmission behaviors, men who had sex with women only, the impoverished, the homeless, failure to achieve durable viral suppression, and those who were depressed. Decreased odds of ED visits were seen per 100-cell increase in CD4 count, and moderate alcohol drinkers. An ordinal model assumes that the change in odds is constant across categories of ED visits.

A multinomial logistic regression does not assume a constant change in odds. Multinomial regression (Table 11.17) comparing those with one visit to those with none found the following factors to be associated with increased ED utilization; being of African American, and being a man who had sex with women only. Comparison of those who made two visits to those who made none found the following factors to be associated with increased ED utilization; being depressed, and using marijuana. Comparison of those who made three or more visits to those who made none found the following factors to be associated with increased ED utilization; being a women who had sex with men only, other sexual transmission category, being homeless, having ever been diagnosed with AIDS, failing to achieve durable viral suppression, and having two or more unmet needs. Drinking moderate amounts of alcohol and for every 100-cell increase in CD4 count were associated with decreased ED utilization.

The main prevalence ratio regression analysis found the following risk factors associated with increased utilization of the ED; women who have sex with men only, being Black, homelessness, failure to achieve durable viral suppressions, and being depressed. CD4 cell count per 100-cell increase was associated with decreased ED utilization. The sensitivity analysis models generally found the same risk factors to be associated with ED utilization as prevalence ratio regression. The sensitivity analysis models tended to also find increased utilization among the impoverished, and the uninsured and decreased utilization among those who drank moderate amounts of alcohol. These results are summarized in Table 11.18. The summary table contains the category that was statistically significant and the direction of the effect in capital letters following the category.

10.3 Additional Hospital Utilization Results

A number of different sensitivity analyses were conducted in order to examine assumptions regarding the way in which variables were coded in the analysis. The main analysis combines the gender variable with the gender and sexual preferences. The gender variable in the study was coded as men, women, transgender, and intersex. We found that women had a prevalence ratio of 1.38 with a 95% confidence interval of 1.04, 1.83. This suggests that women had increased use of the hospital compared to men. The prevalence ratio for transgendered individuals was 1.59 with a 95% confidence interval of 0.71-3.52. The prevalence ratio results of the other variables in the main analysis by less than ten percent when sex was included in the model instead of sexual transmission category.

We compared the results of models, which included CD4 count as a continuous variable to models with CD4 classified according to categories. The categories were 0-49, 50-199, 200-349, 350-499, and greater than 500. The prevalence ratios for the continuous coding were 0.85 (0.79-0.83). The continuous variable coding assumes that each one hundred-cell change in CD4 count leads to the same amount of change in hospital utilization. The categorization of CD4 count does not display the same linear trend. In the hospitalization analysis, the effect of CD4 count plateaus at categories of 200-500 cells.

There were no discrepancies between the logistic regression model and the prevalence ratio model. In general, prevalence ratio modeling led to narrower confidence intervals than logistic regression.

We pursued several additional modeling options for the outcome variable in addition to prevalence ratio regression. Logistic regression and prevalence ratio models require dichotomizing the outcome variable. Converting a continuous variable to a dichotomous one leads to a loss of information. Hospital visits are both overdispersed and have excess zeros. For simplicity, the first models used the Poisson and negative binomial distributions. The second set of models run used the zero-inflated Poisson and zero inflated negative binomial distributions. In the setting of survey data there is no likelihood ratio test to compare the Poisson and negative binomial models. There is also no likelihood ratio test to compare the standard Poisson and negative binomial models with the zero inflated forms. Finally, we conducted ordinal and multinomial logistic regression on the number of hospital visits. Hospital visits were classified into those participants who made no visits, one visit, two visits, and three or more visits.

Results from Poisson modeling (Table 11.23) demonstrated that increased rates of visits were seen among those who were homeless, had ever been diagnosed with AIDS, and those who had two or more unmet needs. Hospital utilization was decreased for every 100-cell increase in CD4 count. These Poisson model results are generally in line with those from the prevalence ratio regression. The risk factors with increased utilization match those previously identified from the literature.

Results from the negative binomial regression (Table 10.24) found having less than a high school education, being homeless, having ever been diagnosed with AIDS, and being depressed were associated with increased hospitalization rates. Moderate alcohol consumption and for every 100-cell increase in CD4 count were associated with decreased hospitalization rates. The negative binomial model results are in line with the prevalence ratio regression results. The negative binomial results share similar effect sizes with the Poisson model.

Results from zero inflated models consist of two parts. The first part is rate ratios among participants with one or more visits to the hospital. The second part contains odds ratios comparing those who visited the hospital to those who did not. Two zero-inflated models were calculated. The first using the Poisson distribution and the second using the negative binomial distribution. Poisson rate ratios (Table 11.25) demonstrated increased hospital utilization among those with a less than high school education and those with two or more unmet needs. Being of Hispanic ethnicity and using marijuana were associated with decreased hospital utilization. The Poisson odds ratio (Table 11.26) demonstrated increased hospitalization per one hundred fewer CD4 cells and decreased utilization among those were ages 30-39 and 40-49 years old.

Negative binomial rate ratios (Table 10.25) demonstrated increased hospitalization among the homeless, ever having been diagnosed with AIDs, failure to achieve durable viral suppression, and having three or more viral load or CD4 tests in the past year. Moderate alcohol consumption was associated with decreased hospitalization. The negative binomial odds ratio portion of the model was not stable, and thus we do no present those results.

The ordinal model divided hospital utilization into four groups. People were classified as not using hospital in the last year, making one hospital visit, two hospital visits, or three or more hospital visits. Ordinal logistic regression (Table 11.27) demonstrated increased odds of hospitalization among Blacks, those with an other sexual transmission behavior, the impoverished, the homeless those who failed to achieve durable viral suppression, and the depressed. Men who had sex with women only, those who consumed moderate amounts of alcohol and for every 100-cell increase in CD4 count had decreased hospital utilization. An ordinal model assumes that the change in odds is constant across categories of hospital visits.

A multinomial logistic regression does not assume a constant change in odds. Multinomial regression (Table 11.28) comparing those with one visit to those with none found that age, homelessness, failure to achieve durable viralogic suppression, and being depressed were associated with increased hospitalization. Comparison of those who made two visits to those who made none found the following factors to be associated with increased hospitalization; being depressed and failing to achieve durable viral suppression. Comparison of those who made three visits to those who made none found that having ever been diagnosed with AIDS was associated with increased odds of hospitalization.

The main prevalence ratio regression analysis found the following risk factors associated with increased odds of the hospitalization; being homeless, having ever been diagnosed with AIDS, failure to achieve durable viralogic suppression, and being depressed. For every 100 cell increase in CD4 counts the prevalence of hospital admissions declined. The sensitivity analysis models generally found the same risk factors to be associated with hospitalization as prevalence ratio regression. The results of the sensitivity analysis are summarized in Table 11.29.

Table 11.10 Prevalence ratio results for emergency department utilization using sexual transmission category

Variable Name	Bivariate PR[19] (95% CI[20])	Multivariate PR (95% CI)
Age in years		
18-29	Reference	Reference
29-39	1.16 (0.79-1.70)	1.01 0.65-1.56
40-49	1.00 (0.71-1.41)	1.02 0.75-1.40
$\geq$50	0.83 (0.58-1.19)	0.89 0.64-1.25
Sexual transmission category		
Men who have sex with men	Reference	Reference
Men who have sex with women only	1.07 (0.85-1.36)	0.76 0.58-0.99*
Women who have sex with men	1.42 (1.16-1.76)*[21]	1.12 0.91-1.39
Other	2.21 (1.50-3.23)*	1.70 1.11-2.50*
Race		
Non Hispanic White	Reference	Reference
Non Hispanic Black	1.48 (1.18-1.85)*	1.24 0.98-1.58
Hispanic	1.31 (0.98-1.76)	1.06 0.77-1.44
Other	1.49 (1.05-2.11)*	1.27 0.88-1.83
Education		
< High school	1.65 (1.34-2.02)*	1.12 0.90-1.40
High School diploma or equivalent	1.09 (0.87-1.36)	0.99 0.78-1.24
> High school	Reference	Reference
Poverty		
Below the federal poverty line	1.76 (1.46-2.11)*	1.22 0.98-1.53
Above the federal poverty line	Reference	Reference
Insured		
No	Reference	Reference
Yes	1.18 (0.88-1.57)	1.27 0.94-1.72
Homelessness		
No	Reference	Reference
Yes	2.09 (1.55-2.81)*	1.46 1.08-1.97*
Incarcerated		
No	Reference	Reference
Yes	1.82 (1.31-2.51)*	1.11 0.79-1.57
Number of unmet needs		
0	Reference	Reference
1	1.19 (0.89-1.58)	1.03 0.79-1.36
2 or More	1.84 (1.49-2.39)*	1.30 0.99-1.68
CD4+ T-cell count per 100 increase		

[19] PR=prevalence ratio
[20] CI=confidence interval
[21] P-value $\leq$ 0.05

<u>Continuous</u>		
0-50		2.84 1.98-4.06*
51-200		2.06 1.53-2.77*
200-350		1.19 0.92-1.54
350-500		1.40 1.14-1.70*
>500		Reference
<u>Lifetime AIDS status</u>		
Any lifetime AIDS diagnosis	1.53 (1.20-1.96)	1.08 0.82-1.42
No lifetime AIDS diagnosis	Reference	Reference
<u>Durable viral supression</u>		
No	1.79 (1.45-2.22)*	1.22 0.99-1.49
Yes	Reference	Reference
<u># of CD4 count and viral Load tests</u>		
<3	Reference	Reference
3 or More	0.91 (0.75-1.09)	1.06 0.88-1.27
<u>Depression</u>		
Not Depressed	Reference	Reference
Depressed	2.08 (1.65-2.63)*	1.57 1.24-1.99*
<u>Smoking</u>		
Current	0.92 (0.69-1.23)	1.09 0.80-1.50
Former	1.24 (0.99-1.54)	0.99 0.79-1.27
Never	Reference	Reference
<u>Alcohol use</u>		
None	Reference	Reference
Moderate	0.82 (0.66-1.02)	0.79 (0.61-1.01)
Hazardous/Binge	1.00 (0.76-1.32)	0.78 (0.59-1.04)
<u>Drug use for non-medical purposes</u>		
None	Reference	Reference
Marijuana Only	1.15 (0.83-1.57)	1.18 0.86-1.62
Other Non-Injection drugs	1.30 (1.01-1.69)	1.21 0.92-1.61
Injection Drug Use	1.71 (0.85-3.44)	1.32 0.71-2.49

Table 11.11 All variables included Logistic Regression Results Modeling of Emergency Department Utilization [22]

Variable Name	Odds Ratio	95% CI
18-29	1.00	1.00,1.00
30-39	1.06	0.63,1.78
40-49	1.07	0.74,1.55
>=50	0.90	0.61,1.33
White, non-Hispanic	1.00	1.00,1.00
Black, non-Hispanic	1.36	1.03,1.79
Hispanic or Latino	1.07	0.73,1.56
Other	1.33	0.84,2.09
Any MSM	1.00	1.00,1.00
MSW Only	0.72	0.53,0.99
Any WSM	1.14	0.88,1.48
Other	1.94	1.14,3.29
<High School	1.00	1.00,1.00
HS Diploma or Equivalent	0.87	0.62,1.21
More than High School	0.88	0.68,1.15
Not Impoverished	1.00	1.00,1.00
Impoverished	1.28	0.98,1.67
Insured	1.00	1.00,1.00
Uninsured	1.37	0.94,1.97
Not Homeless	1.00	1.00,1.00
Homeless	1.60	1.09,2.34
Not Incarcerated	1.00	1.00,1.00
Incarcerated	1.12	0.74,1.68
Ever Diagnosed with AIDS	1.00	1.00,1.00
Never Diagnosed with AIDS	1.09	0.76,1.58
CD4 count per 100 increase	0.89	0.83,0.95
All Viral Loads Suppressed	1.00	1.00,1.00
Not Suppressed VL[23]	1.29	1.01,1.65

[22] Logistic regression for the association of the above factors with emergency department utilization. Calculated using Stata 12with adjustment for the survey nature of the data.

[23] VL=viral load

Table 11.11 (continued) Logistic Regression Results of Emergency Department Utilization

Variable Name	Odds Ratio	
Not Depressed	1.00	1.00,1.00
Depressed	1.78	1.34,2.37
None	1.00	1.00,1.00
Moderate	0.75	0.56,1.02
Heavy/binge	0.75	0.54,1.04
Never Smoker	1.00	1.00,1.00
Former Smoker	1.11	0.76,1.63
Current Smoking	1.02	0.77,1.36
Injection Drug Use	1.34	0.64,2.83
Other Non IDU[24]	1.24	0.88,1.75
Marijuana only	1.25	0.86,1.81
No Drug Use	1.00	1.00,1.00
0 Unmet needs	1.00	1.00,1.00
1 Unmet Need	1.04	0.74,1.45
2 Unmet Needs	1.32	0.96,1.82
<3 CD4 or Viral Load Tests	1.00	1.00,1.00
>=3 CD4 or Viral Load Tests	1.04	0.83,1.30

[24] IDU=injection drug user

Table 11.12 Emergency Department Utilization Poisson Regression Results

Variable Name	Incidence Rate Ratio	95% CI
18-29	1.00	1.00,1.00
30-39	0.96	0.52,1.76
40-49	0.91	0.57,1.47
>=50	0.69	0.43,1.10
White, non-Hispanic	1.00	1.00,1.00
Black, non-Hispanic	1.04	0.71,1.50
Hispanic or Latino	0.69	0.44,1.08
Other	1.47	0.56,3.86
Any MSM	1.00	1.00,1.00
MSW Only	0.91	0.64,1.30
Any WSM	1.35	0.97,1.89
Other	1.58	0.89,2.83
<High School	0.99	0.66,1.50
HS Diploma or Equivalent	0.98	0.65,1.48
>High School	1.00	1.00,1.00
Not Impoverished	1.00	1.00,1.00
Impoverished	1.22	0.76,1.95
Insured	1.00	1.00,1.00
Uninsured	1.59	1.01,2.48
Not Homeless	1.00	1.00,1.00
Homeless	2.26	1.46,3.52
Not Incarcerated	1.00	1.00,1.00
Incarcerated	1.53	0.85,2.75
CD4 per 100 cell change	0.86	0.79,0.95
Never Diagnosed with AIDS	1.00	1.00,1.00
Diagnosed with AIDS	1.55	1.07,2.23
All Viral Loads Suppressed	1.00	1.00,1.00
Not Suppressed VL	1.31	0.94,1.83
Not Depressed	1.00	1.00,1.00
Depressed	1.57	0.98,2.51

Table 11.12 (cont) Emergency Department Utilization Poisson Regression Results

Variable Name	Incidence Rate Ratio	95% CI
No Alcohol Use	1.00	1.00,1.00
Moderate	0.73	0.54,1.00
Heavy/binge	0.84	0.44,1.62
Never Smoker	1.00	1.00,1.00
Former Smoker	1.13	0.77,1.67
Current Smoking	1.22	0.85,1.74
IDU	1.63	0.63,4.20
Other Non IDU	0.77	0.50,1.19
MJ only	0.79	0.48,1.30
None	1.00	1.00,1.00
0 Unmet Needs	1.00	1.00,1.00
1 Unmet Need	1.14	0.78,1.65
2 Unmet Needs	1.55	0.90,2.66
2 or fewer CD4 or viral load tests	1.00	1.00,1.00
3 or more tests	1.06	0.79,1.43

Table 11.13 Emergency Department Utilization Negative Binomial Regression Results

Variable Name	Incidence Rate Ratio	95% CI
18-29	1.00	1.00,1.00
30-39	1.05	0.53,2.05
40-49	0.95	0.61,1.48
>=50	0.78	0.48,1.28
White, non-Hispanic	1.00	1.00,1.00
Black, non-Hispanic	1.11	0.77,1.60
Hispanic or Latino	0.81	0.54,1.21
Other	1.52	0.77,2.99
Any MSM	1.00	1.00,1.00
MSW Only	0.77	0.58,1.01
Any WSM	1.34	0.97,1.85
Other	2.22	1.19,4.12
<High School	1.09	0.80,1.49
HS Diploma or Equivalent	1.07	0.69,1.65
>High School	1.00	1.00,1.00
Not Impoverished	1.00	1.00,1.00
Impoverished	1.37	1.04,1.81
Insured	1.00	1.00,1.00
Uninsured	1.38	0.87,2.19
Not Homeless	1.00	1.00,1.00
Homeless	2.41	1.49,3.89
Not Incarcerated	1.00	1.00,1.00
Incarcerated	1.55	0.93,2.60
Never Diagnosed with AIDS	1.00	1.00,1.00
Diagnosed with AIDS	1.30	0.95,1.77
CD4 per 100 cell change	0.88	0.82,0.94
All Viral Loads Suppressed	1.00	1.00,1.00
Not Suppressed VL	1.47	1.10,1.95
Not Depressed	1.00	1.00,1.00
Depressed	1.83	1.41,2.39

Table 11.13 (cont) Emergency Department Utilization Negative Binomial Regression Results

Variable Name	Incidence Rate Ratio	95% CI
No Alcohol Use	1.00	1.00,1.00
Moderate	0.62	0.47,0.81
Heavy/binge	0.67	0.45,1.00
Never Smoker	1.00	1.00,1.00
Former Smoker	1.09	0.77,1.56
Current Smoking	1.20	0.85,1.70
IDU	1.29	0.56,2.97
Other Non IDU	0.90	0.66,1.21
Marijuana only	1.01	0.65,1.55
None	1.00	1.00,1.00
0 Unmet Needs	1.00	1.00,1.00
1 Unmet Needs	1.18	0.82,1.70
2 or more Unmet Needs	1.40	1.04,1.88
<3 CD4 or viral load tests	1.00	1.00,1.00
3 or more tests	1.06	0.82,1.36

Table 11.14 Emergency Department Utilization Zero Inflated Poisson and Negative Binomial Regression Results for the Non-Zero Part of the Model [25]

Variable Name	Incidence Rate Ratio And 95% CI		Negative Binomial IRR and 95% CI	
18-29	1.00	1.00,1.00	1.00	1.00,1.00
30-39	0.84	0.41,1.72	0.90	0.47,1.74
40-49	0.80	0.45,1.40	0.93	0.57,1.50
>=50	0.70	0.34,1.42	0.78	0.47,1.30
White, non-Hispanic	1.00	1.00,1.00	1.00	1.00,1.00
Black, non-Hispanic	0.75	0.47,1.20	1.24	0.87,1.78
Hispanic or Latino	0.68	0.44,1.06	0.80	0.54,1.18
Other	1.55	0.58,4.14	2.79	1.31,5.96
Any MSM	1.00	1.00,1.00	1.00	1.00,1.00
MSW Only	1.15	0.69,1.90	0.60	0.45,0.79
Any WSM	1.27	0.95,1.71	1.25	0.90,1.72
Other	0.90	0.48,1.69	1.70	0.94,3.06
<High School	0.76	0.47,1.24	1.07	0.78,1.47
HS Diploma or Equivalent	1.04	0.73,1.47	1.15	0.73,1.80
>High School	1.00	1.00,1.00	1.00	1.00,1.00
Not Impoverished	1.00	1.00,1.00	1.00	1.00,1.00
Impoverished	1.11	0.74,1.66	1.15	0.87,1.53
Insured	1.00	1.00,1.00	1.00	1.00,1.00
Uninsured	1.32	0.87,1.99	1.13	0.73,1.76
Not Homeless	1.00	1.00,1.00	1.00	1.00,1.00
Homeless	1.86	1.37,2.51	3.72	2.23,6.20
Not Incarcerated	1.00	1.00,1.00	1.00	1.00,1.00
Incarcerated	1.49	0.95,2.33	1.51	0.94,2.43
Never Diagnosed with AIDS	1.00	1.00,1.00	1.00	1.00,1.00
Ever Diagnosed with AIDS	2.10	1.40,3.16	1.86	1.40,2.47

[25] [25] Tables 5.6 and 5.7 contain the results of zero inflated Poisson and negative binomial models. Zero inflated models consist of two parts. The first part calculates rate ratios for those persons with one or more visits. The second part calculates the odds ratio for people with zero visits compared to this with one or more visits.

Table 11.14 (cont)Emergency Department Utilization Zero Inflated Poisson and Negative Binomial Regression Results for the Non-Zero Part of the Model [26]

Variable Name	Incidence Rate Ratio And 95% CI		Negative Binomial IRR and 95% CI	
CD4 count per 100 cell increase	0.98	0.93,1.04	0.88	0.83,0.94
All Viral Loads Suppressed	1.00	1.00,1.00	1.00	1.00,1.00
Not Suppressed VL	1.15	0.89,1.48	1.04	0.79,1.36
Not Depressed	1.00	1.00,1.00	1.00	1.00,1.00
Depressed	1.08	0.76,1.55	1.60	1.24,2.08
None	1.00	1.00,1.00	1.00	1.00,1.00
Moderate	0.78	0.56,1.10	0.56	0.42,0.74
Heavy/binge	0.88	0.51,1.51	0.53	0.36,0.77
Never Smoker	1.00	1.00,1.00	1.00	1.00,1.00
Former Smoker	1.06	0.66,1.70	1.07	0.76,1.51
Current Smoking	1.36	0.98,1.90	1.16	0.81,1.65
IDU	1.11	0.50,2.46	1.42	0.64,3.14
Other Non IDU	0.60	0.42,0.86	0.84	0.60,1.17
MJ only	0.55	0.37,0.82	1.01	0.67,1.51
None	1.00	1.00,1.00	1.00	1.00,1.00
0 Unmet Needs	1.00	1.00,1.00	1.00	1.00,1.00
1 Unmet Need	1.26	0.83,1.93	1.15	0.79,1.67
2 or more Unmet Needs	1.19	0.76,1.88	1.09	0.82,1.45
<3 CD4 or viral load tests	1.00	1.00,1.00	1.00	1.00,1.00
3 or more tests	1.05	0.78,1.42	1.22	0.96,1.56

[26] [26] Tables 5.6 and 5.7 contain the results of zero inflated Poisson and negative binomial models. Zero inflated models consist of two parts. The first part calculates rate ratios for those persons with one or more visits. The second part calculates the odds ratio for people with zero visits compared to this with one or more visits.

Table 11.15 Emergency Department Utilization Zero Inflated Poisson and Negative Binomial Regression Results for the Inflated Part of the Model

Variable Name	Odds Ratio Poisson	95% CI	Odds Ratio NB[27] 95% CI
18-29	1.00	1.00,1.00	
30-39	0.85	0.44,1.62	
40-49	0.84	0.52,1.35	
>=50	0.95	0.53,1.68	
White, non-Hispanic	1.00	1.00,1.00	
Black, non-Hispanic	0.64	0.46,0.91	
Hispanic or Latino	0.80	0.51,1.26	
Other	0.88	0.54,1.42	
Any MSM	1.00	1.00,1.00	
MSW Only	1.49	0.93,2.39	
Any WSM	0.97	0.70,1.33	
Other	0.45	0.22,0.91	
<High School	0.76	0.51,1.13	
HS Diploma or Equivalent	1.04	0.79,1.35	
>High School	1.00	1.00,1.00	
Not Impoverished	1.00	1.00,1.00	
Impoverished	0.81	0.60,1.11	
Insured	1.00	1.00,1.00	
Uninsured	0.83	0.53,1.29	
Not Homeless	1.00	1.00,1.00	
Homeless	0.76	0.51,1.14	
Not Incarcerated	1.00	1.00,1.00	
Incarcerated	1.03	0.66,1.59	
Never Diagnosed with AIDS	1.00	1.00,1.00	
Ever Diagnosed with AIDS	1.35	0.80,2.26	
CD4 count per 100 cell increase	1.13	1.05,1.22	

[27] The negative binomial model produces results for the inflated portion that are not correct. Estimates ranged from 0 to 10E+23

Table 11.15 (cont) Emergency Department Utilization Zero Inflated Poisson and Negative Binomial Regression Results for the Inflated Part of the Model

Variable Name	Odds Ratio Poisson	95% CI	Odds Ratio NB[28] 95% CI
All Viral Loads Suppressed	1.00	1.00,1.00	
Not Suppressed VL	0.82	0.62,1.07	
Not Depressed	1.00	1.00,1.00	
Depressed	0.56	0.40,0.78	
None	1.00	1.00,1.00	
Moderate	1.20	0.81,1.78	
Heavy/binge	1.25	0.85,1.84	
Never Smoker	1.00	1.00,1.00	
Former Smoker	0.91	0.54,1.52	
Current Smoking	1.11	0.78,1.58	
IDU	0.74	0.39,1.41	
Other Non IDU	0.63	0.42,0.93	
MJ only	0.58	0.38,0.91	
None	1.00	1.00,1.00	
0 Unmet Needs	1.00	1.00,1.00	
1 Unmet Need	1.06	0.71,1.59	
2 or more Unmet Needs	0.80	0.56,1.14	
<3 CD4 or viral load tests	1.00	1.00,1.00	
3 or more tests	0.98	0.76,1.28	

[28] The negative binomial model produces results for the inflated portion that are not correct. Estimates ranged from 0 to 10E+23

Table 11.16 Results of Multivariate Ordinal Logistic Modeling of Number of Emergency Department Visits [29]

Variable Name	Odds Ratio and 95%CI	
18-29	1.00	1.00,1.00
30-39	1.04	0.61,1.75
40-49	1.05	0.73,1.53
>=50	0.89	0.60,1.32
White, non-Hispanic	1.00	1.00,1.00
Black, non-Hispanic	1.33	1.02,1.75
Hispanic or Latino	1.05	0.71,1.54
Other	1.31	0.83,2.06
Any MSM	1.00	1.00,1.00
MSW Only	0.73	0.54,0.98
Any WSM	1.16	0.89,1.51
Other	1.92	1.08,3.44
<High School	1.07	0.82,1.39
HS Diploma or Equivalent	0.96	0.71,1.29
>High School	1.00	1.00,1.00
Not Impoverished	1.00	1.00,1.00
Impoverished	1.31	1.00,1.72
Insured	1.00	1.00,1.00
Uninsured	1.36	0.93,2.01
Not Homeless	1.00	1.00,1.00
Homeless	1.62	1.10,2.39
Not Incarcerated	1.00	1.00,1.00
Incarcerated	1.17	0.76,1.80
Never Diagnosed with AIDS	1.00	1.00,1.00
Ever Diagnosed with AIDS	1.14	0.78,1.65
CD4 count per 100 cell increase	0.88	0.83,0.95
All Viral Loads Suppressed	1.00	1.00,1.00
Not Suppressed VL	1.30	1.01,1.67

[29] This model was calculated using the same dataset used in Table 5.3-5.5. The number of visits for the ordinal model was classified as zero visits, one visit, two visits, three or more visits.

Table 11.16 (cont)Results of Multivariate Ordinal Logistic Modeling of Number of Emergency Department Visits [30]

Variable Name	Odds Ratio and 95%CI	
Not Depressed	1.00	1.00,1.00
Depressed	1.82	1.37,2.42
None	1.00	1.00,1.00
Moderate	0.74	0.54,1.00
Heavy/binge	0.74	0.53,1.04
Never Smoker	1.00	1.00,1.00
Former Smoker	1.12	0.76,1.63
Current Smoking	1.02	0.77,1.37
IDU	1.33	0.61,2.91
Other Non IDU	1.24	0.88,1.76
MJ only	1.23	0.86,1.78
None	1.00	1.00,1.00
0 Unmet Needs	1.00	1.00,1.00
1 Unmet Needs	1.05	0.75,1.46
2 or more Unmet Needs	1.35	0.98,1.86
<3 CD4 or viral load tests	1.00	1.00,1.00
3 or more tests	1.03	0.82,1.28

[30] This model was calculated using the same dataset used in Table 5.3-5.5. The number of visits for the ordinal model was classified as zero visits, one visit, two visits, three or more visits.

Table 11.17 Results of Multivariate Multinomial Logistic Modeling of Number of Emergency Department Visits [31]

Variable Name	Odds Ratio 95% CI 1visit vs 0		Odds Ratio 95% CI 2 visits vs 0		Odds Ratio 95% CI 3+ visits vs 0	
18-29	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
30-39	1.11	0.64,1.94	1.23	0.34,4.46	0.86	0.35,2.15
40-49	1.15	0.69,1.93	1.07	0.37,3.11	0.93	0.42,2.07
>=50	0.89	0.49,1.64	1.06	0.36,3.09	0.80	0.38,1.71
White	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Black	1.60	1.05,2.43	1.47	0.93,2.31	0.95	0.58,1.54
Hispanic	1.46	0.94,2.26	1.06	0.53,2.14	0.60	0.29,1.24
Other	1.69	0.95,2.99	1.08	0.25,4.64	1.02	0.32,3.22
Any MSM	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
MSW Only	0.60	0.37,0.97	0.88	0.48,1.62	0.84	0.50,1.42
Any WSM	1.05	0.73,1.52	0.84	0.44,1.60	1.62	1.00,2.63
Other	1.64	0.91,2.95	1.56	0.61,3.98	2.85	1.04,7.85
<High School	1.49	0.90,2.45	1.16	0.63,2.14	0.73	0.46,1.14
HS Diploma	1.20	0.81,1.78	0.83	0.33,2.08	0.81	0.47,1.39
>High School	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Not Impoverished	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Impoverished	0.99	0.73,1.34	1.72	0.95,3.11	1.61	0.98,2.64
Insured	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Uninsured	1.52	0.99,2.34	1.34	0.74,2.41	1.15	0.56,2.37
Not Homeless	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Homeless	1.40	0.81,2.41	1.41	0.70,2.84	2.05	1.14,3.70
Not Incarcerated	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Incarcerated	0.89	0.48,1.65	0.85	0.33,2.18	1.74	0.86,3.52
Never Diagnosed	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Ever Diagnosed	0.89	0.60,1.33	0.84	0.45,1.54	2.28	1.30,3.99
CD4 per 100	0.92	0.84,1.00	0.87	0.77,0.99	0.84	0.76,0.93
Viral Suppresion	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
VL Unsuppressed	1.33	0.96,1.85	0.75	0.47,1.20	1.86	1.18,2.93
Not Depressed	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Depressed	1.46	0.95,2.24	2.96	1.73,5.09	1.66	0.99,2.77

[31] This model was calculated using the same dataset as Tables 5.3-5.6. The number of visits for the multinomial model was classified as zero visits, one visit, two visits, three or more visits.

Table 11.17 (cont) Results of Multivariate Multinomial Logistic Modeling of Number of Emergency Department Visits [32]

Variable Name	Odds Ratio 95% CI 1 visit vs 0 visits		Odds Ratio 95% CI 2 visits vs 0		Odds Ratio 95% CI 3+ visits vs 0	
None	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Moderate	0.95	0.60,1.50	0.78	0.52,1.18	0.49	0.31,0.78
Heavy/binge	0.79	0.51,1.21	1.02	0.53,1.99	0.54	0.26,1.15
Never Smoker	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Former Smoker	1.19	0.71,1.99	0.92	0.51,1.66	1.16	0.66,2.02
Current Smoking	1.00	0.67,1.49	1.09	0.59,2.00	0.99	0.61,1.62
IDU	0.80	0.34,1.91	2.84	1.14,7.06	1.11	0.36,3.40
Other Non IDU	1.31	0.84,2.04	1.05	0.45,2.46	1.23	0.67,2.28
MJ only	1.16	0.67,2.00	1.88	1.06,3.33	0.94	0.50,1.77
None	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
0 Unmet Needs	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
1 Unmet Need	0.94	0.60,1.46	1.13	0.61,2.09	1.17	0.71,1.93
>=2 Unmet Needs	1.31	0.86,1.99	1.03	0.48,2.17	1.71	1.07,2.74
<3 CD4/VL Tests	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
>=3 CD4/VL Tests	1.11	0.80,1.53	0.95	0.62,1.46	1.04	0.68,1.58

[32] This model was calculated using the same dataset as Tables 5.3-5.6. The number of visits for the multinomial model was classified as zero visits, one visit, two visits, three or more visits.

Table 11.18 Summary of the Factors associated with Emergency Department Utilization Using Poisson, negative binomial, zero-inflated Poisson and negative binomial, ordinal and multinomial logistic regression[33]

Model	Age	Sexual transmission Group	Race	Education	Impoverished
Prevalence Ratio	NS	Men who have sex with women only UP	NS	NS	NS
Poisson	NS	NS	NS	NS	NS
Negative Binomial	NS	Other UP	NS	NS	Impoverished UP
Zero Inflated Poisson Incidence	NS	NS	NS	NS	NS
Zero Inflated Negative Binomial Incidence	NS	NS	Other UP	NS	NS
Zero Inflated Poisson Odds Ratios	NS	Other	Black DOWN	NS	NS
Multinomial Logistic Regression	NS	Other UP Men who have sex with women only DOWN	Black UP	NS	Impoverished UP
Ordinal Logistic 2vs1	NS	Men who have sex with women only DOWN	Black UP	NS	NS
Ordinal Logistic 3vs1	NS	NS	NS	NS	NS
Ordinal Logistic 4vs1	NS	Women who have sex with men only UP Other	NS	NS	NS

[33] The word following the variable name denotes the direction of the effect.

Table 11.18 (cont) Summary of the Factors associated with Emergency Department Utilization Using Poisson, negative binomial, zero-inflated Poisson and negative binomial, ordinal and multinomial logistic regression

Model	Insurance	Homeless	Incarcerated	Impoverished	CD4 Count
Prevalence Ratio	NS	Homeless UP	NS	NS	CD4 count UP
Poisson	Uninsured UP	Homeless UP	NS	NS	CD4 Count UP
Negative Binomial	NS	Homeless UP	NS	NS	CD4 Count UP
Zero Inflated Poisson Incidence	NS	Homeless UP	NS	NS	NS
Zero Inflated Negative Binomial Incidence	NS	Homeless UP	NS	NS	CD4 Count UP
Zero Inflated Poisson Odds Ratios	NS	NS	NS	NS	CD4 Count UP
Multinomial Logistic Regression	NS	Homeless UP	NS	NS	CD4 Count UP
Ordinal Logistic 2vs1	NS	NS	NS	NS	NS
Ordinal Logistic 3vs1	NS	NS	NS	NS	CD4 Count UP
Ordinal Logistic 4vs1	Ns	Homeless UP	NS	NS	CD4 Count UP

Table 11.18 (cont) Summary of the Factors associated with Emergency Department Utilization Using Poisson, negative binomial, zero-inflated Poisson and negative binomial, ordinal and multinomial logistic regression

Model	Viral Load	AIDS Diagnosis	Depressed	Alcohol Use	Smoking	Drug use for Non-Medical Purposes
Prevalence Ratio		NS	Depressed	NS	NS	NS
Poisson	NS	AIDS Diagnosis. UP	NS	Moderate EtOH DOWN	NS	NS
Negative Binomial	Viral Load UP	NS	Depressed	Moderate EtOH DOWN	NS	NS
Zero Inflated Poisson Incidence	NS	AIDS Diagnosis UP	NS	Moderate EtOH DOWN	NS	Marijuana Only DOWN
Zero Inflated Negative Binomial Incidence	NS	AIDS Diagnosis UP	NS	Moderate EtoH DOWN Heavy EtOH DOWN	NS	NS
Zero Inflated Poisson Odds Ratios	NS	NS	Depressed	NS	NS	Marijuana Only DOWN Other Non-IDU DOWN
Multinomial Logistic Regression	Viral Load UP	NS	Depressed	Moderate EtOH DOWN		
Ordinal Logistic 2vs1	NS	NS	NS	NS	NS	NS
Ordinal Logistic 3vs1	NS	NS	Depressed	NS	NS	Marijuana Only DOWN
Ordinal Logistic 4vs1	Viral Load UP	AIDS Diagnosis UP	NS	Moderate EtOH DOWN	NS	NS

Table 11.18 (cont)Summary of the Factors associated with Emergency Department Utilization Using Poisson, negative binomial, zero-inflated Poisson and negative binomial, ordinal and multinomial logistic regression

Model	Unmet Needs	Viral Load and CD4 Tests
Prevalence Ratio	NS	NS
Poisson	NS	NS
Negative Binomial	Two or more unmet needs UP	NS
Zero Inflated Poisson Incidence	NS	NS
Zero Inflated Negative Binomial Incidence	NS	NS
Zero Inflated Poisson Odds Ratios	NS	NS
Multinomial Logistic Regression	NS	NS
Ordinal Logistic 2vs1	NS	NS
Ordinal Logistic 3vs1	NS	NS
Ordinal Logistic 4vs1	NS	NS

Table 11.19 Results of the Exploratory Factor goodness of fit tests using the model with primary care visits are listed first. The results from the main manuscript model are listed second. [34]

Fit Index	1 Factor Model	2 Factor Model	3 Factor Model	4 Factor Model	5 Factor Model	6 Factor Model	7 Factor Model
CFI[35]	.407	.651	.829	.940	.978	.991	.996
TLI[36]	.323	.539	.736	.890	.951	.974	.987
RMSEA[37]	.055	.045	.034	.022	.015	.010	.008
CFI[38]	.383	.498	NC[39]	.968	NC	.994	.999
TLI[40]	.295	.337	NC	.941	NC	.983	.995
RMSEA[41]	.072	.070	NC	.021	NC	.011	.006

[34] The goodness of fit tests were calculated for structural equation models containing between 1 and 5 latent factors using the MPLUS software.
[35] CFI-Comparative fit index
[36] Tucker Lewis Index
[37] Root mean square error of approximation
[38] CFI-Comparative fit index
[39] NC=non convergent model
[40] Tucker Lewis Index
[41] Root mean square error of approximation

Table 11.20 Classification of Hospital Utilization at the Predicted Probability of ½ [42]

	Predicted to Use the Hospital	Predicted not to Use the Hospital
Admitted to the Hospital	3	281
Not Admitted to the Hospital	6	3482
Totals	9	3753

[42] Predicted probability of hospital was calculated for each individual in the dataset using the coefficients from logistic regression. These were then classified into being below or above ½ . If above ½ the person was considered to have been admitted to the hospital. If below ½ the person was considered to have not used the hospital. The classification was compared against the persons actual outcome to determine sensitivity and specificity.

Table 11.21 Prevalence ratio regression results of bivariate and multivariate associations between the measured variables and hospital utilization

Variable Name	Bivariate PR[43] (95% CI[44])	Multivariate PR (95%CI)
Age in years		
18-29	Reference	Reference
29-39	1.57 (0.97-2.55)	1.49 0.94-2.36
40-49	1.32 (0.83-2.10)	1.42 0.92-2.17
≥50	1.12 (0.69-1.83)	1.27 0.82 1.97
Sexual behavior transmission group		
Men who have sex with men	Reference	Reference
Men who have sex with women only	1.21 (0.90-1.64)	0.84 0.55-1.29
Women who have sex with women or men	1.36 (1.00-1.83)*	1.20 0.89-1.61
Other	2.49 (1.53-4.05)*	1.83 1.06-3.16
Race		
Non Hispanic White	Reference	Reference
Non Hispanic Black	1.22 (0.92-1.62)	0.87 0.63-1.20
Hispanic	1.47 (1.02-2.13)*	1.06 0.67-1.68
Other	0.90 (0.50-1.60)	0.59 0.29-1.23
Education		
< High School	1.80 (1.37-2.37)*	1.14 0.82-1.59
High School diploma or equivalent	1.11 (0.85-1.43)	0.93 0.74-1.16
> High School	Reference	Reference
Poverty		
Below the federal poverty line	1.82 (1.44-2.29)*	1.16 0.89-1.50
Above the federal poverty line	Reference	Reference
Insured		
No	1.28 (0.93-1.79)	1.07 0.78-1.47
Yes	Reference	Reference
Homeless		
No	Reference	Reference
Yes	2.54 (1.64-3.94)*	1.73 1.15-2.60
Incarcerated		
No	Reference	Reference
Yes	2.15 (1.49-3.12)*	1.18 0.81-1.71
Number of Unmet Needs		
0	Reference	Reference
1	1.25 (0.95-1.63)	0.94 0.71-1.23
2 or More	1.76 (1.36-2.27)	1.11 0.84-1.46

[43] PR=prevalence ratio
[44] CI=confidence interval

Geometric Mean CD4 count		
0-50		4.38 2.96-6.46
50-200		3.16 2.38-4.20
200-350		1.47 1.09-1.96
350-500		1.44 1.05-1.99
500+		Reference
Lifetime AIDS Status		
No lifetime AIDS diagnosis	3.01 (2.11-4.32)*	1.81 1.13 2.91
Any lifetime AIDS diagnosis	Reference	Reference
All Viral Loads in 2009 <200		
No	2.36 (1.74-3.21)*	1.46 1.08-1.97
Yes	Reference	Reference
# of CD4 Count and Viral Load Tests		
<3	Reference	Reference
3 or More	1.05 (0.82-1.34)	1.15 0.92-1.44
Depression		.
Not Depressed	Reference	Reference
Depressed	2.29 (1.37-3.13)*	1.53 1.07-2.21
Smoking		
Current	1.05 (0.77-1.42)	1.20 0.86-1.68
Former	1.47 (1.17-1.88)	1.20 0.96-1.49
Never	Reference	Reference
Alcohol use		
None	Reference	Reference
Moderate	0.84 (0.64-1.10)	0.84 0.60-1.17
Hazardous or Binge	1.11 (0.77-1.58)	0.86 0.54-1.37
Drug use for non-medical purposes		
None	Reference	Reference
Marijuana only	1.23 (0.82-1.85)	1.03 0.53-1.99
Other Non-Injection drugs	1.37 (0.96-1.96)	1.06 0.64-1.77
Injection drug use	1.70 (0.82-3.57)	1.22 0.79-1.89

Table 11.22 Table of Logistic Regression Results for who was admitted at least once to hospital

Variable Name	Odds Ratio	95%CI
18-29	1.00	1.00,1.00
30-39	1.73	1.00,2.99
40-49	1.59	0.96,2.62
>=50	1.37	0.82,2.30
White, non-Hispanic	1.00	1.00,1.00
Black, non-Hispanic	0.91	0.62,1.33
Hispanic or Latino	1.08	0.63,1.83
Other	0.56	0.24,1.28
Any MSM	1.00	1.00,1.00
MSW Only	0.81	0.49,1.35
Any WSM	1.21	0.84,1.74
Other	2.11	1.04,4.28
<High School	1.16	0.78,1.73
HS Diploma or Equivalent	0.90	0.68,1.20
>High School	1.00	1.00,1.00
Not Impoverished	1.00	1.00,1.00
Impoverished	1.22	0.90,1.64
Insured	1.00	1.00,1.00
Uninsured	1.12	0.76,1.65
Not Homeless	1.00	1.00,1.00
Homeless	1.98	1.20,3.27
Not Incarcerated	1.00	1.00,1.00
Incarcerated	1.17	0.76,1.80
Never Diagnosed with AIDS	1.00	1.00,1.00
Ever Diagnosed with AIDS	2.13	1.25,3.63
CD4 per 100 cell change	0.82	0.74,0.92
All Viral Loads Suppressed	1.00	1.00,1.00
Not Suppressed VL	1.69	1.19,2.40
Not Depressed	1.00	1.00,1.00
Depressed	1.73	1.12,2.68

Table 11.22(cont) Table of Logistic Regression Results for who was admitted at least once to hospital

Variable Name	Odds Ratio	95%CI
None	1.00	1.00,1.00
Moderate	0.81	0.55,1.20
Heavy/binge	0.84	0.48,1.45
Never Smoker	1.00	1.00,1.00
Former Smoker	1.24	0.81,1.88
Current Smoking	1.28	0.99,1.66
IDU	0.98	0.47,2.06
Other Non IDU	1.07	0.60,1.91
MJ only	1.31	0.79,2.16
None	1.00	1.00,1.00
0 unmet needs	1.00	1.00,1.00
1 unmet need	0.93	0.66,1.30
2 unmet needs	1.09	0.78,1.52
<3 CD4 or Viral Load Test	1.00	1.00,1.00
>=3 CD4 or Viral Load Tests	1.14	0.87,1.50

Table 11.23 Results of Multivariate Poisson Modeling of Number of Hospital Admissions [45]

Variable Name	Incidence Rate Ratio	95%CI
18-29	1.00	1.00,1.00
30-39	1.14	0.54,2.39
40-49	1.07	0.51,2.25
>=50	0.92	0.41,2.06
White, non-Hispanic	1.00	1.00,1.00
Black, non-Hispanic	1.05	0.78,1.41
Hispanic or Latino	0.81	0.47,1.40
Other	0.53	0.24,1.16
Any MSM	1.00	1.00,1.00
MSW Only	0.65	0.42,1.01
Any WSM	1.26	0.83,1.91
Other	1.56	0.74,3.30
<High School	1.46	0.98,2.17
HS Diploma or Equivalent	1.12	0.84,1.48
>High School	1.00	1.00,1.00
Not Impoverished	1.00	1.00,1.00
Impoverished	1.30	0.98,1.71
Insured	1.00	1.00,1.00
Uninsured	1.18	0.82,1.69
Not Homeless	1.00	1.00,1.00
Homeless	2.27	1.18,4.35
Not Incarcerated	1.00	1.00,1.00
Incarcerated	1.00	0.52,1.93
Never Diagnosed with AIDS	1.00	1.00,1.00
Ever Diagnosed with AIDS	2.78	1.62,4.76
CD4 per 100 cell change	0.81	0.73,0.90
All Viral Loads Suppressed	1.00	1.00,1.00
Not Suppressed VL	1.35	0.89,2.05

[45] Poisson and Negative binomial models were calculated by using hospital admissions as a continuous variable. The dataset and variable definitions are the same as those used in the logistic regression paper.

Table 11.23(cont) Results of Multivariate Poisson Modeling of Number of Hospital Admissions

Variable Name	Incidence Rate Ratio	95%CI
Not Depressed	1.00	1.00,1.00
Depressed	1.32	0.79,2.20
None	1.00	1.00,1.00
Moderate	0.76	0.49,1.18
Heavy/binge	1.09	0.60,1.99
Never Smoker	1.00	1.00,1.00
Former Smoker	1.10	0.69,1.75
Current Smoking	1.13	0.74,1.73
IDU	0.72	0.39,1.32
Other Non IDU	0.91	0.49,1.71
MJ only	0.89	0.53,1.49
None	1.00	1.00,1.00
0 unmet needs	1.00	1.00,1.00
1 Unmet Need	1.12	0.77,1.63
2 unmet needs	1.59	1.06,2.38
<3 CD4 or Viral Load Test	1.00	1.00,1.00
>=3 CD4 or Viral Load Tests	1.06	0.78,1.46

Table 11.24 Results of Multivariate Negative Binomial Modeling of Number of Hospital Admissions

Variable Name	Incidence Rate Ratio	95%CI
18-29	1.00	1.00,1.00
30-39	1.73	0.97,3.09
40-49	1.39	0.77,2.51
>=50	1.06	0.54,2.10
White, non-Hispanic	1.00	1.00,1.00
Black, non-Hispanic	1.21	0.89,1.66
Hispanic or Latino	0.96	0.58,1.60
Other	0.49	0.23,1.06
Any MSM	1.00	1.00,1.00
MSW Only	0.72	0.45,1.16
Any WSM	1.17	0.83,1.67
Other	2.12	0.90,5.02
<High School	1.58	1.03,2.43
HS Diploma or Equivalent	1.06	0.76,1.46
>High School	1.00	1.00,1.00
Not Impoverished	1.00	1.00,1.00
Impoverished	1.21	0.88,1.67
Insured	1.00	1.00,1.00
Uninsured	1.26	0.80,1.97
Not Homeless	1.00	1.00,1.00
Homeless	2.09	1.18,3.70
Not Incarcerated	1.00	1.00,1.00
Incarcerated	1.19	0.65,2.20
Never Diagnosed with AIDS	1.00	1.00,1.00
Ever Diagnosed with AIDS	2.81	1.55,5.11
CD4 per 100 cell change	0.86	0.78,0.96
All Viral Loads Suppressed	1.00	1.00,1.00
Not Suppressed VL	1.72	1.22,2.41
Not Depressed	1.00	1.00,1.00
Depressed	1.58	1.07,2.32

Table 11.24(cont) Results of Multivariate Negative Binomial Modeling of Number of Hospital Admissions

Variable Name	Incidence Rate Ratio	95%CI
None	1.00	1.00,1.00
Moderate	0.61	0.42,0.88
Heavy/binge	0.76	0.48,1.22
Never Smoker	1.00	1.00,1.00
Former Smoker	1.13	0.74,1.74
Current Smoking	1.20	0.85,1.70
IDU	0.88	0.48,1.61
Other Non IDU	1.20	0.68,2.12
MJ only	0.98	0.60,1.62
None	1.00	1.00,1.00
0 unmet needs	1.00	1.00,1.00
1 Unmet Need	1.00	0.68,1.46
2 unmet needs	1.40	0.99,2.00
<3 CD4 or Viral Load Test	1.00	1.00,1.00
>=3 CD4 or Viral Load Tests	1.14	0.81,1.61

Table 11.25 Results of the Non-Zero portion of the Zero Inflated Poisson and Negative Binomial Models of Hospital Admissions [46]

Variable Name	Poisson Incidence Rate Ratio	95%CI	Negative Binomial IRR	95%CI
18-29	1.00	1.00,1.00	1.00	1.00,1.00
30-39	0.88	0.45,1.74	0.63	0.28,1.39
40-49	0.76	0.39,1.49	0.74	0.33,1.64
>=50	0.72	0.32,1.60	0.53	0.22,1.26
White, non-Hispanic	1.00	1.00,1.00	1.00	1.00,1.00
Black, non-Hispanic	1.03	0.71,1.49	1.19	0.80,1.76
Hispanic or Latino	0.50	0.28,0.90	0.93	0.51,1.68
Other	0.62	0.23,1.69	0.76	0.29,2.02
Any MSM	1.00	1.00,1.00	1.00	1.00,1.00
MSW Only	0.67	0.41,1.09	0.80	0.46,1.40
Any WSM	0.94	0.63,1.40	1.37	0.91,2.06
Other	0.89	0.40,2.01	1.62	0.70,3.79
<High School	1.77	1.06,2.97	0.84	0.54,1.32
HS Diploma or Equivalent	1.50	0.89,2.52	0.95	0.66,1.38
>High School	1.00	1.00,1.00	1.00	1.00,1.00
Not Impoverished	1.00	1.00,1.00	1.00	1.00,1.00
Impoverished	1.49	0.94,2.36	1.23	0.75,2.01
Insured	1.00	1.00,1.00	1.00	1.00,1.00
Uninsured	1.71	0.93,3.15	0.84	0.38,1.86
Not Homeless	1.00	1.00,1.00	1.00	1.00,1.00
Homeless	1.49	0.96,2.31	2.79	1.57,4.95
Not Incarcerated	1.00	1.00,1.00	1.00	1.00,1.00
Incarcerated	0.82	0.47,1.42	1.09	0.53,2.22
Never Diagnosed with AIDS	1.00	1.00,1.00	1.00	1.00,1.00
Ever Diagnosed with AIDS	1.74	0.98,3.09	2.45	1.20,4.99
CD4 per 100 cell change	0.99	0.93,1.05	0.92	0.81,1.04

[46] Tables 5.15 and 5.16 contain the results of zero inflated Poisson and negative binomial models. Zero inflated models consist of two parts. The first part calculates rate ratios for those persons with one or more visits. The second part calculates the odds ratio for people with zero visits compared to this with one or more visits.

Table 11.25(cont) Results of the Non-Zero portion of the Zero Inflated Poisson and Negative Binomial Models of Hospital Admissions

Variable Name	Poisson Incidence Rate Ratio	95%CI	Negative Binomial IRR	95%CI
All Viral Loads Suppressed	1.00	1.00,1.00	1.00	1.00,1.00
Not Suppressed VL	1.00	0.59,1.70	1.72	1.22,2.43
Not Depressed	1.00	1.00,1.00	1.00	1.00,1.00
Depressed	0.86	0.60,1.23	1.14	0.72,1.80
None	1.00	1.00,1.00	1.00	1.00,1.00
Moderate	0.66	0.42,1.03	0.63	0.40,0.99
Heavy/binge	1.39	0.73,2.67	1.02	0.53,1.99
Never Smoker	1.00	1.00,1.00	1.00	1.00,1.00
Former Smoker	1.08	0.58,2.04	0.83	0.46,1.49
Current Smoking	1.12	0.66,1.91	0.94	0.64,1.37
IDU	0.38	0.15,1.01	1.17	0.60,2.30
Other Non IDU	1.06	0.68,1.64	1.27	0.68,2.36
MJ only	0.49	0.26,0.91	0.69	0.33,1.44
None	1.00	1.00,1.00	1.00	1.00,1.00
0 Unmet Needs	1.00	1.00,1.00	1.00	1.00,1.00
1 Unmet Need	1.35	0.78,2.35	1.65	0.88,3.10
2 Unmet Needs	1.68	1.10,2.57	1.34	0.92,1.96
<3 CD4 or Viral Load Test	1.00	1.00,1.00	1.00	1.00,1.00
>=3 CD4 or Viral Load Tests	1.23	0.83,1.83	1.69	1.14,2.50

Table 11.26 Results of the Inflated portion of the Zero Inflated Poisson and Negative Binomial Models of Hospital Admissions [47]

Variable Name	Poisson Incidence Rate Ratio	95%CI
18-29	1.00	1.00,1.00
30-39	0.50	0.26,0.97
40-49	0.53	0.30,0.95
>=50	0.60	0.32,1.13
White, non-Hispanic	1.00	1.00,1.00
Black, non-Hispanic	1.07	0.62,1.83
Hispanic or Latino	0.55	0.26,1.16
Other	1.34	0.44,4.07
Any MSM	1.00	1.00,1.00
MSW Only	0.98	0.55,1.73
Any WSM	0.73	0.44,1.20
Other	0.41	0.14,1.21
<High School	1.24	0.67,2.29
HS Diploma or Equivalent	1.47	0.93,2.34
>High School	1.00	1.00,1.00
Not Impoverished	1.00	1.00,1.00
Impoverished	1.09	0.67,1.78
Insured	1.00	1.00,1.00
Uninsured	1.28	0.63,2.62
Not Homeless	1.00	1.00,1.00
Homeless	0.58	0.32,1.06
Not Incarcerated	1.00	1.00,1.00
Incarcerated	0.76	0.48,1.21
Ever Diagnosed with AIDS	1.00	1.00,1.00
Never Diagnosed with AIDS	0.62	0.30,1.28
CD4 per 100 cell change	1.22	1.08,1.37

[47] Tables 5.15 and 5.16 contain the results of zero inflated Poisson and negative binomial models. Zero inflated models consist of two parts. The first part calculates rate ratios for those persons with one or more visits. The second part calculates the odds ratio for people with zero visits compared to this with one or more visits.

Table 11.26(cont) Results of the Inflated portion of the Zero Inflated Poisson and Negative Binomial Models of Hospital Admissions

Variable Name	Poisson Incidence Rate Ratio	95%CI
All Viral Loads Suppressed	1.00	1.00,1.00
Not Suppressed VL	0.58	0.31,1.09
Not Depressed	1.00	1.00,1.00
Depressed	0.51	0.30,0.85
None	1.00	1.00,1.00
Moderate	0.96	0.58,1.59
Heavy/binge	1.49	0.78,2.86
Never Smoker	1.00	1.00,1.00
Former Smoker	0.85	0.45,1.60
Current Smoking	0.85	0.55,1.33
IDU	0.47	0.12,1.77
Other Non IDU	0.90	0.45,1.82
MJ only	0.43	0.20,0.92
None	1.00	1.00,1.00
0 Unmet Needs	1.00	1.00,1.00
1 Unmet Need	1.33	0.82,2.15
2 Unmet Needs	1.26	0.80,1.98
<3 CD4 or Viral Load Test	1.00	1.00,1.00
>=3 CD4 or Viral Load Tests	1.04	0.67,1.61

Table 11.27 Results of Multivariate Ordinal Logistic Modeling of Number of Hospital Admissions [48]

Variable Name	Odds Ratio	95% CI
18-29	1.00	1.00,1.00
30-39	1.70	0.96,3.02
40-49	1.53	0.90,2.59
>=50	1.29	0.76,2.21
White, non-Hispanic	1.00	1.00,1.00
Black, non-Hispanic	0.90	0.63,1.30
Hispanic or Latino	1.04	0.62,1.77
Other	0.57	0.25,1.32
Any MSM	1.00	1.00,1.00
MSW Only	0.80	0.48,1.33
Any WSM	1.21	0.84,1.75
Other	2.01	0.98,4.10
<High School	1.17	0.79,1.73
HS Diploma or Equivalent	0.92	0.70,1.21
>High School	1.00	1.00,1.00
Not Impoverished	1.00	1.00,1.00
Impoverished	1.22	0.91,1.64
Insured	1.00	1.00,1.00
Uninsured	1.13	0.77,1.64
Not Homeless	1.00	1.00,1.00
Homeless	1.96	1.18,3.28
Not Incarcerated	1.00	1.00,1.00
Incarcerated	1.14	0.71,1.81
Never Diagnosed with AIDS	1.00	1.00,1.00
Ever Diagnosed with AIDS	2.15	1.26,3.68
CD4 per 100 cell change	0.82	0.74,0.91
All Viral Loads Suppressed	1.00	1.00,1.00
Not Suppressed VL	1.67	1.19,2.34

[48] This model was calculated using the same dataset used in Table 5.10-5.12. The number of visits for the ordinal model was classified as zero visits, one visit, two visits, three or more visits.

Table 11.27 Results of Multivariate Ordinal Logistic Modeling of Number of Hospital Admissions

Variable Name	Odds Ratio	95% CI
Not Depressed	1.00	1.00,1.00
Depressed	1.72	1.11,2.65
None	1.00	1.00,1.00
Moderate	0.80	0.54,1.17
Heavy/binge	0.85	0.49,1.48
Never Smoker	1.00	1.00,1.00
Former Smoker	1.24	0.81,1.90
Current Smoking	1.27	0.97,1.65
IDU	0.94	0.47,1.90
Other Non IDU	1.09	0.62,1.94
MJ only	1.30	0.79,2.13
None	1.00	1.00,1.00
0 Unmet Needs	1.00	1.00,1.00
1 Unmet Need	0.94	0.67,1.31
2 Unmet Needs	1.09	0.78,1.53
<3 CD4 or Viral Load Test	1.00	1.00,1.00
>=3 CD4 or Viral Load Tests	1.15	0.88,1.51

Table 11.28 Results of Multivariate Multinomial Logistic Modeling of Number of Hospital Admissions [49]

Variable Name	Odds Ratio 1 visit vs 0	95% CI	Odds Ratio 2 visits vs 0	95% CI	Odds Ratio 3+visits vs 0	95% CI
18-29	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
30-39	2.58	1.08,6.12	1.35	0.49,3.69	1.27	0.31,5.17
40-49	2.93	1.20,7.17	0.65	0.28,1.53	1.46	0.38,5.55
>=50	2.84	1.09,7.38	0.42	0.09,1.85	1.04	0.24,4.60
White, non-Hispanic	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Black, non-Hispanic	0.84	0.49,1.46	0.82	0.34,1.99	1.17	0.52,2.64
Hispanic or Latino	1.33	0.69,2.60	1.06	0.46,2.44	0.39	0.11,1.36
Other	0.57	0.19,1.68	0.62	0.16,2.33	0.38	0.07,2.02
Any MSM	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
MSW Only	1.06	0.55,2.03	0.46	0.15,1.34	0.57	0.26,1.25
Any WSM	1.31	0.82,2.11	0.98	0.46,2.10	1.13	0.54,2.39
Other	2.17	0.95,4.96	1.84	0.54,6.27	2.45	0.34,17.58
<High School	1.09	0.64,1.84	1.05	0.50,2.20	1.61	0.74,3.51
HS Diploma or Equivalent	0.89	0.63,1.25	0.90	0.55,1.48	0.97	0.54,1.74
>High School	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Not Impoverished	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Impoverished	1.14	0.76,1.71	1.53	0.95,2.48	1.22	0.59,2.52
Insured	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Uninsured	1.11	0.66,1.87	1.24	0.56,2.76	0.94	0.44,2.01
Not Homeless	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Homeless	2.05	1.22,3.44	1.67	0.76,3.69	2.08	0.77,5.64
Not Incarcerated	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Incarcerated	1.07	0.72,1.61	1.20	0.51,2.79	1.41	0.47,4.19
Never Diagnosed with AIDS	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Ever Diagnosed with AIDS	1.75	0.97,3.16	2.06	0.55,7.76	6.34	1.28,31.39
CD4 per 100 change	0.85	0.76,0.95	0.78	0.55,1.10	0.76	0.65,0.89
All Viral Loads Suppressed	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Not Suppressed VL[50]	1.63	1.02,2.60	2.57	1.33,4.99	1.28	0.65,2.50

[49] This model was calculated using the same dataset as Tables 5.10-5.13. The number of visits for the multinomial model was classified as zero visits, one visit, two visits, three or more visits.

[50] VL=viral load

Table 11.28 Results of Multivariate Multinomial Logistic Modeling of Number of Hospital Admissions

Variable Name	Odds Ratio	95% CI	Odds Ratio	95% CI	Odds Ratio	95% CI
	1visit vs 0			2visits vs 0	3+visits vs 0	
Not Depressed	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Depressed	1.77	1.04,3.00	2.30	1.23,4.31	1.15	0.61,2.16
None	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Moderate	0.98	0.59,1.64	0.61	0.35,1.05	0.58	0.26,1.25
Heavy/binge	0.76	0.38,1.52	0.85	0.34,2.09	1.05	0.46,2.41
Never Smoker	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
Former Smoker	1.34	0.80,2.25	1.23	0.49,3.06	0.91	0.31,2.70
Current Smoking	1.29	0.88,1.88	1.48	0.70,3.13	1.11	0.51,2.39
IDU[51]	1.06	0.51,2.18	1.00	0.27,3.70	0.61	0.16,2.31
Other Non IDU	1.11	0.50,2.49	0.65	0.24,1.75	1.35	0.48,3.82
Marijuna only	1.57	0.89,2.78	1.30	0.60,2.84	0.57	0.17,1.88
None	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
0 Unmet Needs	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
1 Unmet Need	0.84	0.52,1.37	0.92	0.37,2.32	1.35	0.63,2.89
2+ More Unmet Needs	0.99	0.67,1.47	1.01	0.48,2.11	1.70	0.85,3.42
<3 CD4 or Viral Load Tests	1.00	1.00,1.00	1.00	1.00,1.00	1.00	1.00,1.00
>=3 CD4 or Viral Load Tests	1.06	0.73,1.53	1.12	0.67,1.88	1.64	0.95,2.83

[51] IDU=injection drug user

Table 11.29 Summary of the Factors associated with Emergency Department Utilization Using Poisson, negative binomial, zero-inflated Poisson and negative binomial, ordinal and multinomial logistic regression

Model	Age	Sexual transmission Group	Race	Education	Impoverished
Prevalence Ratio	Age 18-29 UP	Other UP	NS	NS	NS
Poisson	NS	NS	NS	NS	NS
Negative Binomial	NS	NS	NS	Less than High School UP	NS
Zero Inflated Poisson Incidence	NS	NS	Hispanic DOWN	Less than High School UP	NS
Zero Inflated Negative Binomial Incidence	NS	NS	NS	NS	NS
Zero Inflated Poisson Odds Ratios	Age UP	NS	NS	NS	NS
Multinomial Logistic Regression	NS	NS	NS	NS	NS
Ordinal Logistic 2vs1	Age UP	NS	NS	NS	NS
Ordinal Logistic 3vs1	NS	NS	NS	NS	NS
Ordinal Logistic 4vs1	NS	NS	NS	NS	NS

Table 11.29 (cont) Summary of the Factors associated with Emergency Department Utilization Using Poisson, negative binomial, zero-inflated Poisson and negative binomial, ordinal and multinomial logistic regression

Model	Insurance	Homeless	Incarcerated	CD4 Count
Prevalence Ratio	NS	Homeless UP	NS	CD4 Count DOWN
Poisson	NS	Homeless UP	NS	CD4 count DOWN
Negative Binomial	NS	Homeless UP	NS	CD4 count DOWN
Zero Inflated Poisson Incidence	NS	NS	NS	NS
Zero Inflated Negative Binomial Incidence	NS	Homeless UP	NS	NS
Zero Inflated Poisson Odds Ratios	NS	NS	NS	CD4 count UP
Multinomial Logistic Regression	NS	Homeless UP	NS	CD4 count DOWN
Ordinal Logistic 2vs1	NS	Homeless UP	NS	NS
Ordinal Logistic 3vs1	NS	NS	NS	NS
Ordinal Logistic 4vs1	NS	NS	NS	NS

Table 11.29 (cont) Summary of the Factors associated with Emergency Department Utilization Using Poisson, negative binomial, zero-inflated Poisson and negative binomial, ordinal and multinomial logistic regression

Model	Viral Load	AIDS Diagnosis	Depressed	Alcohol Use	Smoking	Drug use for Non-Medical Purposes
Prevalence Ratio	Viral Load UP	AIDS Diagnosis UP	Depressed UP	NS	NS	NS
Poisson	NS	AIDS Diagnosis UP	NS	NS	NS	NS
Negative Binomial	NS	AIDS Diagnosis UP	Depressed UP	Moderate EtOH DOWN	NS	NS
Zero Inflated Poisson Incidence	NS	NS	NS	NS	NS	Marijuana only DOWN
Zero Inflated Negative Binomial Incidence	Viral Load Up	AIDS Diagnosis UP	NS	Moderate EtOH DOWN	NS	NS
Zero Inflated Poisson Odds Ratios	NS	NS	NS	NS	NS	NS
Multinomial Logistic Regression	Viral Load UP	AIDS Diagnosis UP	Depressed UP	NS	NS	NS
Ordinal Logistic 2vs1	Viral load UP	NS	Depressed UP	NS	NS	NS
Ordinal Logistic 3vs1	Viral Load UP	NS	Depressed UP	NS	NS	NS
Ordinal Logistic 4vs1	NS	AIDS Diagnosis UP	NS	NS	NS	NS

Table 11.29 (cont)Summary of the Factors associated with Emergency Department Utilization Using Poisson, negative binomial, zero-inflated Poisson and negative binomial, ordinal and multinomial logistic regression

Model	Unmet Needs	Viral Load and CD4 Tests
Prevalence Ratio	NS	NS
Poisson	2 or more Unmet Needs UP	NS
Negative Binomial	NS	NS
Zero Inflated Poisson Incidence	2 or more unmet needs UP	NS
Zero Inflated Negative Binomial Incidence	NS	Three or more tests UP
Zero Inflated Poisson Odds Ratios	NS	NS
Multinomial Logistic Regression	NS	NS
Ordinal Logistic 2vs1	NS	NS
Ordinal Logistic 3vs1	NS	NS
Ordinal Logistic 4vs1	NS	NS

Appendix 1: Questionaire Formatting

A16. During the **past 12 months**, how many times did you go to an emergency room or urgent care center for HIV medical care?

A17. During the **past 12 months**, how many times were you admitted to a hospital because of an HIV-related illness? (Please don't include visits that were made only to the emergency room.)

Male Respondent – Female Partner

S1. During the **past 12 months**, have you had oral, vaginal, or anal sex with a woman? *[M_FOVASX]*

No .... ❑ 0 → *Skip to S6*
Yes .... ❑ 1
Refused to answer .... ❑ 7 } *Skip to S6*
Don't know .... ❑ 8 }

Male Respondent – Male Partner

S6. During the **past 12 months**, have you had oral or anal sex with a man? *[M_MOASX]*

No .... ❑ 0 → *Skip to Say box before U1*
Yes .... ❑ 1
Refused to answer .... ❑ 7 } *Skip to Say box before U1*
Don't know .... ❑ 8 }

Female Respondent – Male Partner

S12. During the **past 12 months**, have you had oral, vaginal, or anal sex with a man? *[F_MOVASX]*

No .... ❑ 0 → *Skip to S16*
Yes .... ❑ 1
Refused to answer .... ❑ 7 } *Skip to S16*
Don't know .... ❑ 8 }

Female Respondent – Female Partner

S16. During the **past 12 months**, have you had sex with a woman? *[F_FSX]*

No .... ❑ 0 → *Skip to Say box before U1*
Yes .... ❑ 1
Refused to answer .... ❑ 7 } *Skip to Say box before U1*
Don't know .... ❑ 8 }

D4. Do you consider yourself to be Hispanic or Latino? ***[HISPAN_9]***

No........ ❑ 0
Yes........ ❑ 1

Refused to answer.. ❑ 7

Don't know.. ❑ 8

D5. Which racial group or groups do you consider yourself to be in? You may choose more than one option. ***[READ CHOICES. CHECK ALL THAT APPLY.] [RACE_9]***

American Indian or Alaska Native.. ❑ 1 ***[RACE_9A]***

Asian... ❑ 2 ***[RACE_9B]***

Black or African American... ❑ 3 ***[RACE_9C]***

Native Hawaiian or Other Pacific Islander............................ ❑ 4 ***[RACE_9D]***

White.. ❑ 5 ***[RACE_9E]***

Refused to answer.. ❑ 77

Don't know...

D3. What is the highest level of education you completed? ***[DON'T READ CHOICES. CHECK ONLY ONE.] [EDUC]***

Never attended school.. ❑ 1

Grades 1 through 8... ❑ 2

Grades 9 through 11... ❑ 3

Grade 12 or GED.. ❑ 4

Some college, associate's degree, or technical degree.......... ❑ 5

Bachelor's degree... ❑ 6

Any post–graduate studies.. ❑ 7

Refused to answer.. ❑ 77

Don't know.. ❑ 88

D12. During the **past 12 months,** have you been arrested and put in jail, detention, or prison for longer than 24 hours? ***[JAIL]***

No.. ❑ 0

Yes... ❑ 1

Refused to answer.. ❑ 7

Don't know.. ❑ 8

D13. During the **past 12 months**, have you had any kind of health insurance or health coverage? This includes Medicaid and Medicare. ***[HTHINS_9]***

No.. ❑ 0 → ***Skip to D14***

Yes... ❑ 1

Refused to answer.. ❑ 7 } ***Skip to D14***

Don't know.. ❑ 8

	During the **past 12 months**, have you:	**No** (0)	**Yes** (1)	**Refused** (7)	**Don't know** (8)
D11a.	…lived on the street? ***[HOMEL_9A]***	❑0	❑1	❑7	❑8
D11b.	…lived in a shelter? ***[HOMEL_9B]***	❑0	❑1	❑7	❑8

	During the **past 12 months**, have you:	**No** (0)	**Yes** (1)	**Refused** (7)	**Don't know** (8)
D11c.	…lived in a Single Room Occupancy (SRO) hotel? ***[HOMEL_9C]***	❑0	❑1	❑7	❑8
D11d.	…lived in a car? ***[HOMEL_9D]***	❑0	❑1	❑7	❑8

D15. In **2008** (2009), what was your combined **monthly** or **yearly** household income from all sources before taxes? When I say "combined household income," I mean the total amount of money from all people living in the household. ***[DON'T READ CHOICES.]***

SAY: "Now I am going to ask you some questions about the **past 30 days**." ***[SHOW RESPONDENT CALENDAR.]***

U4. During the **past 30 days**, on how many days did you have an alcoholic drink? ***[DRINK_9]***

___ ____ ***[Refused to answer = 77, Don't know = 88]***

***Inconsistency check**: U4 (number of days had an alcoholic drink during the past 30 days) must be between 0 and 30.*

Interviewer instructions: If U4 (number of days consumed alcohol during the past 30 days) is "0," "Refused to answer," or "Don't know," skip to Say box before U8.

SAY: "For the next questions, a drink of alcohol is a 12 oz beer, a 5 oz glass of wine, or a 1.5 oz shot of liquor." ***[SHOW ALCHOHOL RESPONSE CARD.]***

U5. During the **past 30 days**, how many alcoholic drinks did you have on a typical day when you were drinking? ***[NDRINK_9]***

____ ____ ***[Refused to answer = 77, Don't know = 88]***

U6. During the **past 30 days**, on how many days did you have 5 or more alcoholic drinks in one sitting? ***[DRINK5_9]***

____ ____ *[Refused to answer = 77, Don't know = 88]*

Inconsistency check: U6 (number of days had 5 or more drinks during the past 30 days) must be ≤ 30 or ≤ U4 (number of days had a drink during the past 30 days).

Interviewer instructions: Skip to Say box before U8.

U7. During the **past 30 days**, on how many days did you have 4 or more alcoholic drinks in one sitting? ***[DRINK4_9]***

____ ____ *[Refused to answer = 77, Don't know = 88]*

Inconsistency check: U7 (number of days had 4 or more drinks during the past 30 days) must be ≤ 30 or ≤ U4 (number of days had a drink during the past 30 days).

Non-Injection Drug Use

SAY: "Now I'm going to ask you about drugs that you may have used, but didn't inject. I will refer to these as non-injection drugs. This includes drugs like marijuana, crack, club drugs, and painkillers. Tell me about the drugs you used that were not for medical purposes."

U8. During the **past 12 months**, did you use any non-injection drugs? *[ANID12_9]*

No	❑ 0	→ *Skip to Say box before U12*
Yes	❑ 1	
Refused to answer	❑ 7	} *Skip to Say box before U12*
Don't know	❑ 8	

SAY: "I'm going to read you a list of non-injection drugs. For each one I mention, please tell me how often you used it during the **past 12 months**. Don't include drugs you injected or drugs that were used for medical purposes."

Interviewer instructions: If the respondent's drug use was sporadic during the past 12 months, ask the respondent to choose the response option that best characterizes his or her use.

	During the **past 12 months**, how often did you use: *[SHOW RESPONSE CARD J.]*	**Daily** (1)	**Weekly** (2)	**Monthly** (3)	**Less than monthly** (4)	**Never** (5)	**Refused to answer** (7)	**Don't Know** (8)
U9a.	…methamphetamines, also called crystal meth, tina, crank, ice? *[CRYMTC_9]*	❑1	❑2	❑3	❑4	❑5	❑7	❑8
U9b.	…other amphetamines or stimulants? *[AMPHET_9]*	❑1	❑2	❑3	❑4	❑5	❑7	❑8
U9c.	…crack? *[CRACK1_9]*	❑1	❑2	❑3	❑4	❑5	❑7	❑8
U9d.	…cocaine that is smoked or snorted? *[COCSMO_9]*	❑1	❑2	❑3	❑4	❑5	❑7	❑8
U9e.	…downers, such as Valium, Ativan, or Xanax? *[DOWNER_9]*	❑1	❑2	❑3	❑4	❑5	❑7	❑8
U9f.	…painkillers, such as Oxycontin, Vicodin, or Percocet? *[PAINKI_9]*	❑1	❑2	❑3	❑4	❑5	❑7	❑8
U9g.	…hallucinogens, such as LSD or mushrooms?	❑1	❑2	❑3	❑4	❑5	❑7	❑8

Injection Drug Use

SAY: "The next questions are about injection drug use. This means injecting drugs yourself or having someone else inject you. Remember, your answers will be kept confidential."

U12. During the **past 12 months**, have you shot up or injected any drugs that weren't used for medical purposes? By shooting up, I mean anytime you might have used drugs with a needle, either by mainlining, skin popping, or muscling. *[INJECT12]*

No	☐ 0	→ *Skip to Say box before P1*
Yes	☐ 1	
Refused to answer	☐ 7	*Skip to Say box before P1*
Don't know	☐ 8	

SAY: "Now I'm going to read you a list of drugs. For each drug I mention, please tell me how often you injected it during the **past 12 months**."

Interviewer instructions: If the respondent's drug use was sporadic during the past 12 months, ask the respondent to choose the response option that best characterizes his or her use.

	During the past 12 months, how often did you inject: *[SHOW RESPONSE CARD J.]*	Daily (1)	Weekly (2)	Monthly (3)	Less than monthly (4)	Never (5)	Refused to answer (7)	Don't Know (8)
U13a.	…heroin and cocaine together, also called speedballs? *[HERCOC_9]*	☐1	☐2	☐3	☐4	☐5	☐7	☐8
U13b.	…heroin alone? *[HEROII_9]*	☐1	☐2	☐3	☐4	☐5	☐7	☐8
U13c.	…cocaine alone? *[COCAII_9]*	☐1	☐2	☐3	☐4	☐5	☐7	☐8
U13d.	…crack? *[CRACKI_9]*	☐1	☐2	☐3	☐4	☐5	☐7	☐8
U13e.	…methamphetamines, also called crystal, meth, tina, or crank? *[CRAMTI_9]*	☐1	☐2	☐3	☐4	☐5	☐7	☐8
U13f.	…other amphetamines or stimulants? *[AMPHEI_9]*	☐1	☐2	☐3	☐4	☐5	☐7	☐8
U13g.	…Oxycontin? *[OXYCON_9]*	☐1	☐2	☐3	☐4	☐5	☐7	☐8
U13h.	…steroids or hormones? *[STRHRI_9]*	☐1	☐2	☐3	☐4	☐5	☐7	☐8

	During the past 12 months, how often did you inject: *[SHOW RESPONSE CARD J.]*	Daily (1)	Weekly (2)	Monthly (3)	Less than monthly (4)	Never (5)	Refused to answer (7)	Don't Know (8)
U13i.	…any other drug *(Specify:________)*? *[OINJDI_9][OINJD9OS]*	☐1	☐2	☐3	☐4	☐5	☐7	☐8

SAY: "The next questions are about smoking cigarettes."

U1. Have you smoked at least <u>100</u> cigarettes in your entire life? *[CIG_EVR]*

No	❑ 0	→ *Skip to Say box before U2*
Yes	❑ 1	
Refused to answer	❑ 7	*Skip to Say box before U2*
Don't know	❑ 8	

U1a. How often do you smoke cigarettes now? ***[SHOW RESPONSE CARD J.]*** *[CIG_OFT]*

Daily	❑ 1
Weekly	❑ 2
Monthly	❑ 3
Less than monthly	❑ 4
Never	❑ 5
Refused to answer	❑ 7
Don't know	❑ 8

SAY: "Now I'm going to ask about services you used or needed during the **past 12 months**. Remember, the past 12 months is last year (***DATE WITH PREVIOUS YEAR***) to now (***INTERVIEW DATE***)."

QDS programming note for Say box before met and unmet need questions: The QDS program should enter the appropriate dates. EXAMPLE: If IDATE is 11/11/2008 then the program should read "That is from last year, 11/11/2007 to now 11/11/2008."

Interviewer instructions: Show Response Card C. If response to A20a is "No," "Refused to answer," or "Don't know," go to A20b; otherwise, skip to A21a. If response to A20b is "Yes," go to A20c; otherwise, skip to A21a. Follow the same pattern for A20–A36.

		During the **past 12 months**, did you get: ***CODE:*** ***No = 0,*** ***Yes = 1, Refused to answer = 7,*** ***Don't know = 8***	***IF "NO" IN A20a–A36a ASK:*** During the **past 12 months**, have you needed: ***CODE:*** ***No = 0,*** ***Yes = 1, Refused to answer = 7,*** ***Don't know = 8***	***IF "YES" IN A20b-A36b ASK:*** What was the <u>main reason</u> you haven't been able to get this service during the **past 12 months**? ***CODE:*** ***SEE CODE LIST BELOW FOR RESPONSES.*** ***[DON'T READ CHOICES. CHECK ONLY ONE.]***
A20.	HIV case management services	a. [______] *[HIVC12_9]*	b. [______] *[HIVCMS_9]*	c. [______] *[HIVCRS_9]* Other *(Specify:________)* *[HIVC_9OS]*
A21.	Counseling about how to prevent the spread of HIV	a. [______] *[HIVE12_9]*	b. [______] *[HIVEDU_9]*	c. [______] *[HIVERS_9]* Other *(Specify:________)* *[HIVE_9OS]*
Interviewer instructions: If applicable, use the state program name for ADAP when asking A22 (medicine through ADAP).				
A22.	Medicine through the AIDS Drug Assistance Program (ADAP)	a. [______] *[GET_ADAP]*	b. [______] *[NED_ADAP]*	c. [______] *[RS_ADAP]* Other *(Specify:________)* *[RS_A_9OS]*

A23.	Professional help remembering to take your HIV medicines on time or correctly	a. [______] *[ASS12_9]*	b. [______] *[ASS_9]*	c. [______] *[ASSRS_9]* Other *(Specify:________)* *[ASSR_9OS]*
A24.	HIV peer group support	a. [______] *[GET_GRP]*	b. [______] *[NED_GRP]*	c. [______] *[RS_GRP]* Other *(Specify:________)* *[RS_G_9OS]*
A25.	Dental care	a. [______] *[DENS12_9]*	b. [______] *[DENSER_9]*	c. [______] *[DENSRS_9]* Other *(Specify:________)* *[DENS_9OS]*
A26.	Mental health services	a. [______] *[MENC12_9]*	b. [______] *[MENCON_9]*	c. [______] *[MENCRS_9]* Other *(Specify:________)* *[MENC_9OS]*
A27.	Drug or alcohol counseling or treatment	a. [______] *[GET_SUBU]*	b. [______] *[NED_SUBU]*	c. [______] *[RS_SUBU]* Other *(Specify:________)* *[RS_U_9OS]*
A28.	Public benefits including Supplemental Security Income (SSI) or Social Security Disability Insurance (SSDI)	a. [______] *[GET_SSDI]*	b. [______] *[NED_SSDI]*	c. [______] *[RS_SSDI]* Other *(Specify:________)* *[RS_S_9OS]*

A29.	Domestic violence services	a. [______] *[GET_DOMS]*	b. [______] *[NED_DOMS]*	c. [______] *[RS_DOMS]* Other *(Specify:________)* *[RS_D_9OS]*
A30.	Shelter or housing services	a. [______] *[SHLT12_9]*	b. [______] *[SHLTER_9]*	c. [______] *[SHLTRS_9]* Other *(Specify:________)* *[SHLT_9OS]*
A31.	Meal or food services	a. [______] *[MLSF12_9]*	b. [______] *[MLSFOD_9]*	c. [______] *[MLSFRS_9]* Other *(Specify:________)* *[MLSF_9OS]*
A32.	Home health services	a. [______] *[HHSA12_9]*	b. [______] *[HHSASS_9]*	c. [______] *[HHSARS_9]* Other *(Specify:________)* *[HHSA_9OS]*
A33.	Transportation assistance	a. [______] *[TRAS12_9]*	b. [______] *[TRASAS_9]*	c. [______] *[TRASRS_9]* Other *(Specify:________)* *[TRAS_9OS]*
A34.	Childcare services	a. [______] *[CHLD12_9]*	b. [______] *[CHLDCR_9]*	c. [______] *[CHLDRS_9]* Other *(Specify:________)* *[CHLD_9OS]*

A35.	Interpreter services	a. [______] *[GET_INTS]*	b. [______] *[NED_INTS]*	c. [______] *[RS_INTS]* Other *(Specify:*________) *[RS_I_9OS]*
A36.	Other HIV-related services	a. [______] *[OTHS12_9]* ***If "Yes," then ask:*** Other 1 *(Specify:*________) *[OTHSP_91]* Other 2 *(Specify:*________) *[OTHSP_92]* Other 3 *(Specify:*________) *[OTHSP_93]* Other 4 *(Specify:*________) *[OTHSP_94]*	b. [______] *[OTHSER_9]* ***If "Yes," then ask:*** Other 1 *(Specify:*________) *[OTHSE_91]* Other 2 *(Specify:*________) *[OTHSE_92]* Other 3 *(Specify:*________) *[OTHSE_93]* Other 4 *(Specify:*________) *[OTHSE_94]*	Other 1 ca. [______] *[OTHSR1_9]* Other 1 *(Specify:*________) *[O112_9OS]* Other 2 cb. [______] *[OTHSR2_9]* Other 2 *(Specify:*________) *[O212_9OS]* Other 3 cc. [______] *[OTHSR3_9]* Other 3 *(Specify:*________) *[O312_9OS]* Other 4 cd. [______] *[OTHSR4_9]* Other 4 *(Specify:*________) *[O412_9OS]*

Appendix 2:

Race/ethnicity was determined by asking whether participants considered themselves to be Hispanic or not and then by asking which racial group they felt they belonged to. (White, Asian, Pacific Islander, Black, Indian, or Multiracial) Persons who were impoverished were classified by taking the midpoint of the income range they reported and based on the number of dependents they had using the DHHS poverty guidelines. Homelessness was based on self report as living on the street, in a shelter, single room occupancy hotel or in a car. Incarceration was coded as yes or no based on the following question, “During the **past 12 months,** have you been arrested and put in jail, detention, or prison for longer than 24 hours?”. Health insurance status was coded yes or no based on the following question, During the **past 12 months**, have you had any kind of health insurance or health coverage? This includes Medicaid and Medicare. “ CD4 count was used in the model as a continuous variable based on the mean geometric CD4 count based on medical record review. Viral Load was coded as being undectable or less than 200 copies/mL at all measurements during the prior year based on the medical record. We calculated the number of CD4 and viral load measurements in the prior year based on the medical record and classified it as those with fewer than three or three or more measurements. We categorized alcohol use on the basis of the National Institute on Alcohol Abuse and Alcoholism (NIAAA) criteria combing heavy and binge drinking. The NIAAA criteria classify heavy drinking as more than fourteen drinks per week for men and more than seven drinks per week for women. Binge drinking is classified as more than four drinks in a sitting for women and more than five drinks in a sitting for me. Depression was classified according to the PHQ-8.[203] Drug use for a non medical purpose was classified as none, use of marijuana only, use of only non-injection illicit drugs, and use of injection drugs.

Code to create the variables for the ED and Hospital Analysis

```
****outcome variables*****

*was the patient admitted to the hospital at least once
gen admitted=1 if hosp>0
replace admitted=0 if hosp==0
replace admitted=. if hosp==.d |hosp==.r

*did the patient recieve emergent or urgen care at least once
gen emergency=1 if eru_vi_9>0
replace emergency=0 if eru_vi_9==0
replace emergency=. if eru_vi_9==.d
tab emergency eru_vi_9, missing

*generate a variable of ED use for ordinal logistic
gen emergencyologit=0 if eru_vi_9==0
replace emergencyologit=1 if eru_vi_9==1
replace emergencyologit=2 if eru_vi_9==2
replace emergencyologit=3 if eru_vi_9>2
replace emergencyologit=. if eru_vi_9==.d
tab emergencyologit, missing

*generate a variable of hospital use for ordinal logistic
gen hospologit=0 if hosp==0
replace hospologit=1 if hosp==1
replace hospologit=2 if hosp==2
replace hospologit=3 if hosp>2
replace hospologit=. if hosp==.d |hosp==.r
tab hospologit, missing


********demographic variables**************
*generate the age categories that I want to use in my analysis
gen joshage=_agegrp3
tab joshage _agegrp3

*generate the sex categories that I want
gen joshsexgender=_gender
*or use gendercheck which drop transgender, intersex
gen gendercheck=_gender if _gender==1 | _gender==2



* 1= "(1)Any MSM (MSM only+MSMW)"
                        * 2= "(2)MSW only"
                        * 3= "(3)Any WSM (WSM only+WSMW)"
                        * 4= "(4)Other"
                        *.D="(.D)Do not know"
                   * .R="(.R)Refused to answer";

*generate the race groups
gen joshrace=_newrace
replace joshrace=4 if _newrace==4 | _newrace==5 | _newrace==6 | _newrace==7
replace joshrace=. if _newrace==.d | _newrace==.u
tab joshrace _newrace, missing
```

```
*gen alternate race whites vs all others
gen race2=_newrace if _newrace==1
replace race2=0 if _newrace>1 & _newrace<=7


*generate the education categories I want to use in my analysis
gen josheducation=_educ
replace josheducation=. if _educ==.r
tab josheducation _educ, missing

*generate the poverty line data
*remember that here 0 is above the poverty line
*1 is below the poverty line
gen joshpoverty=_poverty
replace joshpoverty=. if _poverty==.d | _poverty==.r | _poverty==.u
tab joshpoverty _poverty, missing

*generate the insurance variable
gen joshinsurance=hthins_9
replace joshinsurance=. if hthins_9==.d
tab joshinsurance hthins_9, missing

*was the patient homeless, living in a shelter, vehicle, or SRO
gen joshhomeless=_homeless
encode joshhomeless, gen(joshhomeless2)
tab joshhomeless2 _homeless, missing

*was the patient incarcerated
gen joshincarcerated=jail
replace joshincarcerated=. if jail==.d
tab joshincarcerated jail, missing

*was the patient prescribed ART in 2009
gen joshart=_art_ivf
replace joshart=. if _art_ivf==.u
tab joshart _art_ivf, missing

*what was the geometric mean cd4 count categorized in 2009
gen joshcd4=0 if  _mlogcd4cnt_ivf<50
replace joshcd4=1 if _mlogcd4cnt_ivf>=50 &  _mlogcd4cnt_ivf<=199
replace joshcd4=2 if  _mlogcd4cnt_ivf>=200 &  _mlogcd4cnt_ivf<=349
replace joshcd4=3 if  _mlogcd4cnt_ivf>=350 &  _mlogcd4cnt_ivf<=499
replace joshcd4=4 if  _mlogcd4cnt_ivf>=500
replace joshcd4=. if  _mlogcd4cnt_ivf==.u
tab joshcd4, missing


gen joshcd4number2=_mlogcd4cnt_ivf/100
replace joshcd4number2=. if _mlogcd4cnt_ivf==.u

*was the most recent viral load suppressed
*0=undetectable
*1=detectable
gen joshrecentvl=_rcntvlstatus_ivf
replace joshrecentvl=. if  _rcntvlstatus_ivf==.
```

```
*were all viral loads in 2009 suppressed
*0=all vls supressed
*1=at least 1 unsuppressed
*no missings
gen joshallvl=  _allvlstatus_ivf_2
replace joshallvl=. if  _allvlstatus_ivf_2==.

*generate a collapsed AIDS variable
gen collapsedaids=1 if _newcat5_aids_mix==1 | _newcat5_aids_mix==2 | _newcat5_aids_mix==3 |
_newcat5_aids_mix==4
replace collapsedaids=0 if _newcat5_aids_mix==5
replace collapsedaids=. if _newcat5_aids_mix==.u
tab collapsedaids _newcat5_aids_mix, missing

*depressive symptoms based on PHQ-8
*need to account for inccorect phq coding
gen depression1=anx_depa-1
gen depression2=anx_depb-1
gen depression3=anx_depc-1
gen depression4=anx_depd-1
gen depression5=anx_depe-1
gen depression6=anx_depf-1
gen depression7=anx_depg-1
gen depression8=anx_deph-1

*check the missings
gen missinganx=1 if anx_depa==. | anx_depa==.d  | anx_depa==.r
replace missinganx=1 if anx_depa==. | anx_depa==.d  | anx_depa==.r
replace missinganx=1 if anx_depb==. | anx_depb==.d  | anx_depb==.r
replace missinganx=1 if anx_depc==. | anx_depc==.d  | anx_depc==.r
replace missinganx=1 if anx_depd==. | anx_depd==.d  | anx_depd==.r
replace missinganx=1 if anx_depe==. | anx_depe==.d  | anx_depe==.r
replace missinganx=1 if anx_depf==. | anx_depf==.d  | anx_depf==.r
replace missinganx=1 if anx_depg==. | anx_depg==.d  | anx_depg==.r
replace missinganx=1 if anx_deph==. | anx_deph==.d  | anx_deph==.r


*sum the total phq scores
egen totalphq=rsum(depression1 depression2 depression3 depression4 depression5 depression6
depression7 depression8)

*if total is greater than 10 patient is depressed
gen joshdepressed=1 if totalphq>=10
replace joshdepressed=0 if totalphq<10
replace joshdepressed=. if missinganx==1

*what is the patients smoking status
gen joshsmoking=0 if cig_evr==0
replace joshsmoking=1 if cig_evr==1 & cig_oft==5
replace joshsmoking=2 if cig_evr==1 & cig_oft<=4
gen cigmissing=1 if cig_evr==. | cig_evr==.d | cig_oft==.d | cig_oft==.
replace joshsmoking=. if cigmissing==1


*define excess drinks per week
gen drinkcheck=drink_9*ndrink_9
```

```
gen drinkcheck2=drinkcheck/4.2857
gen heavy=1 if drinkcheck2>14 & _gender==1 & drinkcheck2~=.
replace heavy=1 if drinkcheck2>7 & _gender==2 & drinkcheck2~=.

*amount of alcohol
gen joshdrinking=3 if drink4_9==1 & _gender==2
replace joshdrinking=3 if drink5_9==1 & _gender==1
replace joshdrinking=3 if heavy==1
replace joshdrinking=2 if alcoho_9<=4 & joshdrinking~=3
replace joshdrinking=1 if alcoho_9==5
tab joshdrinking alcoho_9, missing


*generate the use of drugs
*find those people who are marijuana only
gen mj=1 if anid12_9==1 & mariju_9<=4 & (crymtc_9==5 & amphet_9==5 & crack1_9==5 &
cocsmo_9==5 & downer_9==5 & painki_9==5 & halluc_9==5 & xect_9==5 & speck_9==5 & ghb_9==5
& heroin_9==5 & popper_9==5 &strhor_9==5 & oninjd_9==5)
*find those who use other non injection drugs
gen othernoninjection=1 if anid12_9==1 & mj~=1
*find those who use injection drugs
gen injectiondrugs=1 if inject12==1

*generate the overall variable
gen joshillicitdrugs=1 if injectiondrugs==1
replace joshillicitdrugs=2 if othernoninjection==1 & joshillicitdrugs~=1
replace joshillicitdrugs=3 if mj==1 & (joshillicitdrugs~=1 & joshillicitdrugs~=2)
replace joshillicitdrugs=4 if (mj~=1 & othernoninjection~=1 & injectiondrugs~=1)

*generating the missing drug use variables
gen missingdrugs=1 if anid12_9==. | anid12_9==.d | anid12_9==.r
replace missingdrugs=1 if  crymtc_9==. | crymtc_9==.d | crymtc_9==.r
replace missingdrugs=1 if  amphet_9==. | amphet_9==.d | amphet_9==.r
replace missingdrugs=1 if  crack1_9==. | crack1_9==.d | crack1_9==.r
replace missingdrugs=1 if  cocsmo_9==. | cocsmo_9==.d | cocsmo_9==.r
replace missingdrugs=1 if  downer_9==. | downer_9==.d | downer_9==.r
replace missingdrugs=1 if  painki_9==. | painki_9==.d | painki_9==.r
replace missingdrugs=1 if  halluc_9==. | halluc_9==.d | halluc_9==.r
replace missingdrugs=1 if  xect_9==. | xect_9==.d | xect_9==.r
replace missingdrugs=1 if  speck_9==. | speck_9==.d | speck_9==.r
replace missingdrugs=1 if  ghb_9==. | ghb_9==.d | ghb_9==.r
replace missingdrugs=1 if  heroin_9==. | heroin_9==.d | heroin_9==.r
replace missingdrugs=1 if  popper_9==. | popper_9==.d | popper_9==.r
replace missingdrugs=1 if  strhor_9==. | strhor_9==.d | strhor_9==.r
replace missingdrugs=1 if oninjd_9==. | oninjd_9==.d | oninjd_9==.r
replace missingdrugs=1 if inject12==. | inject12==.d | inject12==.r
replace joshillicitdrugs=. if missingdrugs==1

*generate a total unmet needs score
gen unmet1=1 if hivcms_9==1 & hivc12_9==0
gen unmet2=1 if hivedu_9==1 & hive12_9==0
gen unmet3=1 if ned_adap==1 & get_adap==0
gen unmet4=1 if ass_9==1 & ass12_9==0
gen unmet5=1 if ned_grp==1 & get_grp==0
gen unmet6=1 if denser_9==1 & dens12_9==0
gen unmet7=1 if mencon_9==1 & menc12_9==0
```

```
gen unmet8=1 if ned_subu==1 & get_subu==0
gen unmet9=1 if ned_ssdi==1 & get_ssdi==0
gen unmet10=1 if ned_doms==1 & get_doms==0
gen unmet11=1 if shlter_9==1 & shlt12_9==0
gen unmet12=1 if mlsfod_9==1 & mlsf12_9==0
gen unmet13=1 if hhsass_9==1 & hhsa12_9==0
gen unmet14=1 if trasas_9==1 & tras12_9==0
gen unmet15=1 if chldcr_9==1 & chld12_9==0

*generate the score and account for the missings
egen totalunmetscore= rsum(unmet*)
gen missingneed=1 if hivc12_9==.d |hive12_9==.d | get_adap==.d | ass12_9==.d | get_grp==.d |
dens12_9==.d |menc12_9==.d | get_subu==.d |get_ssdi==.d | get_doms==.d  |shlt12_9==.d | mlsf12_9==.d
|hhsa12_9==.d |tras12_9==.d |chld12_9==.d
replace missingneed=1 if hivc12_9==.r |hive12_9==.r | get_adap==.r | ass12_9==.r | get_grp==.r |
dens12_9==.r |menc12_9==.r | get_subu==.r |get_ssdi==.r | get_doms==.r  |shlt12_9==.r | mlsf12_9==.r
|hhsa12_9==.r |tras12_9==.r |chld12_9==.r
replace missingneed=1 if hivcms_9==.d | hivedu_9==.d | ned_adap==.d | ass_9==.d | ned_grp==.d |
denser_9==.d | mencon_9==.d | ned_subu==.d | ned_ssdi==.d | ned_doms==.d | shlter_9==.d |
mlsfod_9==.d | hhsass_9==.d | trasas_9==.d | chldcr_9==.d
replace missingneed=1 if hivcms_9==.r | hivedu_9==.r | ned_adap==.r | ass_9==.r | ned_grp==.r |
denser_9==.r | mencon_9==.r | ned_subu==.r | ned_ssdi==.r | ned_doms==.r | shlter_9==.r | mlsfod_9==.r |
hhsass_9==.r | trasas_9==.r | chldcr_9==.r
replace totalunmetscore=. if missingneed==1

*generate a 0 compared to at least one unmetneed
gen halfunmetscore=1 if totalunmetscore>=1
replace halfunmetscore=0 if totalunmetscore==0
replace halfunmetscore=. if totalunmetscore==.

*generate a 0,1,2+ unmet needs score
gen unmetneeds2=0 if totalunmetscore==0
replace unmetneeds2=1 if totalunmetscore==1
replace unmetneeds2=2 if totalunmetscore>1
replace unmetneeds2=. if totalunmetscore==.

*generate an unmetneeds score of 0-4 vs 5 or more
gen unmetneeds=totalunmetscore if totalunmetscore<5
replace unmetneeds=5 if totalunmetscore>=5
replace unmetneeds=. if totalunmetscore==.

*generate the number of primary care visits
gen pcpvisits=1 if timecar==1
replace pcpvisits=2 if timecar==2
replace pcpvisits=3 if timecar>=3
replace pcpvisits=. if timecar==.d | timecar==.r | timecar==. | timecar==.s

*writing label definitions for the variables
label define yesno 0 "No" 1 "Yes"
label define yesno2 1 "No" 2 "yes"
label define age 1 "18-29" 2 "29-39" 3 "40-49" 4 ">=50"
label define riskgroup 1 "ANY MSM" 2 "MSW Only" 3 "Any WSM" 4 "Other"
label define race 1 "White, non-Hispanic" 2 "Black, non-Hispanic" 3 "Hispanic or Latino" 4 "Other"
label define education 1 "<High School" 2 "HS diploma or equivalent" 3 ">High School"
label define poverty 0 "Not in Poverty" 1 "Impoverished"
label define homeless 0 "Not Homeless" 1 "Homeless"
```

```
label define CD4count 0 "0-49" 1 "50-199" 2 "200-349" 3 "350-499" 4 ">=500"
label define aidscat 1 "Clinical and Immunologic AIDS" 2 "Clinical AIDS Only" 3 "Immunologic AIDS only" 4 "AIDS NOS" 5 "No AIDS"
label define vlstatus 0 "All Supressed" 2 "Unsuprssed"
label define smoking  0 "Never" 1 "Former" 2 "current"
label define drinking 3 "Heavy/binge" 2 "Moderate" 1 "None"
label define druguse 4 "None" 3 "MJ only" 2 "Other Non IDU" 1" IDU"

*assigning the labels to variables
label values joshage age
label values _partcomposite2 riskgroup
label values joshrace race
label values josheducation education
label values joshpoverty poverty
label values joshinsurance yesno
label values joshhomeless2 yesno2
label values joshincarcerated yesno
label values joshart yesno
label values joshcd4 CD4count
label values _newcat5_aids_mix aidscat
label values joshallvl vlstatus
label values joshdepressed yesno
label values joshsmoking smoking
label values joshdrinking drinking
label values joshillicitdrugs druguse



*number of cd4 tests
gen cd4testcount=1 if  _cd12_n_9==1 |  _cd12_n_9==0 |  _cd12_n_9==2 |  _cd12_n_9==3
replace cd4testcount=2 if  _cd12_n_9==4
replace cd4testcount=3 if  _cd12_n_9>4
replace cd4testcount=. if  _cd12_n_9==.d |  _cd12_n_9==.r |  _cd12_n_9==.u

gen testsinyear=_cd4vltest_num3_vf
```

Code for the ED Analysis

```
*survey setting the data
svyset nat_clust_owt [pweight=nat_owt], strata(nat_strat_owt)

*basic tabs of general participant distribution
svy: tab joshage, cell column
svy: tab joshsexgender, cell column
svy: tab _partcomposite2, cell column
svy: tab joshrace, cell column
svy: tab josheducation, cell column
svy: tab joshpoverty, cell column
svy: tab joshinsurance, cell column
svy: tab joshhomeless2, cell column
svy: tab joshincarcerated, cell column
svy: tab joshart, cell column
svy: tab joshcd4, cell column
svy: tab   _newcat5_aids_mix, cell column
svy: tab collapsedaids, cell column
svy: tab joshrecentvl, cell column
svy: tab joshallvl, cell column
```

```
svy: tab joshdepressed, cell column
svy: tab joshsmoking, cell column
svy: tab joshdrinking, cell column
svy: tab joshillicitdrugs, cell column
svy: tab totalunmetscore, cell column
svy: tab unmetneeds, cell column
svy: tab unmetneeds2, cell column
svy: tab halfunmetscore, cell column
svy: tab pcpvisits, cell column
svy: tab testsinyear, cell column

*cross tables emergency department code
svy: tab joshage emergency, cell column row pearson
svy: tab joshsexgender emergency, cell column row pearson
svy: tab _partcomposite2 emergency, cell column row pearson
svy: tab joshrace emergency, cell column row pearson
svy: tab josheducation emergency, cell column row pearson
svy: tab joshpoverty emergency, cell column row pearson
svy: tab joshinsurance emergency, cell column row pearson
svy: tab joshhomeless2 emergency, cell column row pearson
svy: tab joshincarcerated emergency, cell column row pearson
svy: tab joshart emergency, cell column row pearson
svy: tab joshcd4 emergency, cell column row pearson
svy: tab collapsedaids emergency, cell column row pearson
svy: tab   _newcat5_aids_mix emergency, cell column row pearson
svy: tab joshrecentvl emergency, cell column row pearson
svy: tab joshallvl emergency, cell column row pearson
svy: tab joshdepressed emergency, cell column row pearson
svy: tab joshsmoking emergency, cell column row pearson
svy: tab joshdrinking emergency, cell column row pearson
svy: tab joshillicitdrugs emergency, cell column row pearson
svy: tab unmetneeds emergency, cell column row pearson
svy: tab halfunmetscore emergency, cell column row pearson
svy: tab unmetneeds2 emergency, cell column row pearson
svy: tab pcpvisits emergency, cell column row pearson
svy: tab testsinyear emergency, cell column row pearson

*simple tabs for numbers
 tab joshage emergency
 tab joshsexgender emergency
 tab _partcomposite2 emergency
 tab joshrace emergency
 tab josheducation emergency
 tab joshpoverty emergency
 tab joshinsurance emergency
 tab joshhomeless2 emergency
 tab joshincarcerated emergency
 tab joshart emergency
 tab joshcd4 emergency
 tab collapsedaids emergency
 tab   _newcat5_aids_mix emergency
 tab joshrecentvl emergency
 tab joshallvl emergency
 tab joshdepressed emergency
 tab joshsmoking emergency
 tab joshdrinking emergency
```

```
 tab joshillicitdrugs emergency
 tab unmetneeds emergency
 tab halfunmetscore emergency
 tab unmetneeds2 emergency
 tab pcpvisits emergency
 tab testsinyear emergency




*char statements to get right exposure level
char joshillicitdrugs [omit] 4
char josheducation [omit] 3
char joshcd4 [omit] 4
char  _newcat5_aids_mix [omit] 5

*regression models for the emergency department analysis
*age bivariate risk and logistic
svy: glm emergency i.joshage, family(binomial) link(log) eform
xi: svy: logistic emergency i.joshage
estimates store ed1
estout ed1 using emergencybivariate.doc, varlabel(_cons Constant 1b.joshage "18-29" 2.joshage "30-39"
3.joshage "40-49" 4.joshage ">=50" ) eform cells("b(fmt(2)) ci()")
adjrr _Ijoshage_2
adjrr _Ijoshage_3
adjrr _Ijoshage_4

*hiv risk group
svy: glm emergency i._partcomposite2, family(binomial) link(log) eform
xi: svy: logistic emergency i._partcomposite2
estimates store ed2
estout ed2 using emergencybivariate.doc, append varlabel(_cons Constant 1b._partcomposite2 "Any MSM"
2._partcomposite2 "MSW Only" 3._partcomposite2 "Any WSM"  4._partcomposite2 "Other" ) eform
cells("b(fmt(2)) ci()")
adjrr _I_partcomp_2
adjrr _I_partcomp_3
adjrr _I_partcomp_4

*race bivariate
svy: glm emergency i.joshrace, family(binomial) link(log) eform
xi: svy: logistic emergency i.joshrace
estimates store ed3
estout ed3 using emergencybivariate.doc, append varlabel(_cons Constant 1b.joshrace "White, non-
Hispanic" 2.joshrace "Black, non-Hispanic" 3.joshrace "Hispanic or Latino" 4.joshrace "Other") eform
cells("b(fmt(2)) ci()")
adjrr _Ijoshrace_2
adjrr _Ijoshrace_3
adjrr _Ijoshrace_4

*education bivariate
xi: svy: glm emergency i.josheducation, family(binomial) link(log) eform
xi: svy: logistic emergency i.josheducation
estimates store ed4
estout ed4 using emergencbivariate.doc, append varlabel(_cons Constant 1.josheducation "<High School"
2.josheducation "HS Diploma or Equivalent" 3b.josheducation ">High School" ) eform cells("b(fmt(2))
ci()")
```

```
adjrr _Ijosheduca_1
adjrr _Ijosheduca_2

*poverty risk and logistic regression
svy: glm emergency i.joshpoverty, family(binomial) link(log) eform
xi: svy:  logistic emergency i.joshpoverty
estimates store ed5
estout ed5 using emergencybivariate.doc, append varlabel(_cons Constant 0b.joshpoverty "Not
Impoverished" 1.joshpoverty "Impoverished") eform cells("b(fmt(2)) ci()")
adjrr _Ijoshpov

*insurance bivariate
svy: glm emergency i.joshinsurance, family(binomial) link(log) eform
xi: svy: logistic emergency i.joshinsurance
estimates store ed6
estout ed6  using emergencybivariate.doc, append varlabel(_cons Constant  0b.joshinsurance "Insured"
1.joshinsurance "Uninsured") eform cells("b(fmt(2)) ci()")
adjrr _Ijoshins

*homelessness bivariate
svy: glm emergency i.joshhomeless2, family(binomial) link(log) eform
xi: svy: logistic emergency i.joshhomeless2
estimates store ed7
estout ed7 using emergencybivariate.doc, append varlabel(_cons Constant  1b.joshhomeless2 "Not
Homeless" 2.joshhomeless2 "Homeless" 0b.joshinsurance) eform cells("b(fmt(2)) ci()")
adjrr _Ijoshhom

*incarceration bivariate
svy: glm emergency i.joshincarcerated, family(binomial) link(log) eform
xi: svy: logistic emergency i.joshincarcerated
estimates store ed8
estout ed8 using emergencybivariate.doc, append varlabel(_cons Constant  0b.joshincarcerated "Not
Incarcerated" 1.joshincarcerated "Incarcerated") eform cells("b(fmt(2)) ci()")
adjrr _Ijoshinc

*receipt of anti-retroviral therapy
svy: glm emergency i.joshart, family(binomial) link(log) eform
xi: svy: logistic emergency I.joshart
estimates store ed9
estout ed9 using emergencybivariate.doc, append varlabel(_cons Constant 0b.joshart "Not on ART"
1.joshart "On ART") eform cells("b(fmt(2)) ci()")
adjrr _Ijoshart

*cd4 counts
xi: svy: glm emergency i.joshcd4, family(binomial) link(log) eform
xi: svy: logistic emergency i.joshcd4
estimates store ed10
estout ed10 using emergencybivariate.doc, append varlabel(_cons Constant 1.joshcd4 "50-199" 2.joshcd4
"200-349" 3.joshcd4 "350-499" 4b.joshcd4 ">=500") eform cells("b(fmt(2)) ci()")
adjrr _Ijoshcd4_0
adjrr _Ijoshcd4_1
adjrr _Ijoshcd4_2
adjrr _Ijoshcd4_3

*continuous cd4 count
svy: logistic emergency _mlogcd4cnt_ivf
```

```
adjrr _mlogcd4cnt_ivf

*continuous per 100
xi: svy: logistic emergency joshcd4number2
adjrr joshcd4number2

*lifetime aids status
xi: svy: glm emergency i.collapsedaids, family(binomial) link(log) eform
xi: svy: logistic emergency i.collapsedaids
estimates store ed11
estout ed11 using emergencybivariate.doc, append varlabel(_cons Constant  1._newcat5_aids_mix
"Clinical and Immunologic AIDS" 2._newcat5_aids_mix  "Clinical AIDS Only" 3._newcat5_aids_mix
"Immunologic AIDS only" 4._newcat5_aids_mix "AIDS NOS" 5b._newcat5_aids_mix "No AIDS" ) eform
cells("b(fmt(2)) ci()")
adjrr _Icollap

*durable viral load suppression
svy: glm emergency i.joshallvl, family(binomial) link(log) eform
xi: svy: logistic emergency i.joshallvl
estimate store ed12
estout ed12 using emergencybivariate.doc, append varlabel(_cons Constant  0b.joshallvl "All Viral Loads
Suppressed" 1.joshallvl "Not Suppressed VL") eform cells("b(fmt(2)) ci()")
adjrr _Ijoshal

*depression bivariate
svy: glm emergency i.joshdepressed, family(binomial) link(log) eform
xi: svy: logistic emergency I.joshdepressed
estimate store ed13
estout ed13 using emergencybivariate.doc, append varlabel(_cons Constant  0b.joshdepressed "Not
Depressed" 1.joshdepressed "Depressed"  ) eform cells("b(fmt(2)) ci()")
adjrr _Ijoshdep

*smoking bivariate
svy: glm emergency i.joshsmoking, family(binomial) link(log) eform
xi: svy: logistic emergency I.joshsmoking
estimate store ed14
estout ed14 using emergencybivariate.doc, append varlabel(_cons Constant  0b.joshsmoking "Never
Smoker" 1.joshsmoking "Former Smoker" 2.joshsmoking "Current Smoking") eform cells("b(fmt(2)) ci()")
adjrr _Ijoshsmoki_1
adjrr _Ijoshsmoki_2

*drinking bivariate
svy: glm emergency i.joshdrinking, family(binomial) link(log) eform
xi: svy: logistic emergency i.joshdrinking
estimate store ed15
estout ed15 using emergencybivariate.doc, append varlabel(_cons Constant   1b.joshdrinking   "None"
3.joshdrinking "Heavy/binge" 2.joshdrinking "Moderate") eform cells("b(fmt(2)) ci()")
adjrr _Ijoshdrink_2
adjrr _Ijoshdrink_3

*illicit drug use bivariate
xi: svy: glm emergency i.joshillicitdrugs, family(binomial) link(log) eform
xi: svy: logistic emergency i.joshillicitdrugs
estimate store ed16
```

```
estout ed16 using emergencybivariate.doc, append varlabel(_cons Constant  4b.joshillicitdrugs "None"
3.joshillicitdrugs "MJ only" 2.joshillicitdrugs "Other Non IDU" 1.joshillicitdrugs "IDU") eform
cells("b(fmt(2)) ci()")
adjrr _Ijoshillic_1
adjrr _Ijoshillic_2
adjrr _Ijoshillic_3

*unmet needs for service bivariate
xi: svy: glm emergency i.unmetneeds2, family(binomial) link(log) eform
xi: svy: logistic emergency i.unmetneeds2
estimate store ed17
estout ed17 using emergencybivariate.doc, append varlabel(_cons Constant ) eform cells("b(fmt(2)) ci()")
adjrr  _Iunmetneed_1
adjrr _Iunmetneed_2

*pcpvisits bivariate
xi: svy: glm emergency i.pcpvisits, family(binomial) link(log) eform
xi: svy: logistic emergency i.pcpvisits
estimates store ed18
estout ed18 using emergencybivariate.doc, append varlabel(_cons Constant) eform cells("b(fmt(2)) ci()")
adjrr _Ipcpvisits_2
adjrr _Ipcpvisits_3


*testsinyear bivariate
xi: svy: logistic emergency i.testsinyear
adjrr _Itestsinye_1

*final with cd4 per 100
svy: logistic emergency i.joshage i.joshrace i._partcomposite2 i.josheducation i.joshpoverty i.joshinsurance
i.joshhomeless2 i.joshincarcerated i.collapsedaids  joshcd4number2 i.joshallvl i.joshdepressed
i.joshdrinking i.joshsmoking i.joshillicitdrugs i.unmetneeds2  i.testsinyear
estimates store emergencylogistic
estout emergencylogistic using emergencylogistic.doc, replace varlabel(_cons Constant 1b.joshage "18-29"
2.joshage "30-39" 3.joshage "40-49" 4.joshage ">=50"  1b._partcomposite2 "Any MSM"
2._partcomposite2 "MSW Only" 3._partcomposite2 "Any WSM"  4._partcomposite2 "Other" 1b.joshrace
"White, non-Hispanic" 2.joshrace "Black, non-Hispanic" 3.joshrace "Hispanic or Latino" 4.joshrace
"Other" 1.josheducation "<High School" 2.josheducation "HS Diploma or Equivalent" 3b.josheducation
">High School" 0b.joshpoverty "Not Impoverished" 1.joshpoverty "Impoverished" 1b.joshhomeless2 "Not
Homeless" 2.joshhomeless2 "Homeless" 0b.joshinsurance "Insured" 1.joshinsurance "Uninsured"
0b.joshincarcerated "Not Incarcerated" 1.joshincarcerated "Incarcerated" 0b.joshart "Not on ART" 1.joshart
"On ART" 0b.joshallvl "All Viral Loads Suppressed" 1.joshallvl "Not Suppressed VL" 0b.joshdepressed
"Not Depressed" 1.joshdepressed "Depressed"  1b.joshdrinking   "None" 3.joshdrinking "Heavy/binge"
2.joshdrinking "Moderate" 0b.joshsmoking "Never Smoker" 1.joshsmoking "Former Smoker"
2.joshsmoking "Current Smoking" 4b.joshillicitdrugs "None" 3.joshillicitdrugs "MJ only" 2.joshillicitdrugs
"Other Non IDU" 1.joshillicitdrugs "IDU" 0b.halfunmetscore "No Unmet Needs" 1.halfunmetscore "At
Least one Unmet Need" 0.joshcd4 "0-49" 1.joshcd4 "50-199" 2.joshcd4 "200-349" 3.joshcd4 "350-499"
4b.joshcd4 ">=500" 1._newcat5_aids_mix  "Clinical and Immunologic AIDS" 2._newcat5_aids_mix
"Clinical AIDS Only" 3._newcat5_aids_mix  "Immunologic AIDS only" 4._newcat5_aids_mix "AIDS
NOS" 5b._newcat5_aids_mix "No AIDS" 1.testsinyear "1 Visit" 2.testsinyear "2 Visits" 3.testsinyear "3
visits") eform cells("b(fmt(2)) ci(fmt(2))  ")
predict emergencyprobtests
gen emergencyprobtests1=1 if emergencyprobtests>=.5 & emergencyprobtests~=.
replace emergencyprobtests1=0 if emergencyprobtests<.5 & emergencyprobtests~=.
roctab emergency emergencyprobtests, graph
tab emergencyprobtests1 emergency
```

adjrr _Ijoshage_2
adjrr _Ijoshage_3
adjrr _Ijoshage_4
adjrr _Ijoshrace_2
adjrr _Ijoshrace_3
adjrr _Ijoshrace_4
adjrr _I_partcomp_2
adjrr _I_partcomp_3
adjrr _I_partcomp_4
adjrr _Ijosheduca_1
adjrr _Ijosheduca_2
adjrr _Ijoshpover_1
adjrr _Ijoshinsur_1
adjrr _Ijoshhomel_2
adjrr _Ijoshincar_1
adjrr _Icollapsed_1
adjrr joshcd4number2
adjrr _Ijoshallvl_1
adjrr _Ijoshdepre_1
adjrr _Ijoshdrink_2
adjrr _Ijoshdrink_3
adjrr _Ijoshsmoki_1
adjrr _Ijoshsmoki_2
adjrr _Ijoshillic_1
adjrr _Ijoshillic_2
adjrr _Ijoshillic_3
adjrr _Iunmetneed_1
adjrr _Iunmetneed_2
adjrr _Itestsinye_1

Code for the Hospital Analysis

```
*numerical tabs not percentages
tab joshage admitted
tab joshsexgender admitted
tab _partcomposite2 admitted
tab joshrace admitted
tab josheducation admitted
tab joshpoverty admitted
tab joshinsurance admitted
tab joshhomeless2 admitted
tab joshincarcerated admitted
tab joshart admitted
tab joshcd4 admitted
tab collapsedaids admitted
tab _newcat5_aids_mix admitted
tab joshrecentvl admitted
tab  joshallvl admitted
tab joshdepressed admitted
tab  joshsmoking admitted
tab  joshdrinking admitted
tab  joshillicitdrugs admitted
tab  halfunmetscore admitted
tab  unmetneeds2 admitted
tab pcpvisits admitted
tab testsinyear admitted

*cross tables admission to the hospital code
svy: tab joshage admitted, cell column row pearson
svy: tab joshsexgender admitted, cell column row pearson
svy: tab _partcomposite2 admitted, cell column row pearson
svy: tab joshrace admitted, cell column row pearson
svy: tab josheducation admitted, cell column row pearson
svy: tab joshpoverty admitted, cell column row pearson
svy: tab joshinsurance admitted, cell column row pearson
svy: tab joshhomeless2 admitted, cell column row pearson
svy: tab joshincarcerated admitted, cell column row pearson
svy: tab joshart admitted, cell column row pearson
svy: tab joshcd4 admitted, cell column row pearson
svy: tab collapsedaids admitted, cell column row pearson
svy: tab   _newcat5_aids_mix admitted, cell column row pearson
svy: tab joshrecentvl admitted, cell column row pearson
svy: tab joshallvl admitted, cell column row pearson
svy: tab joshdepressed admitted, cell column row pearson
svy: tab joshsmoking admitted, cell column row pearson
svy: tab joshdrinking admitted, cell column row pearson
svy: tab joshillicitdrugs admitted, cell column row pearson
svy: tab halfunmetscore admitted, cell column row pearson
svy: tab unmetneeds2 admitted, cell column row pearson
svy: tab pcpvisits admitted, cell column row pearson
svy: tab testsinyear admitted, cell column row pearson

*regression models for the admitted to the hospital analysis
*age bivariate risk and logistic
svy: glm admitted i.joshage, family(binomial) link(log) eform
xi: svy: logistic admitted i.joshage
estimates store ed1
```

```
estout ed1 using admittedbivariate.doc, varlabel(_cons Constant 1b.joshage "18-29" 2.joshage "30-39"
3.joshage "40-49" 4.joshage ">=50" ) eform cells("b(fmt(2)) ci()")
adjrr _Ijoshage_2
adjrr _Ijoshage_3
adjrr _Ijoshage_4

*hiv risk group
svy: glm admitted i._partcomposite2, family(binomial) link(log) eform
xi: svy: logistic admitted i._partcomposite2
estimates store ed2
estout ed2 using admittedbivariate.doc, append varlabel(_cons Constant 1b._partcomposite2 "Any MSM"
2._partcomposite2 "MSW Only" 3._partcomposite2 "Any WSM"  4._partcomposite2 "Other" ) eform
cells("b(fmt(2)) ci()")
adjrr _I_partcomp_2
adjrr _I_partcomp_3
adjrr _I_partcomp_4

*race bivariate
svy: glm admitted i.joshrace, family(binomial) link(log) eform
xi: svy: logistic admitted i.joshrace
estimates store ed3
estout ed3 using admittedbivariate.doc, append varlabel(_cons Constant 1b.joshrace "White, non-Hispanic"
2.joshrace "Black, non-Hispanic" 3.joshrace "Hispanic or Latino" 4.joshrace "Other") eform
cells("b(fmt(2)) ci()")
adjrr _Ijoshrace_2
adjrr _Ijoshrace_3
adjrr _Ijoshrace_4

*education bivariate
xi: svy: glm admitted i.josheducation, family(binomial) link(log) eform
xi: svy: logistic admitted i.josheducation
estimates store ed4
estout ed4 using emergencbivariate.doc, append varlabel(_cons Constant 1.josheducation "<High School"
2.josheducation "HS Diploma or Equivalent" 3b.josheducation ">High School" ) eform cells("b(fmt(2))
ci()")
adjrr _Ijosheduca_1
adjrr _Ijosheduca_2

*poverty risk and logistic regression
svy: glm admitted i.joshpoverty, family(binomial) link(log) eform
xi: svy:  logistic admitted i.joshpoverty
estimates store ed5
estout ed5 using admittedbivariate.doc, append varlabel(_cons Constant 0b.joshpoverty "Not
Impoverished" 1.joshpoverty "Impoverished") eform cells("b(fmt(2)) ci()")
adjrr _Ijoshpov

*insurance bivariate
svy: glm admitted i.joshinsurance, family(binomial) link(log) eform
xi: svy: logistic admitted i.joshinsurance
estimates store ed6
estout ed6  using admittedbivariate.doc, append varlabel(_cons Constant  0b.joshinsurance "Insured"
1.joshinsurance "Uninsured") eform cells("b(fmt(2)) ci()")
adjrr _Ijoshins

*homelessness bivariate
svy: glm admitted i.joshhomeless2, family(binomial) link(log) eform
```

```
xi: svy: logistic admitted i.joshhomeless2
estimates store ed7
estout ed7 using admittedbivariate.doc, append varlabel(_cons Constant  1b.joshhomeless2 "Not Homeless"
2.joshhomeless2 "Homeless" 0b.joshinsurance) eform cells("b(fmt(2)) ci()")
adjrr _Ijoshhom

*incarceration bivariate
svy: glm admitted i.joshincarcerated, family(binomial) link(log) eform
xi: svy: logistic admitted i.joshincarcerated
estimates store ed8
estout ed8 using admittedbivariate.doc, append varlabel(_cons Constant  0b.joshincarcerated "Not
Incarcerated" 1.joshincarcerated "Incarcerated") eform cells("b(fmt(2)) ci()")
adjrr _Ijoshinc

*receipt of anti-retroviral therapy
svy: glm admitted i.joshart, family(binomial) link(log) eform
xi: svy: logistic admitted I.joshart
estimates store ed9
estout ed9 using admittedbivariate.doc, append varlabel(_cons Constant 0b.joshart "Not on ART" 1.joshart
"On ART") eform cells("b(fmt(2)) ci()")
adjrr _Ijoshart

*cd4 counts
xi: svy: glm admitted i.joshcd4, family(binomial) link(log) eform
xi: svy: logistic admitted i.joshcd4
estimates store ed10
estout ed10 using admittedbivariate.doc, append varlabel(_cons Constant 1.joshcd4 "50-199" 2.joshcd4
"200-349" 3.joshcd4 "350-499" 4b.joshcd4 ">=500") eform cells("b(fmt(2)) ci()")
adjrr _Ijoshcd4_0
adjrr _Ijoshcd4_1
adjrr _Ijoshcd4_2
adjrr _Ijoshcd4_3

*checking continuous cd4 counts
 svy: logistic admitted _mlogcd4cnt_ivf
adjrr _mlog~nt_ivf

* per100 cd4 counts
svy: logistic admitted joshcd4number2
adjrr joshcd4number2

*lifetime aids status
xi: svy: glm admitted i.collapsedaids, family(binomial) link(log) eform
xi: svy: logistic admitted i.collapsedaids
estimates store ed11
estout ed11 using admittedbivariate.doc, append varlabel(_cons Constant  1._newcat5_aids_mix  "Clinical
and Immunologic AIDS" 2._newcat5_aids_mix  "Clinical AIDS Only" 3._newcat5_aids_mix
"Immunologic AIDS only" 4._newcat5_aids_mix "AIDS NOS" 5b._newcat5_aids_mix "No AIDS" ) eform
cells("b(fmt(2)) ci()")
adjrr _Icollap

*durable viral load suppression
svy: glm admitted i.joshallvl, family(binomial) link(log) eform
xi: svy: logistic admitted i.joshallvl
estimate store ed12
```

```
estout ed12 using admittedbivariate.doc, append varlabel(_cons Constant  0b.joshallvl "All Viral Loads
Suppressed" 1.joshallvl "Not Suppressed VL") eform cells("b(fmt(2)) ci()")
adjrr _Ijoshal

*depression bivariate
svy: glm admitted i.joshdepressed, family(binomial) link(log) eform
xi: svy: logistic admitted I.joshdepressed
estimate store ed13
estout ed13 using admittedbivariate.doc, append varlabel(_cons Constant  0b.joshdepressed "Not
Depressed" 1.joshdepressed "Depressed"  ) eform cells("b(fmt(2)) ci()")
adjrr _Ijoshdepre_1



*smoking bivariate
svy: glm admitted i.joshsmoking, family(binomial) link(log) eform
xi: svy: logistic admitted I.joshsmoking
estimate store ed14
estout ed14 using admittedbivariate.doc, append varlabel(_cons Constant  0b.joshsmoking "Never Smoker"
1.joshsmoking "Former Smoker" 2.joshsmoking "Current Smoking") eform cells("b(fmt(2)) ci()")
adjrr _Ijoshsmoki_1
adjrr _Ijoshsmoki_2

*drinking bivariate
svy: glm admitted i.joshdrinking, family(binomial) link(log) eform
xi: svy: logistic admitted i.joshdrinking
estimate store ed15
estout ed15 using admittedbivariate.doc, append varlabel(_cons Constant   1b.joshdrinking   "None"
3.joshdrinking "Heavy/binge" 2.joshdrinking "Moderate") eform cells("b(fmt(2)) ci()")
adjrr _Ijoshdrink_2
adjrr _Ijoshdrink_3

*illicit drug use bivariate
xi: svy: glm admitted i.joshillicitdrugs, family(binomial) link(log) eform
xi: svy: logistic admitted i.joshillicitdrugs
estimate store ed16
estout ed16 using admittedbivariate.doc, append varlabel(_cons Constant  4b.joshillicitdrugs "None"
3.joshillicitdrugs "MJ only" 2.joshillicitdrugs "Other Non IDU" 1.joshillicitdrugs "IDU") eform
cells("b(fmt(2)) ci()")
adjrr _Ijoshillic_1
adjrr _Ijoshillic_2
adjrr _Ijoshillic_3

*unmet needs for service bivariate
xi: svy: glm admitted i.unmetneeds2, family(binomial) link(log) eform
xi: svy: logistic admitted i.unmetneeds2
estimate store ed17
estout ed17 using admittedbivariate.doc, append varlabel(_cons Constant ) eform cells("b(fmt(2)) ci()")
adjrr  _Iunmetneed_1
adjrr _Iunmetneed_2

*pcpvisits bivariate
xi: svy: glm admitted i.pcpvisits, family(binomial) link(log) eform
xi: svy: logistic admitted i.pcpvisits
estimates store ed18
estout ed18 using admittedbivariate.doc, append varlabel(_cons Constant) eform cells("b(fmt(2)) ci()")
```

```
adjrr _Ipcpvisits_2
adjrr _Ipcpvisits_3

*testsinyear bivariate
xi: svy: logistic admitted i.testsinyear
adjrr _Itestsinye_1

*final with cd4 per 100
svy: logistic admitted i.joshage i.joshrace i._partcomposite2 ib(#3).josheducation i.joshpoverty
i.joshinsurance i.joshhomeless2 i.joshincarcerated  i.collapsedaids joshcd4number2 i.joshallvl
i.joshdepressed i.joshdrinking i.joshsmoking ib(#4).joshillicitdrugs i.unmetneeds2 i.testsinyear
estimates store hospitallogistic
estout hospitallogistic using hospitallogistic.doc, replace varlabel(_cons Constant 1b.joshage "18-29"
2.joshage "30-39" 3.joshage "40-49" 4.joshage ">=50"  1b._partcomposite2 "Any MSM"
2._partcomposite2 "MSW Only" 3._partcomposite2 "Any WSM"  4._partcomposite2 "Other" 1b.joshrace
"White, non-Hispanic" 2.joshrace "Black, non-Hispanic" 3.joshrace "Hispanic or Latino" 4.joshrace
"Other" 1.josheducation "<High School" 2.josheducation "HS Diploma or Equivalent" 3b.josheducation
">High School" 0b.joshpoverty "Not Impoverished" 1.joshpoverty "Impoverished" 1b.joshhomeless2 "Not
Homeless" 2.joshhomeless2 "Homeless" 0b.joshinsurance "Insured" 1.joshinsurance "Uninsured"
0b.joshincarcerated "Not Incarcerated" 1.joshincarcerated "Incarcerated" 0b.joshart "Not on ART" 1.joshart
"On ART" 0b.joshallvl "All Viral Loads Suppressed" 1.joshallvl "Not Suppressed VL" 0b.joshdepressed
"Not Depressed" 1.joshdepressed "Depressed"  1b.joshdrinking   "None" 3.joshdrinking "Heavy/binge"
2.joshdrinking "Moderate" 0b.joshsmoking "Never Smoker" 1.joshsmoking "Former Smoker"
2.joshsmoking "Current Smoking" 4b.joshillicitdrugs "None" 3.joshillicitdrugs "MJ only" 2.joshillicitdrugs
"Other Non IDU" 1.joshillicitdrugs "IDU" 0b.halfunmetscore "No Unmet Needs" 1.halfunmetscore "At
Least one Unmet Need" 0.joshcd4 "0-49" 1.joshcd4 "50-199" 2.joshcd4 "200-349" 3.joshcd4 "350-499"
4b.joshcd4 ">=500" 1._newcat5_aids_mix  "Clinical and Immunologic AIDS" 2._newcat5_aids_mix
"Clinical AIDS Only" 3._newcat5_aids_mix  "Immunologic AIDS only" 4._newcat5_aids_mix "AIDS
NOS" 5b._newcat5_aids_mix "No AIDS" 1.testsinyear "1 Visit" 2.testsinyear "2 Visits" 3.testsinyear "3
visits") eform cells("b(fmt(2)) ci(fmt(2))  ")

adjrr _Ijoshage_2
adjrr _Ijoshage_3
adjrr _Ijoshage_4
adjrr _Ijoshrace_2
adjrr _Ijoshrace_3
adjrr _Ijoshrace_4
adjrr _I_partcomp_2
adjrr _I_partcomp_3
adjrr _I_partcomp_4
adjrr _Ijosheduca_1
adjrr _Ijosheduca_2
adjrr _Ijoshpover_1
adjrr _Ijoshinsur_1
adjrr _Ijoshhomel_2
adjrr _Ijoshincar_1
adjrr _Icollapsed_1
adjrr  joshcd4number2
adjrr _Ijoshallvl_1
adjrr _Ijoshdepre_1
adjrr _Ijoshdrink_2
adjrr _Ijoshdrink_3
adjrr _Ijoshsmoki_1
adjrr _Ijoshsmoki_2
adjrr _Ijoshillic_1
adjrr _Ijoshillic_2
```

```
adjrr _Ijoshillic_3
adjrr  _Iunmetneed_1
adjrr _Iunmetneed_2
adjrr _Itestsinye_1

predict admittedprobtests
gen admittedprobtests1=1 if admittedprobtests>=.5 & admittedprobtests~=.
replace admittedprobtests1=0 if admittedprobtests<.5 & admittedprobtests~=.
roctab admitted admittedprobtests, graph
tab admittedprobtests1 admitted
```

Emergency Department and Hospital SEM Dataset Creation Code

```
keep parid nat_owt nat_strat_owt nat_clust_owt emergency joshage _partcomposite2 joshrace
josheducation joshpoverty joshinsurance joshhomeless2 joshincarcerated _mlogcd4cnt_ivf joshallvl
collapsedaids joshdepressed joshdrinking joshsmoking joshillicitdrugs unmetneeds2 testsinyear
rename _partcomposite2  partcomposite
rename nat_owt natweight
rename nat_strat_owt natstrat
rename nat_clust_owt natclust
rename _mlogcd4cnt_ivf cd4count
stata2mplus using "\\cdc\project\NCHHSTP_BCSB_Data\COT_OTHER\JoshJ\factored11-5-13.dta",
replace

keep parid nat_owt nat_strat_owt nat_clust_owt admitted joshage _partcomposite2 joshrace josheducation
joshpoverty joshinsurance joshhomeless2 joshincarcerated  _mlogcd4cnt_ivf joshallvl collapsedaids
joshdepressed joshdrinking joshsmoking joshillicitdrugs unmetneeds2 testsinyear
rename _partcomposite2  partcomposite
rename nat_owt natweight
rename nat_strat_owt natstrat
rename nat_clust_owt natclust
rename _mlogcd4cnt_ivf cd4count
stata2mplus using "\\cdc\project\NCHHSTP_BCSB_Data\COT_OTHER\JoshJ\factorhosp11-5-13.dta",
replace
```

Emergency Department Structural Equation Model Code

```
Title:
  Stata2Mplus conversion for \\cdc\project\NCHHSTP_BCSB_Data\COT_OTHER\JoshJ\edcd4cont9-16-
2013.dta.dta
  List of variables converted shown below

  partcomposite : sex partner type based on _partcomposite ^[_partcomposite2]
    1: ANY MSM
    2: MSW Only
    3: Any WSM
    4: Other
  cd4count : geometric mean cd4 counts-spif and spvf^[_mlogcd4cnt_ivf]
  natweight : final national weight
  natstrat : national strata for variance estimation
  natclust : national cluster for variance estimation
  emergency :
  joshage :
    1: 18-29
    2: 29-39
    3: 40-49
    4: >=50
  joshrace :
    1: White, non-Hispanic
    2: Black, non-Hispanic
    3: Hispanic or Latino
    4: Other
  josheducation :
    1: <High School
    2: HS diploma or equivalent
    3: >High School
  joshpoverty :
    0: Not in Poverty
    1: Impoverished
  joshinsurance :
    0: No
    1: Yes
  joshhomeless2 :
    1: No
    2: yes
  joshincarcerated :
    0: No
    1: Yes
  joshallvl :
    0: All Supressed
  collapsedaids :
  joshdepressed :
    0: No
    1: Yes
  joshsmoking :
    0: Never
    1: Former
    2: current
  joshdrinking :
    1: None
    2: Moderate
    3: Heavy/binge
```

```
  joshillicitdrugs :
    1: IDU
    2: Other Non IDU
    3: MJ only
    4: None
  unmetneeds2 :
  testsinyear :

Data:
  File is \\cdc\project\NCHHSTP_BCSB_Data\COT_OTHER\JoshJ\edcd4cont9-16-2013.dta.dat ;
Variable:
  Names are
     partcomposite cd4count natweight natstrat natclust emergency joshage
     joshrace josheducation joshpoverty joshinsurance joshhomeless2 joshincarcerated
     joshallvl collapsedaids joshdepressed joshsmoking joshdrinking joshillicitdrugs
     unmetneeds2 testsinyear;
  Missing are all (-9999) ;
Categorical are
     partcomposite  emergency joshage joshpoverty
     josheducation  joshinsurance joshhomeless2 joshincarcerated
      joshallvl collapsedaids joshdepressed joshsmoking
     joshdrinking joshillicitdrugs unmetneeds2 testsinyear;

   Nominal are joshrace;

    usevariables are  emergency partcomposite  joshrace joshage
     josheducation joshpoverty joshinsurance joshhomeless2 joshincarcerated
     cd4count joshallvl collapsedaids joshdepressed joshsmoking
     joshdrinking joshillicitdrugs unmetneeds2 testsinyear;




 STRATIFICATION IS natstrat;
    CLUSTER IS natclust;
    WEIGHT IS natweight;

Model:
       f1 by partcomposite@1 joshage joshrace#1 joshrace#2 joshrace#3 josheducation ;
       f1 by joshdrinking joshsmoking joshillicitdrugs;
       f2 by joshpoverty@1 ;
       f2 by joshinsurance joshincarcerated ;
       f2 by joshhomeless2;
       f3 by cd4count@1 joshallvl collapsedaids testsinyear;
       f3 by joshdepressed unmetneeds2 ;
       emergency on f1 f2 f3

Analysis:
   Type = complex;
   INTEGRATION =8;


OUTPUT: tech1 tech2 tech3 tech4 tech8 sampstat standardized;
```

Hospital Utilization Structural Equation Model Code

```
Title:
  Stata2Mplus conversion for \\cdc\project\NCHHSTP_BCSB_Data\COT_OTHER\JoshJ\hospcontcd49-16-
2013.dta.dta
  List of variables converted shown below

  partcomposite : sex partner type based on _partcomposite ^[_partcomposite2]
    1: ANY MSM
    2: MSW Only
    3: Any WSM
    4: Other
  cd4count : geometric mean cd4 counts-spif and spvf^[_mlogcd4cnt_ivf]
  natweight : final national weight
  natstrat : national strata for variance estimation
  natclust : national cluster for variance estimation
  admitted :
  joshage :
    1: 18-29
    2: 29-39
    3: 40-49
    4: >=50
  joshrace :
    1: White, non-Hispanic
    2: Black, non-Hispanic
    3: Hispanic or Latino
    4: Other
  josheducation :
    1: <High School
    2: HS diploma or equivalent
    3: >High School
  joshpoverty :
    0: Not in Poverty
    1: Impoverished
  joshinsurance :
    0: No
    1: Yes
  joshhomeless2 :
    1: No
    2: yes
  joshincarcerated :
    0: No
    1: Yes
  joshallvl :
    0: All Supressed
  collapsedaids :
  joshdepressed :
    0: No
    1: Yes
  joshsmoking :
    0: Never
    1: Former
    2: current
  joshdrinking :
    1: None
    2: Moderate
    3: Heavy/binge
```

```
  joshillicitdrugs :
    1: IDU
    2: Other Non IDU
    3: MJ only
    4: None
  unmetneeds2 :
  testsinyear :

Data:
  File is \\cdc\project\NCHHSTP_BCSB_Data\COT_OTHER\JoshJ\hospcontcd49-16-2013.dta.dat ;
Variable:
  Names are
     partcomposite cd4count natweight natstrat natclust admitted joshage
     joshrace josheducation joshpoverty joshinsurance joshhomeless2 joshincarcerated
     joshallvl collapsedaids joshdepressed joshsmoking joshdrinking joshillicitdrugs
     unmetneeds2 testsinyear;
  Missing are all (-9999) ;
Categorical are
     partcomposite  admitted joshage joshpoverty
     josheducation  joshinsurance joshhomeless2 joshincarcerated
      joshallvl collapsedaids joshdepressed joshsmoking
     joshdrinking joshillicitdrugs unmetneeds2 testsinyear;

   Nominal are joshrace;

    usevariables are  admitted partcomposite  joshrace joshage
     josheducation joshpoverty joshinsurance joshhomeless2 joshincarcerated
     cd4count joshallvl collapsedaids joshdepressed joshsmoking
     joshdrinking joshillicitdrugs unmetneeds2 testsinyear;




 STRATIFICATION IS natstrat;
    CLUSTER IS natclust;
    WEIGHT IS natweight;

Model:
      f1 by partcomposite@1 joshage joshrace#1 joshrace#2 joshrace#3 josheducation ;
      f1 by joshdrinking joshsmoking joshillicitdrugs;
      f2 by joshpoverty@1 ;
      f2 by joshinsurance joshincarcerated ;
      f2 by joshhomeless2;
      f3 by cd4count@1 joshallvl collapsedaids testsinyear;
      f3 by joshdepressed unmetneeds2 ;
      admitted on f1 f2 f3

Analysis:
   Type = complex;
   INTEGRATION =10;


OUTPUT: tech1 tech2 tech3 tech4 tech8 sampstat standardized;
```

Code for the ED and Hospital Sensitivity Analysis

```
***************Switching to continuous CD4 count************************
*******look at jaceks preferred variables and ED use
******Standard Poisson Model*****
svy: poisson eru_vi_9  i.joshage i.joshrace i._partcomposite2 ib(#3).josheducation i.joshpoverty
i.joshinsurance i.joshhomeless2 i.joshincarcerated  joshcd4number2 i.collapsedaids i.joshallvl
i.joshdepressed i.joshdrinking i.joshsmoking ib(#4).joshillicitdrugs i.unmetneeds2 i.testsinyear, irr
estimates store emergencycontpoisson
estout emergencycontpoisson using emergencycontpoisson.doc, replace varlabel(_cons Constant
1b.joshage "18-29" 2.joshage "30-39" 3.joshage "40-49" 4.joshage ">=50"  1b._partcomposite2 "Any
MSM" 2._partcomposite2 "MSW Only" 3._partcomposite2 "Any WSM"  4._partcomposite2 "Other"
1b.joshrace "White, non-Hispanic" 2.joshrace "Black, non-Hispanic" 3.joshrace "Hispanic or Latino"
4.joshrace "Other" 1.josheducation "<High School" 2.josheducation "HS Diploma or Equivalent"
3b.josheducation ">High School" 0b.joshpoverty "Not Impoverished" 1.joshpoverty "Impoverished"
1b.joshhomeless2 "Not Homeless" 2.joshhomeless2 "Homeless" 0b.joshinsurance "Insured"
1.joshinsurance "Uninsured" 0b.joshincarcerated "Not Incarcerated" 1.joshincarcerated "Incarcerated"
0b.joshart "Not on ART" 1.joshart "On ART" 0b.joshallvl "All Viral Loads Suppressed" 1.joshallvl "Not
Suppressed VL" 0b.joshdepressed "Not Depressed" 1.joshdepressed "Depressed"  1b.joshdrinking   "None"
3.joshdrinking "Heavy/binge" 2.joshdrinking "Moderate" 0b.joshsmoking "Never Smoker" 1.joshsmoking
"Former Smoker" 2.joshsmoking "Current Smoking" 4b.joshillicitdrugs "None" 3.joshillicitdrugs "MJ
only" 2.joshillicitdrugs "Other Non IDU" 1.joshillicitdrugs "IDU" 0b.halfunmetscore "No Unmet Needs"
1.halfunmetscore "At Least one Unmet Need" 0.joshcd4 "0-49" 1.joshcd4 "50-199" 2.joshcd4 "200-349"
3.joshcd4 "350-499" 4b.joshcd4 ">=500" 1._newcat5_aids_mix  "Clinical and Immunologic AIDS"
2._newcat5_aids_mix  "Clinical AIDS Only" 3._newcat5_aids_mix  "Immunologic AIDS only"
4._newcat5_aids_mix "AIDS NOS" 5b._newcat5_aids_mix "No AIDS" 1.testsinyear "1 Visit" 2.testsinyear
"2 Visits" 3.testsinyear "3 visits") eform cells("b(fmt(2)) ci(fmt(2))  ")

*******Zero Inflated Poisson Model*****
svy: zip eru_vi_9  i.joshage i.joshrace i._partcomposite2 ib(#3).josheducation i.joshpoverty i.joshinsurance
i.joshhomeless2 i.joshincarcerated  i.collapsedaids joshcd4number2 i.joshallvl i.joshdepressed
i.joshdrinking i.joshsmoking ib(#4).joshillicitdrugs i.unmetneeds2 i.testsinyear, inflate (i.joshage i.joshrace
i._partcomposite2 ib(#3).josheducation i.joshpoverty i.joshinsurance i.joshhomeless2 i.joshincarcerated
i.collapsedaids joshcd4number2 i.joshallvl i.joshdepressed i.joshdrinking i.joshsmoking
ib(#4).joshillicitdrugs i.unmetneeds2 i.testsinyear) irr
estimates store emergencycontzipoisson
estout emergencycontzipoisson using emergencycontzipoisson.doc, replace varlabel(_cons Constant
1b.joshage "18-29" 2.joshage "30-39" 3.joshage "40-49" 4.joshage ">=50"  1b._partcomposite2 "Any
MSM" 2._partcomposite2 "MSW Only" 3._partcomposite2 "Any WSM"  4._partcomposite2 "Other"
1b.joshrace "White, non-Hispanic" 2.joshrace "Black, non-Hispanic" 3.joshrace "Hispanic or Latino"
4.joshrace "Other" 1.josheducation "<High School" 2.josheducation "HS Diploma or Equivalent"
3b.josheducation ">High School" 0b.joshpoverty "Not Impoverished" 1.joshpoverty "Impoverished"
1b.joshhomeless2 "Not Homeless" 2.joshhomeless2 "Homeless" 0b.joshinsurance "Insured"
1.joshinsurance "Uninsured" 0b.joshincarcerated "Not Incarcerated" 1.joshincarcerated "Incarcerated"
0b.joshart "Not on ART" 1.joshart "On ART" 0b.joshallvl "All Viral Loads Suppressed" 1.joshallvl "Not
Suppressed VL" 0b.joshdepressed "Not Depressed" 1.joshdepressed "Depressed"  1b.joshdrinking   "None"
3.joshdrinking "Heavy/binge" 2.joshdrinking "Moderate" 0b.joshsmoking "Never Smoker" 1.joshsmoking
"Former Smoker" 2.joshsmoking "Current Smoking" 4b.joshillicitdrugs "None" 3.joshillicitdrugs "MJ
only" 2.joshillicitdrugs "Other Non IDU" 1.joshillicitdrugs "IDU" 0b.halfunmetscore "No Unmet Needs"
1.halfunmetscore "At Least one Unmet Need" 0.joshcd4 "0-49" 1.joshcd4 "50-199" 2.joshcd4 "200-349"
3.joshcd4 "350-499" 4b.joshcd4 ">=500" 1._newcat5_aids_mix  "Clinical and Immunologic AIDS"
2._newcat5_aids_mix  "Clinical AIDS Only" 3._newcat5_aids_mix  "Immunologic AIDS only"
4._newcat5_aids_mix "AIDS NOS" 5b._newcat5_aids_mix "No AIDS" 1.testsinyear "1 Visit" 2.testsinyear
"2 Visits" 3.testsinyear "3 visits") eform cells("b(fmt(2)) ci(fmt(2))  ")
```

```
******Standard negative binomial regression
svy: nbreg eru_vi_9  i.joshage i.joshrace i._partcomposite2 ib(#3).josheducation i.joshpoverty
i.joshinsurance i.joshhomeless2 i.joshincarcerated  i.collapsedaids joshcd4number2 i.joshallvl
i.joshdepressed i.joshdrinking i.joshsmoking ib(#4).joshillicitdrugs i.unmetneeds2 i.testsinyear,  irr
estimates store emergencycontnb
estout emergencycontnb using emergencycontnb.doc, replace varlabel(_cons Constant 1b.joshage "18-29"
2.joshage "30-39" 3.joshage "40-49" 4.joshage ">=50"  1b._partcomposite2 "Any MSM"
2._partcomposite2 "MSW Only" 3._partcomposite2 "Any WSM"  4._partcomposite2 "Other" 1b.joshrace
"White, non-Hispanic" 2.joshrace "Black, non-Hispanic" 3.joshrace "Hispanic or Latino" 4.joshrace
"Other" 1.josheducation "<High School" 2.josheducation "HS Diploma or Equivalent" 3b.josheducation
">High School" 0b.joshpoverty "Not Impoverished" 1.joshpoverty "Impoverished" 1b.joshhomeless2 "Not
Homeless" 2.joshhomeless2 "Homeless" 0b.joshinsurance "Insured" 1.joshinsurance "Uninsured"
0b.joshincarcerated "Not Incarcerated" 1.joshincarcerated "Incarcerated" 0b.joshart "Not on ART" 1.joshart
"On ART" 0b.joshallvl "All Viral Loads Suppressed" 1.joshallvl "Not Suppressed VL" 0b.joshdepressed
"Not Depressed" 1.joshdepressed "Depressed"  1b.joshdrinking   "None" 3.joshdrinking "Heavy/binge"
2.joshdrinking "Moderate" 0b.joshsmoking "Never Smoker" 1.joshsmoking "Former Smoker"
2.joshsmoking "Current Smoking" 4b.joshillicitdrugs "None" 3.joshillicitdrugs "MJ only" 2.joshillicitdrugs
"Other Non IDU" 1.joshillicitdrugs "IDU" 0b.halfunmetscore "No Unmet Needs" 1.halfunmetscore "At
Least one Unmet Need" 0.joshcd4 "0-49" 1.joshcd4 "50-199" 2.joshcd4 "200-349" 3.joshcd4 "350-499"
4b.joshcd4 ">=500" 1._newcat5_aids_mix  "Clinical and Immunologic AIDS" 2._newcat5_aids_mix
"Clinical AIDS Only" 3._newcat5_aids_mix  "Immunologic AIDS only" 4._newcat5_aids_mix "AIDS
NOS" 5b._newcat5_aids_mix "No AIDS" 1.testsinyear "1 Visit" 2.testsinyear "2 Visits" 3.testsinyear "3
visits") eform cells("b(fmt(2)) ci(fmt(2))  ")


******Zero Inflated Negative Binomial Model
svy: zinb eru_vi_9  i.joshage i.joshrace i._partcomposite2 ib(#3).josheducation i.joshpoverty
i.joshinsurance i.joshhomeless2 i.joshincarcerated  i.collapsedaids joshcd4number2 i.joshallvl
i.joshdepressed i.joshdrinking i.joshsmoking ib(#4).joshillicitdrugs i.unmetneeds2 i.testsinyear, inflate
(i.joshage i.joshrace i._partcomposite2 ib(#3).josheducation i.joshpoverty i.joshinsurance i.joshhomeless2
i.joshincarcerated  i.collapsedaids joshcd4number2 i.joshallvl i.joshdepressed i.joshdrinking i.joshsmoking
ib(#4).joshillicitdrugs i.unmetneeds2 i.testsinyear) irr
estimates store emergencycontzinb
estout emergencycontzinb using emergencycontzinb.doc, replace varlabel(_cons Constant 1b.joshage "18-
29" 2.joshage "30-39" 3.joshage "40-49" 4.joshage ">=50"  1b._partcomposite2 "Any MSM"
2._partcomposite2 "MSW Only" 3._partcomposite2 "Any WSM"  4._partcomposite2 "Other" 1b.joshrace
"White, non-Hispanic" 2.joshrace "Black, non-Hispanic" 3.joshrace "Hispanic or Latino" 4.joshrace
"Other" 1.josheducation "<High School" 2.josheducation "HS Diploma or Equivalent" 3b.josheducation
">High School" 0b.joshpoverty "Not Impoverished" 1.joshpoverty "Impoverished" 1b.joshhomeless2 "Not
Homeless" 2.joshhomeless2 "Homeless" 0b.joshinsurance "Insured" 1.joshinsurance "Uninsured"
0b.joshincarcerated "Not Incarcerated" 1.joshincarcerated "Incarcerated" 0b.joshart "Not on ART" 1.joshart
"On ART" 0b.joshallvl "All Viral Loads Suppressed" 1.joshallvl "Not Suppressed VL" 0b.joshdepressed
"Not Depressed" 1.joshdepressed "Depressed"  1b.joshdrinking   "None" 3.joshdrinking "Heavy/binge"
2.joshdrinking "Moderate" 0b.joshsmoking "Never Smoker" 1.joshsmoking "Former Smoker"
2.joshsmoking "Current Smoking" 4b.joshillicitdrugs "None" 3.joshillicitdrugs "MJ only" 2.joshillicitdrugs
"Other Non IDU" 1.joshillicitdrugs "IDU" 0b.halfunmetscore "No Unmet Needs" 1.halfunmetscore "At
Least one Unmet Need" 0.joshcd4 "0-49" 1.joshcd4 "50-199" 2.joshcd4 "200-349" 3.joshcd4 "350-499"
4b.joshcd4 ">=500" 1._newcat5_aids_mix  "Clinical and Immunologic AIDS" 2._newcat5_aids_mix
"Clinical AIDS Only" 3._newcat5_aids_mix  "Immunologic AIDS only" 4._newcat5_aids_mix "AIDS
NOS" 5b._newcat5_aids_mix "No AIDS" 1.testsinyear "1 Visit" 2.testsinyear "2 Visits" 3.testsinyear "3
visits") eform cells("b(fmt(2)) ci(fmt(2))  ")


********look at increasing outcomes with ordinal logistic regression
```

```
svy: ologit emergencyologit  i.joshage i.joshrace i._partcomposite2 ib(#3).josheducation i.joshpoverty
i.joshinsurance i.joshhomeless2 i.joshincarcerated  i.collapsedaids joshcd4number2 i.joshallvl
i.joshdepressed i.joshdrinking i.joshsmoking ib(#4).joshillicitdrugs i.unmetneeds2 i.testsinyear, or
estimates store emergencycontologit
estout emergencycontologit using emergencycontologit.doc, replace varlabel(_cons Constant 1b.joshage
"18-29" 2.joshage "30-39" 3.joshage "40-49" 4.joshage ">=50"  1b._partcomposite2 "Any MSM"
2._partcomposite2 "MSW Only" 3._partcomposite2 "Any WSM"  4._partcomposite2 "Other" 1b.joshrace
"White, non-Hispanic" 2.joshrace "Black, non-Hispanic" 3.joshrace "Hispanic or Latino" 4.joshrace
"Other" 1.josheducation "<High School" 2.josheducation "HS Diploma or Equivalent" 3b.josheducation
">High School" 0b.joshpoverty "Not Impoverished" 1.joshpoverty "Impoverished" 1b.joshhomeless2 "Not
Homeless" 2.joshhomeless2 "Homeless" 0b.joshinsurance "Insured" 1.joshinsurance "Uninsured"
0b.joshincarcerated "Not Incarcerated" 1.joshincarcerated "Incarcerated" 0b.joshart "Not on ART" 1.joshart
"On ART" 0b.joshallvl "All Viral Loads Suppressed" 1.joshallvl "Not Suppressed VL" 0b.joshdepressed
"Not Depressed" 1.joshdepressed "Depressed"  1b.joshdrinking   "None" 3.joshdrinking "Heavy/binge"
2.joshdrinking "Moderate" 0b.joshsmoking "Never Smoker" 1.joshsmoking "Former Smoker"
2.joshsmoking "Current Smoking" 4b.joshillicitdrugs "None" 3.joshillicitdrugs "MJ only" 2.joshillicitdrugs
"Other Non IDU" 1.joshillicitdrugs "IDU" 0b.halfunmetscore "No Unmet Needs" 1.halfunmetscore "At
Least one Unmet Need" 0.joshcd4 "0-49" 1.joshcd4 "50-199" 2.joshcd4 "200-349" 3.joshcd4 "350-499"
4b.joshcd4 ">=500" 1._newcat5_aids_mix  "Clinical and Immunologic AIDS" 2._newcat5_aids_mix
"Clinical AIDS Only" 3._newcat5_aids_mix  "Immunologic AIDS only" 4._newcat5_aids_mix "AIDS
NOS" 5b._newcat5_aids_mix "No AIDS" 1.testsinyear "1 Visit" 2.testsinyear "2 Visits" 3.testsinyear "3
visits") eform cells("b(fmt(2)) ci(fmt(2))  ")


*****looking at increasing outcomes with multinomial logistic regression
svy: mlogit emergencyologit  i.joshage i.joshrace i._partcomposite2 ib(#3).josheducation i.joshpoverty
i.joshinsurance i.joshhomeless2 i.joshincarcerated  i.collapsedaids joshcd4number2 i.joshallvl
i.joshdepressed i.joshdrinking i.joshsmoking ib(#4).joshillicitdrugs i.unmetneeds2 i.testsinyear, rrr
estimates store emergencycontmlogit
estout emergencycontmlogit using emergencycontmlogit.doc, replace varlabel(_cons Constant 1b.joshage
"18-29" 2.joshage "30-39" 3.joshage "40-49" 4.joshage ">=50"  1b._partcomposite2 "Any MSM"
2._partcomposite2 "MSW Only" 3._partcomposite2 "Any WSM"  4._partcomposite2 "Other" 1b.joshrace
"White, non-Hispanic" 2.joshrace "Black, non-Hispanic" 3.joshrace "Hispanic or Latino" 4.joshrace
"Other" 1.josheducation "<High School" 2.josheducation "HS Diploma or Equivalent" 3b.josheducation
">High School" 0b.joshpoverty "Not Impoverished" 1.joshpoverty "Impoverished" 1b.joshhomeless2 "Not
Homeless" 2.joshhomeless2 "Homeless" 0b.joshinsurance "Insured" 1.joshinsurance "Uninsured"
0b.joshincarcerated "Not Incarcerated" 1.joshincarcerated "Incarcerated" 0b.joshart "Not on ART" 1.joshart
"On ART" 0b.joshallvl "All Viral Loads Suppressed" 1.joshallvl "Not Suppressed VL" 0b.joshdepressed
"Not Depressed" 1.joshdepressed "Depressed"  1b.joshdrinking   "None" 3.joshdrinking "Heavy/binge"
2.joshdrinking "Moderate" 0b.joshsmoking "Never Smoker" 1.joshsmoking "Former Smoker"
2.joshsmoking "Current Smoking" 4b.joshillicitdrugs "None" 3.joshillicitdrugs "MJ only" 2.joshillicitdrugs
"Other Non IDU" 1.joshillicitdrugs "IDU" 0b.halfunmetscore "No Unmet Needs" 1.halfunmetscore "At
Least one Unmet Need" 0.joshcd4 "0-49" 1.joshcd4 "50-199" 2.joshcd4 "200-349" 3.joshcd4 "350-499"
4b.joshcd4 ">=500" 1._newcat5_aids_mix  "Clinical and Immunologic AIDS" 2._newcat5_aids_mix
"Clinical AIDS Only" 3._newcat5_aids_mix  "Immunologic AIDS only" 4._newcat5_aids_mix "AIDS
NOS" 5b._newcat5_aids_mix "No AIDS" 1.testsinyear "1 Visit" 2.testsinyear "2 Visits" 3.testsinyear "3
visits") eform cells("b(fmt(2)) ci(fmt(2))  ")


*look at jaceks preferred variables and hospital use
******Standard Poisson Model*****
svy: poisson hosp i.joshage i.joshrace i._partcomposite2 ib(#3).josheducation i.joshpoverty i.joshinsurance
i.joshhomeless2 i.joshincarcerated  i.collapsedaids  joshcd4number2 i.joshallvl i.joshdepressed
i.joshdrinking i.joshsmoking ib(#4).joshillicitdrugs i.unmetneeds2 i.testsinyear, irr
estimates store hospcontpoisson
```

```
estout hospcontpoisson using hospcontpoisson.doc, replace varlabel(_cons Constant 1b.joshage "18-29"
2.joshage "30-39" 3.joshage "40-49" 4.joshage ">=50"  1b._partcomposite2 "Any MSM"
2._partcomposite2 "MSW Only" 3._partcomposite2 "Any WSM"  4._partcomposite2 "Other" 1b.joshrace
"White, non-Hispanic" 2.joshrace "Black, non-Hispanic" 3.joshrace "Hispanic or Latino" 4.joshrace
"Other" 1.josheducation "<High School" 2.josheducation "HS Diploma or Equivalent" 3b.josheducation
">High School" 0b.joshpoverty "Not Impoverished" 1.joshpoverty "Impoverished" 1b.joshhomeless2 "Not
Homeless" 2.joshhomeless2 "Homeless" 0b.joshinsurance "Insured" 1.joshinsurance "Uninsured"
0b.joshincarcerated "Not Incarcerated" 1.joshincarcerated "Incarcerated" 0b.joshart "Not on ART" 1.joshart
"On ART" 0b.joshallvl "All Viral Loads Suppressed" 1.joshallvl "Not Suppressed VL" 0b.joshdepressed
"Not Depressed" 1.joshdepressed "Depressed"  1b.joshdrinking   "None" 3.joshdrinking "Heavy/binge"
2.joshdrinking "Moderate" 0b.joshsmoking "Never Smoker" 1.joshsmoking "Former Smoker"
2.joshsmoking "Current Smoking" 4b.joshillicitdrugs "None" 3.joshillicitdrugs "MJ only" 2.joshillicitdrugs
"Other Non IDU" 1.joshillicitdrugs "IDU" 0b.halfunmetscore "No Unmet Needs" 1.halfunmetscore "At
Least one Unmet Need" 0.joshcd4 "0-49" 1.joshcd4 "50-199" 2.joshcd4 "200-349" 3.joshcd4 "350-499"
4b.joshcd4 ">=500" 1._newcat5_aids_mix  "Clinical and Immunologic AIDS" 2._newcat5_aids_mix
"Clinical AIDS Only" 3._newcat5_aids_mix  "Immunologic AIDS only" 4._newcat5_aids_mix "AIDS
NOS" 5b._newcat5_aids_mix "No AIDS" 1.testsinyear "1 Visit" 2.testsinyear "2 Visits" 3.testsinyear "3
visits") eform cells("b(fmt(2)) ci(fmt(2))  ")

*******Zero Inflated Poisson Model*****
svy: zip hosp  i.joshage i.joshrace i._partcomposite2 ib(#3).josheducation i.joshpoverty i.joshinsurance
i.joshhomeless2 i.joshincarcerated  i.collapsedaids  joshcd4number2 i.joshallvl i.joshdepressed
i.joshdrinking i.joshsmoking ib(#4).joshillicitdrugs i.unmetneeds2 i.testsinyear, inflate (i.joshage i.joshrace
i._partcomposite2 ib(#3).josheducation i.joshpoverty i.joshinsurance i.joshhomeless2 i.joshincarcerated
i.collapsedaids joshcd4number2 i.joshallvl i.joshdepressed i.joshdrinking i.joshsmoking
ib(#4).joshillicitdrugs i.unmetneeds2 i.testsinyear) irr
estimates store hospcontzipoisson
estout hospcontzipoisson using hospcontzipoisson.doc, replace varlabel(_cons Constant 1b.joshage "18-29"
2.joshage "30-39" 3.joshage "40-49" 4.joshage ">=50"  1b._partcomposite2 "Any MSM"
2._partcomposite2 "MSW Only" 3._partcomposite2 "Any WSM"  4._partcomposite2 "Other" 1b.joshrace
"White, non-Hispanic" 2.joshrace "Black, non-Hispanic" 3.joshrace "Hispanic or Latino" 4.joshrace
"Other" 1.josheducation "<High School" 2.josheducation "HS Diploma or Equivalent" 3b.josheducation
">High School" 0b.joshpoverty "Not Impoverished" 1.joshpoverty "Impoverished" 1b.joshhomeless2 "Not
Homeless" 2.joshhomeless2 "Homeless" 0b.joshinsurance "Insured" 1.joshinsurance "Uninsured"
0b.joshincarcerated "Not Incarcerated" 1.joshincarcerated "Incarcerated" 0b.joshart "Not on ART" 1.joshart
"On ART" 0b.joshallvl "All Viral Loads Suppressed" 1.joshallvl "Not Suppressed VL" 0b.joshdepressed
"Not Depressed" 1.joshdepressed "Depressed"  1b.joshdrinking   "None" 3.joshdrinking "Heavy/binge"
2.joshdrinking "Moderate" 0b.joshsmoking "Never Smoker" 1.joshsmoking "Former Smoker"
2.joshsmoking "Current Smoking" 4b.joshillicitdrugs "None" 3.joshillicitdrugs "MJ only" 2.joshillicitdrugs
"Other Non IDU" 1.joshillicitdrugs "IDU" 0b.halfunmetscore "No Unmet Needs" 1.halfunmetscore "At
Least one Unmet Need" 0.joshcd4 "0-49" 1.joshcd4 "50-199" 2.joshcd4 "200-349" 3.joshcd4 "350-499"
4b.joshcd4 ">=500" 1._newcat5_aids_mix  "Clinical and Immunologic AIDS" 2._newcat5_aids_mix
"Clinical AIDS Only" 3._newcat5_aids_mix  "Immunologic AIDS only" 4._newcat5_aids_mix "AIDS
NOS" 5b._newcat5_aids_mix "No AIDS" 1.testsinyear "1 Visit" 2.testsinyear "2 Visits" 3.testsinyear "3
visits") eform cells("b(fmt(2)) ci(fmt(2))  ")


******Standard negative binomial regression
svy: nbreg hosp  i.joshage i.joshrace i._partcomposite2 ib(#3).josheducation i.joshpoverty i.joshinsurance
i.joshhomeless2 i.joshincarcerated  i.collapsedaids  joshcd4number2 i.joshallvl i.joshdepressed
i.joshdrinking i.joshsmoking ib(#4).joshillicitdrugs i.unmetneeds2 i.testsinyear,  irr
estimates store hospcontnb
estout hospcontnb using hospcontnb.doc, replace varlabel(_cons Constant 1b.joshage "18-29" 2.joshage
"30-39" 3.joshage "40-49" 4.joshage ">=50"  1b._partcomposite2 "Any MSM" 2._partcomposite2 "MSW
Only" 3._partcomposite2 "Any WSM"  4._partcomposite2 "Other" 1b.joshrace "White, non-Hispanic"
2.joshrace "Black, non-Hispanic" 3.joshrace "Hispanic or Latino" 4.joshrace "Other" 1.josheducation
```

"<High School" 2.josheducation "HS Diploma or Equivalent" 3b.josheducation ">High School" 0b.joshpoverty "Not Impoverished" 1.joshpoverty "Impoverished" 1b.joshhomeless2 "Not Homeless" 2.joshhomeless2 "Homeless" 0b.joshinsurance "Insured" 1.joshinsurance "Uninsured" 0b.joshincarcerated "Not Incarcerated" 1.joshincarcerated "Incarcerated" 0b.joshart "Not on ART" 1.joshart "On ART" 0b.joshallvl "All Viral Loads Suppressed" 1.joshallvl "Not Suppressed VL" 0b.joshdepressed "Not Depressed" 1.joshdepressed "Depressed" 1b.joshdrinking   "None" 3.joshdrinking "Heavy/binge" 2.joshdrinking "Moderate" 0b.joshsmoking "Never Smoker" 1.joshsmoking "Former Smoker" 2.joshsmoking "Current Smoking" 4b.joshillicitdrugs "None" 3.joshillicitdrugs "MJ only" 2.joshillicitdrugs "Other Non IDU" 1.joshillicitdrugs "IDU" 0b.halfunmetscore "No Unmet Needs" 1.halfunmetscore "At Least one Unmet Need" 0.joshcd4 "0-49" 1.joshcd4 "50-199" 2.joshcd4 "200-349" 3.joshcd4 "350-499" 4b.joshcd4 ">=500" 1._newcat5_aids_mix "Clinical and Immunologic AIDS" 2._newcat5_aids_mix "Clinical AIDS Only" 3._newcat5_aids_mix "Immunologic AIDS only" 4._newcat5_aids_mix "AIDS NOS" 5b._newcat5_aids_mix "No AIDS" 1.testsinyear "1 Visit" 2.testsinyear "2 Visits" 3.testsinyear "3 visits") eform cells("b(fmt(2)) ci(fmt(2)) ")

******Zero Inflated Negative Binomial Model
svy: zinb hosp i.joshage i.joshrace i._partcomposite2 ib(#3).josheducation i.joshpoverty i.joshinsurance i.joshhomeless2 i.joshincarcerated i.collapsedaids joshcd4number2 i.joshallvl i.joshdepressed i.joshdrinking i.joshsmoking ib(#4).joshillicitdrugs i.unmetneeds2 i.testsinyear, inflate (i.joshage i.joshrace i._partcomposite2 ib(#3).josheducation i.joshpoverty i.joshinsurance i.joshhomeless2 i.joshincarcerated i.collapsedaids joshcd4number2 i.joshallvl i.joshdepressed i.joshdrinking i.joshsmoking ib(#4).joshillicitdrugs i.unmetneeds2 i.testsinyear) irr
estimates store hospcontzinb
estout hospcontzinb using hospcontzinb.doc, replace varlabel(_cons Constant 1b.joshage "18-29" 2.joshage "30-39" 3.joshage "40-49" 4.joshage ">=50" 1b._partcomposite2 "Any MSM" 2._partcomposite2 "MSW Only" 3._partcomposite2 "Any WSM" 4._partcomposite2 "Other" 1b.joshrace "White, non-Hispanic" 2.joshrace "Black, non-Hispanic" 3.joshrace "Hispanic or Latino" 4.joshrace "Other" 1.josheducation "<High School" 2.josheducation "HS Diploma or Equivalent" 3b.josheducation ">High School" 0b.joshpoverty "Not Impoverished" 1.joshpoverty "Impoverished" 1b.joshhomeless2 "Not Homeless" 2.joshhomeless2 "Homeless" 0b.joshinsurance "Insured" 1.joshinsurance "Uninsured" 0b.joshincarcerated "Not Incarcerated" 1.joshincarcerated "Incarcerated" 0b.joshart "Not on ART" 1.joshart "On ART" 0b.joshallvl "All Viral Loads Suppressed" 1.joshallvl "Not Suppressed VL" 0b.joshdepressed "Not Depressed" 1.joshdepressed "Depressed" 1b.joshdrinking   "None" 3.joshdrinking "Heavy/binge" 2.joshdrinking "Moderate" 0b.joshsmoking "Never Smoker" 1.joshsmoking "Former Smoker" 2.joshsmoking "Current Smoking" 4b.joshillicitdrugs "None" 3.joshillicitdrugs "MJ only" 2.joshillicitdrugs "Other Non IDU" 1.joshillicitdrugs "IDU" 0b.halfunmetscore "No Unmet Needs" 1.halfunmetscore "At Least one Unmet Need" 0.joshcd4 "0-49" 1.joshcd4 "50-199" 2.joshcd4 "200-349" 3.joshcd4 "350-499" 4b.joshcd4 ">=500" 1._newcat5_aids_mix "Clinical and Immunologic AIDS" 2._newcat5_aids_mix "Clinical AIDS Only" 3._newcat5_aids_mix "Immunologic AIDS only" 4._newcat5_aids_mix "AIDS NOS" 5b._newcat5_aids_mix "No AIDS" 1.testsinyear "1 Visit" 2.testsinyear "2 Visits" 3.testsinyear "3 visits") eform cells("b(fmt(2)) ci(fmt(2)) ")

********look at increasing outcomes with ordinal logistic regression
svy: ologit hospologit i.joshage i.joshrace i._partcomposite2 ib(#3).josheducation i.joshpoverty i.joshinsurance i.joshhomeless2 i.joshincarcerated i.collapsedaids joshcd4number2 i.joshallvl i.joshdepressed i.joshdrinking i.joshsmoking ib(#4).joshillicitdrugs i.unmetneeds2 i.testsinyear, or
estimates store hospcontologit
estout hospcontologit using hospcontologit.doc, replace varlabel(_cons Constant 1b.joshage "18-29" 2.joshage "30-39" 3.joshage "40-49" 4.joshage ">=50" 1b._partcomposite2 "Any MSM" 2._partcomposite2 "MSW Only" 3._partcomposite2 "Any WSM" 4._partcomposite2 "Other" 1b.joshrace "White, non-Hispanic" 2.joshrace "Black, non-Hispanic" 3.joshrace "Hispanic or Latino" 4.joshrace "Other" 1.josheducation "<High School" 2.josheducation "HS Diploma or Equivalent" 3b.josheducation ">High School" 0b.joshpoverty "Not Impoverished" 1.joshpoverty "Impoverished" 1b.joshhomeless2 "Not Homeless" 2.joshhomeless2 "Homeless" 0b.joshinsurance "Insured" 1.joshinsurance "Uninsured"

```
0b.joshincarcerated "Not Incarcerated" 1.joshincarcerated "Incarcerated" 0b.joshart "Not on ART" 1.joshart
"On ART" 0b.joshallvl "All Viral Loads Suppressed" 1.joshallvl "Not Suppressed VL" 0b.joshdepressed
"Not Depressed" 1.joshdepressed "Depressed"  1b.joshdrinking   "None" 3.joshdrinking "Heavy/binge"
2.joshdrinking "Moderate" 0b.joshsmoking "Never Smoker" 1.joshsmoking "Former Smoker"
2.joshsmoking "Current Smoking" 4b.joshillicitdrugs "None" 3.joshillicitdrugs "MJ only" 2.joshillicitdrugs
"Other Non IDU" 1.joshillicitdrugs "IDU" 0b.halfunmetscore "No Unmet Needs" 1.halfunmetscore "At
Least one Unmet Need" 0.joshcd4 "0-49" 1.joshcd4 "50-199" 2.joshcd4 "200-349" 3.joshcd4 "350-499"
4b.joshcd4 ">=500" 1._newcat5_aids_mix  "Clinical and Immunologic AIDS" 2._newcat5_aids_mix
"Clinical AIDS Only" 3._newcat5_aids_mix  "Immunologic AIDS only" 4._newcat5_aids_mix "AIDS
NOS" 5b._newcat5_aids_mix "No AIDS" 1.testsinyear "1 Visit" 2.testsinyear "2 Visits" 3.testsinyear "3
visits") eform cells("b(fmt(2)) ci(fmt(2))  ")


*****looking at increasing outcomes with multinomial logistic regression
svy: mlogit hospologit  i.joshage i.joshrace i._partcomposite2 ib(#3).josheducation i.joshpoverty
i.joshinsurance i.joshhomeless2 i.joshincarcerated  i.collapsedaids  joshcd4number2 i.joshallvl
i.joshdepressed i.joshdrinking i.joshsmoking ib(#4).joshillicitdrugs i.unmetneeds2 i.testsinyear, rrr
estimates store hospcontmlogit
estout hospcontmlogit using hospcontmlogit.doc, replace varlabel(_cons Constant 1b.joshage "18-29"
2.joshage "30-39" 3.joshage "40-49" 4.joshage ">=50"  1b._partcomposite2 "Any MSM"
2._partcomposite2 "MSW Only" 3._partcomposite2 "Any WSM"  4._partcomposite2 "Other" 1b.joshrace
"White, non-Hispanic" 2.joshrace "Black, non-Hispanic" 3.joshrace "Hispanic or Latino" 4.joshrace
"Other" 1.josheducation "<High School" 2.josheducation "HS Diploma or Equivalent" 3b.josheducation
">High School" 0b.joshpoverty "Not Impoverished" 1.joshpoverty "Impoverished" 1b.joshhomeless2 "Not
Homeless" 2.joshhomeless2 "Homeless" 0b.joshinsurance "Insured" 1.joshinsurance "Uninsured"
0b.joshincarcerated "Not Incarcerated" 1.joshincarcerated "Incarcerated" 0b.joshart "Not on ART" 1.joshart
"On ART" 0b.joshallvl "All Viral Loads Suppressed" 1.joshallvl "Not Suppressed VL" 0b.joshdepressed
"Not Depressed" 1.joshdepressed "Depressed"  1b.joshdrinking   "None" 3.joshdrinking "Heavy/binge"
2.joshdrinking "Moderate" 0b.joshsmoking "Never Smoker" 1.joshsmoking "Former Smoker"
2.joshsmoking "Current Smoking" 4b.joshillicitdrugs "None" 3.joshillicitdrugs "MJ only" 2.joshillicitdrugs
"Other Non IDU" 1.joshillicitdrugs "IDU" 0b.halfunmetscore "No Unmet Needs" 1.halfunmetscore "At
Least one Unmet Need" 0.joshcd4 "0-49" 1.joshcd4 "50-199" 2.joshcd4 "200-349" 3.joshcd4 "350-499"
4b.joshcd4 ">=500" 1._newcat5_aids_mix  "Clinical and Immunologic AIDS" 2._newcat5_aids_mix
"Clinical AIDS Only" 3._newcat5_aids_mix  "Immunologic AIDS only" 4._newcat5_aids_mix "AIDS
NOS" 5b._newcat5_aids_mix "No AIDS" 1.testsinyear "1 Visit" 2.testsinyear "2 Visits" 3.testsinyear "3
visits") eform cells("b(fmt(2)) ci(fmt(2))  ")
xi:svy: logistic emergency i.joshage i.joshrace i.joshsexgender i.josheducation i.joshpoverty i.joshinsurance
i.joshhomeless2 i.joshincarcerated i.collapsedaids  joshcd4number2 i.joshallvl i.joshdepressed
i.joshdrinking i.joshsmoking i.joshillicitdrugs i.unmetneeds2  i.testsinyear
adjrr _Ijoshsexge_2
adjrr _Ijoshsexge_3
adjrr _Ijoshsexge_4



xi:svy: logistic emergency i.joshage i.joshrace i._partcomposite2 i.josheducation i.joshpoverty
i.joshinsurance i.joshhomeless2 i.joshincarcerated i.collapsedaids i.joshcd4 i.joshallvl i.joshdepressed
i.joshdrinking i.joshsmoking i.joshillicitdrugs i.unmetneeds2  i.testsinyear
adjrr _Ijoshcd4_0
adjrr _Ijoshcd4_1
adjrr _Ijoshcd4_2
adjrr _Ijoshcd4_3
```

```
xi:svy: logistic admitted i.joshage i.joshrace i.joshsexgender i.josheducation i.joshpoverty i.joshinsurance
i.joshhomeless2 i.joshincarcerated i.collapsedaids  joshcd4number2 i.joshallvl i.joshdepressed
i.joshdrinking i.joshsmoking i.joshillicitdrugs i.unmetneeds2  i.testsinyear
adjrr _Ijoshsexge_2
adjrr _Ijoshsexge_3
adjrr _Ijoshsexge_4
```

```
xi:svy: logistic admitted i.joshage i.joshrace i._partcomposite2 i.josheducation i.joshpoverty i.joshinsurance
i.joshhomeless2 i.joshincarcerated i.collapsedaids i.joshcd4 i.joshallvl i.joshdepressed i.joshdrinking
i.joshsmoking i.joshillicitdrugs i.unmetneeds2  i.testsinyear
adjrr _Ijoshcd4_0
adjrr _Ijoshcd4_1
adjrr _Ijoshcd4_2
adjrr _Ijoshcd4_3
```

Exploratory Factor Analysis Code

```
Title:
  Stata2Mplus conversion for \\cdc\project\NCHHSTP_BCSB_Data\COT_OTHER\JoshJ\edcd4cont9-16-
2013.dta.dta
  List of variables converted shown below

  partcomposite : sex partner type based on _partcomposite ^[_partcomposite2]
    1: ANY MSM
    2: MSW Only
    3: Any WSM
    4: Other
  cd4count : geometric mean cd4 counts-spif and spvf^[_mlogcd4cnt_ivf]
  natweight : final national weight
  natstrat : national strata for variance estimation
  natclust : national cluster for variance estimation
  emergency :
  joshage :
    1: 18-29
    2: 29-39
    3: 40-49
    4: >=50
  joshrace :
    1: White, non-Hispanic
    2: Black, non-Hispanic
    3: Hispanic or Latino
    4: Other
  josheducation :
    1: <High School
    2: HS diploma or equivalent
    3: >High School
  joshpoverty :
    0: Not in Poverty
    1: Impoverished
  joshinsurance :
    0: No
    1: Yes
  joshhomeless2 :
    1: No
    2: yes
  joshincarcerated :
    0: No
    1: Yes
  joshallvl :
    0: All Supressed
  collapsedaids :
  joshdepressed :
    0: No
    1: Yes
  joshsmoking :
    0: Never
    1: Former
    2: current
  joshdrinking :
    1: None
    2: Moderate
    3: Heavy/binge
```

```
  joshillicitdrugs :
    1: IDU
    2: Other Non IDU
    3: MJ only
    4: None
  unmetneeds2 :
  testsinyear :

Data:
  File is \\cdc\project\NCHHSTP_BCSB_Data\COT_OTHER\JoshJ\edcd4cont9-16-2013.dta.dat ;
Variable:
  Names are
     partcomposite cd4count natweight natstrat natclust emergency joshage
     joshrace josheducation joshpoverty joshinsurance joshhomeless2 joshincarcerated
     joshallvl collapsedaids joshdepressed joshsmoking joshdrinking joshillicitdrugs
     unmetneeds2 testsinyear;
  Missing are all (-9999) ;
Categorical are
     partcomposite   joshrace joshage joshpoverty
     josheducation  joshinsurance joshhomeless2 joshincarcerated
      joshallvl collapsedaids joshdepressed joshsmoking
     joshdrinking joshillicitdrugs unmetneeds2 testsinyear;



    usevariables are  partcomposite  joshrace joshage
     josheducation joshpoverty joshinsurance joshhomeless2 joshincarcerated
     cd4count joshallvl collapsedaids joshdepressed joshsmoking
     joshdrinking joshillicitdrugs unmetneeds2 testsinyear;




 STRATIFICATION IS natstrat;
    CLUSTER IS natclust;
    WEIGHT IS natweight;

Model:
      f1 by partcomposite joshage joshrace#1 joshrace#2 joshrace#3 josheducation ;
      f1 by joshdrinking joshsmoking joshillicitdrugs;
      f2 by joshpoverty ;
      f2 by joshinsurance joshincarcerated ;
      f2 by joshhomeless2;
      f3 by cd4count joshallvl collapsedaids testsinyear;
      f3 by joshdepressed unmetneeds2 ;


Analysis:
   Type = complex efa 1 7;



OUTPUT: tech1 tech2 tech3 tech4 tech8 sampstat standardized;
```

1. Centers for Disease C, Prevention. HIV surveillance--United States, 1981-2008. *MMWR. Morbidity and mortality weekly report.* Jun 3 2011;60(21):689-693.
2. Walensky RP, Paltiel AD, Losina E, et al. The survival benefits of AIDS treatment in the United States. *J Infect Dis.* Jul 1 2006;194(1):11-19.
3. Life expectancy of individuals on combination antiretroviral therapy in high-income countries: a collaborative analysis of 14 cohort studies. *Lancet.* Jul 26 2008;372(9635):293-299.
4. Yehia BR, Fleishman JA, Hicks PL, Ridore M, Moore RD, Gebo KA. Inpatient health services utilization among HIV-infected adult patients in care 2002-2007. *J Acquir Immune Defic Syndr.* Mar;53(3):397-404.
5. Shapiro MF, Morton SC, McCaffrey DF, et al. Variations in the care of HIV-infected adults in the United States: results from the HIV Cost and Services Utilization Study. *JAMA.* Jun 23-30 1999;281(24):2305-2315.
6. Network HIVR. Hospital and outpatient health services utilization among HIV-infected patients in care in 1999. *J Acquir Immune Defic Syndr.* May 1 2002;30(1):21-26.
7. Gebo KA, Fleishman JA, Conviser R, et al. Racial and gender disparities in receipt of highly active antiretroviral therapy persist in a multistate sample of HIV patients in 2001. *J Acquir Immune Defic Syndr.* Jan 1 2005;38(1):96-103.
8. Gebo KA, Diener-West M, Moore RD. Hospitalization rates in an urban cohort after the introduction of highly active antiretroviral therapy. *J Acquir Immune Defic Syndr.* Jun 1 2001;27(2):143-152.
9. Gebo KA, Fleishman JA, Conviser R, et al. Contemporary costs of HIV healthcare in the HAART era. *AIDS.* Nov 13;24(17):2705-2715.
10. Pneumocystis pneumonia--Los Angeles. *MMWR. Morbidity and mortality weekly report.* 1981;30(21):250-252.
11. A cluster of Kaposi's sarcoma and Pneumocystis carinii pneumonia among homosexual male residents of Los Angeles and Orange Counties, California. *MMWR. Morbidity and mortality weekly report.* Jun 18 1982;31(23):305-307.
12. Gallo RC, Montagnier L. The chronology of AIDS research. *Nature.* Apr 2-8 1987;326(6112):435-436.
13. Palella FJ, Jr., Delaney KM, Moorman AC, et al. Declining morbidity and mortality among patients with advanced human immunodeficiency virus infection. HIV Outpatient Study Investigators. *N Engl J Med.* Mar 26 1998;338(13):853-860.
14. Services DoHaH. Panel on Antiretroviral Guidelines for Adults and Adolescents. Guidelines for the use of antiretroviral agents in HIV-1-infected adults and adolescents. 2012; http://aidsinfo.nih.gov/contentfiles/lvguidelines/AdultandAdolescentGL.pd. Accessed 10/28/2013, 2013.
15. Brooks JT, Buchacz K, Gebo KA, Mermin J. HIV infection and older Americans: the public health perspective. *Am J Public Health.* Aug 2012;102(8):1516-1526.

16. Chu C, Selwyn PA. An epidemic in evolution: the need for new models of HIV care in the chronic disease era. *J Urban Health.* Jun 2011;88(3):556-566.
17. Centers for Disease C. Diagnoses of HIV Infection in the United States and Dependent Areas, 2013. 2013; http://www.cdc.gov/HIV/library/reports/surveillance/2013/surveillance_Report_vol_25.html. Accessed 3/25, 2015.
18. Sood N, Juday T, Vanderpuye-Orgle J, et al. HIV care providers emphasize the importance of the Ryan White Program for access to and quality of care. *Health affairs.* Mar 2014;33(3):394-400.
19. Blair JM, McNaghten AD, Frazier EL, Skarbinski J, Huang P, Heffelfinger JD. Clinical and behavioral characteristics of adults receiving medical care for HIV infection --- Medical Monitoring Project, United States, 2007. *Morbidity and mortality weekly report. Surveillance summaries (Washington, D.C. : 2002).* Sep 2 2011;60(11):1-20.
20. Riley ED, Moore KL, Haber S, Neilands TB, Cohen J, Kral AH. Population-level effects of uninterrupted health insurance on services use among HIV-positive unstably housed adults. *AIDS Care.* Jul 2011;23(7):822-830.
21. Martin EG, Meehan T, Schackman BR. AIDS drug assistance programs: managers confront uncertainty and need to adapt as the affordable care act kicks in. *Health affairs.* Jun 2013;32(6):1063-1071.
22. El-Sadr WM, Mayer KH, Hodder SL. AIDS in America--forgotten but not gone. *N Engl J Med.* Mar 18 2010;362(11):967-970.
23. Moore RD, Keruly JC, Bartlett JG. Improvement in the health of HIV-infected persons in care: reducing disparities. *Clin Infect Dis.* Nov 2012;55(9):1242-1251.
24. Adeyemi OM, Livak B, McLoyd P, Smith KY, French AL. Racial/ethnic disparities in engagement in care and viral suppression in a large urban HIV clinic. *Clin Infect Dis.* May 2013;56(10):1512-1514.
25. Hall HI, Frazier EL, Rhodes P, et al. Differences in human immunodeficiency virus care and treatment among subpopulations in the United States. *JAMA internal medicine.* Jul 22 2013;173(14):1337-1344.
26. Ambrosioni J, Calmy A, Hirschel B. HIV treatment for prevention. *J Int AIDS Soc.* 2011;14:28.
27. Christopoulos KA, Havlir DV. Overcoming the human immunodeficiency virus obstacle course. *JAMA internal medicine.* Jul 22 2013;173(14):1344-1345.
28. Policy OoNA. National HIV/AIDS Strategy 2010; 1:https://www.aids.gov/federal-resources/national-HIV-aids-strategy/documents/. Accessed 3/25, 2015.
29. Wilkinson JD, Zhao W, Arnsten JH, et al. Longitudinal correlates of health care-seeking behaviors among HIV-seropositive injection drug users: how can we intervene to improve health care utilization? *J Acquir Immune Defic Syndr.* Nov 1 2007;46 Suppl 2:S120-126.
30. Derlet RW, Richards JR. Overcrowding in the nation's emergency departments: complex causes and disturbing effects. *Ann Emerg Med.* Jan 2000;35(1):63-68.
31. Shafazand S, Yang Y, Amore E, O'Neal W, Brixner D. A retrospective, observational cohort analysis of a nationwide database to compare heart failure prescriptions and related health care utilization before and after publication of

updated treatment guidelines in the United States. *Clin Ther.* Aug;32(9):1642-1650.
32. Pearl J. An introduction to causal inference. *The international journal of biostatistics.* 2010;6(2):Article 7.
33. Gebo KA, Chaisson RE, Folkemer JG, Bartlett JG, Moore RD. Costs of HIV medical care in the era of highly active antiretroviral therapy. *AIDS.* May 28 1999;13(8):963-969.
34. Backus LI, Boothroyd DB, Phillips BR, et al. National Quality Forum Performance Measures for HIV/AIDS Care The Department of Veterans Affairs' Experience. *ArcHIVes of Internal Medicine.* Jul 26 2010;170(14):1239-1246.
35. Kazi S, Boroumand S. Assessing quality of primary care provided to the HIV-infected Ryan White population in the Baltimore Eligible Metropolitan Area. *Am J Med Qual.* Nov-Dec 2008;23(6):484-491.
36. Korthuis PT, Fiellin DA, Fu R, et al. Improving adherence to HIV quality of care indicators in persons with opioid dependence: the role of buprenorphine. *J Acquir Immune Defic Syndr.* Mar 1 2011;56 Suppl 1:S83-90.
37. Horberg MA, Aberg JA, Cheever LW, Renner P, O'Brien Kaleba E, Asch SM. Development of national and multiagency HIV care quality measures. *Clin Infect Dis.* Sep 15;51(6):732-738.
38. Mkanta WN, Uphold CR. Theoretical and methodological issues in conducting research related to health care utilization among individuals with HIV infection. *AIDS Patient Care STDS.* Apr 2006;20(4):293-303.
39. Andersen R, Newman JF. Societal and individual determinants of medical care utilization in the United States. *Milbank Mem Fund Q Health Soc.* Winter 1973;51(1):95-124.
40. Rosenstock IM. Why people use health services. *Milbank Mem Fund Q.* Jul 1966;44(3):Suppl:94-127.
41. Janz NK, Becker MH. The Health Belief Model: a decade later. *Health Educ Q.* Spring 1984;11(1):1-47.
42. Andersen RM. Revisiting the behavioral model and access to medical care: does it matter? *J Health Soc Behav.* Mar 1995;36(1):1-10.
43. Fleishman JA, Hsia DC, Hellinger FJ. Correlates of medical service utilization among people with HIV infection. *Health Serv Res.* Dec 1994;29(5):527-548.
44. Josephs JS, Fleishman JA, Korthuis PT, Moore RD, Gebo KA, Network HIVR. Emergency department utilization among HIV-infected patients in a multisite multistate study. *HIV Med.* Jan 2010;11(1):74-84.
45. Amorim LD, Fiaccone RL, Santos CA, et al. Structural equation modeling in epidemiology. *Cad Saude Publica.* Dec 2010;26(12):2251-2262.
46. Stein JA, Andersen RM, Robertson M, Gelberg L. Impact of hepatitis B and C infection on health services utilization in homeless adults: a test of the Gelberg-Andersen Behavioral Model for Vulnerable Populations. *Health Psychol.* Jan 2012;31(1):20-30.
47. Wright S. Correlation and causation Part I. Method of path coefficients. *Journal of Agricultural Research.* Oct-Mar 1920;20:0557-0585.
48. Wright S. The Theory of Path Coefficients a Reply to Niles's Criticism. *Genetics.* May 1923;8(3):239-255.

49. Wright S. The method of path coefficients. *Annals of Mathematical Statistics.* 1934;5:161-215.

50. Pearl J. Nonparametric Identification of Causal Effects, or Structural Modeling without Equations. *Mathematical Social Sciences.* Aug 1995;30(1):99-100.

51. Pearl J. Structural and probabilistic causality. *Causal Learning.* 1996;34:393-435.

52. Pearl J. Graphs, causality, and structural equation models. *Sociological Methods & Research.* Nov 1998;27(2):226-284.

53. Bartholomew DK, Martin Irini Moustaki. *Latent Variable Models and Factor Analysis A Unified Approach.* Vol 3. Chichester, UK: John Wiley and Sons 2011.

54. Kohn LT, Corrigan J, Donaldson MS. *To err is human : building a safer health system.* Washington, D.C.: National Academy Press; 2000.

55. Institute of Medicine (U.S.). Committee on Quality of Health Care in America. *Crossing the quality chasm : a new health system for the 21st century.* Washington, D.C.: National Academy Press; 2001.

56. Horberg MA, Aberg JA, Cheever LW, Renner P, O'Brien Kaleba E, Asch SM. Development of national and multiagency HIV care quality measures. *Clin Infect Dis.* Sep 15 2010;51(6):732-738.

57. Composite Measure Evaluation Framework and National Voluntary Consensus Standards for Mortality and Safety—Composite Measures: A Consensus Report. In: Krumholz HM, ed. Vol 1. Washington, DC: National Quality Forum; 2009. Accessed 11/4/2013.

58. Monitoring HIV Care in the United States: Indicators and Data Systems. In: Ford MAaS, Carol M, ed. 1 ed: National Academies Press 2012: http://books.nap.edu/openbook.php?record_id=13225. Accessed 10/16/2013.

59. Nolan T, Berwick DM. All-or-none measurement raises the bar on performance. *JAMA.* Mar 8 2006;295(10):1168-1170.

60. Ramaswamy M, Kelly PJ, Li X, Berg KM, Litwin AH, Arnsten JH. Social Support Networks and Primary Care Use by HIV-Infected Drug Users. *The Journal of the Association of Nurses in AIDS Care : JANAC.* Aug 4 2012.

61. Patel S, Weiss E, Chhabra R, et al. The Events in Care Screening Questionnaire (ECSQ): a new tool to identify needs and concerns of people with HIV/AIDS. *AIDS Patient Care STDS.* May 2008;22(5):381-393.

62. Barnett PG, Sorensen JL, Wong W, Haug NA, Hall SM. Effect of incentives for medication adherence on health care use and costs in methadone patients with HIV. *Drug Alcohol Depend.* Feb 1 2009;100(1-2):115-121.

63. Smith MY, Rapkin BD, Winkel G, Springer C, Chhabra R, Feldman IS. Housing status and health care service utilization among low-income persons with HIV/AIDS. *J Gen Intern Med.* Oct 2000;15(10):731-738.

64. Cunningham CO, Sohler NL, Berg KM, Shapiro S, Heller D. Type of substance use and access to HIV-related health care. *AIDS Patient Care STDS.* Jun 2006;20(6):399-407.

65. Cunningham CO, Sohler NL, McCoy K, Heller D, Selwyn PA. Health care access and utilization patterns in unstably housed HIV-infected individuals in New York City. *AIDS Patient Care STDS.* Oct 2005;19(10):690-695.

66. Cunningham WE, Sohler NL, Tobias C, et al. Health services utilization for people with HIV infection: comparison of a population targeted for outreach with the U.S. population in care. *Med Care.* Nov 2006;44(11):1038-1047.
67. Sohler NL, Li X, Cunningham CO. Gender disparities in HIV health care utilization among the severely disadvantaged: can we determine the reasons? *AIDS Patient Care STDS.* Sep 2009;23(9):775-783.
68. Sohler NL, Wong MD, Cunningham WE, Cabral H, Drainoni ML, Cunningham CO. Type and pattern of illicit drug use and access to health care services for HIV-infected people. *AIDS Patient Care STDS.* 2007;21 Suppl 1:S68-76.
69. Braitstein P, Li K, Kerr T, Montaner JS, Hogg RS, Wood E. Differences in access to care among injection drug users infected either with HIV and hepatitis C or hepatitis C alone. *AIDS Care.* Oct 2006;18(7):690-693.
70. Kidder DP, Wolitski RJ, Campsmith ML, Nakamura GV. Health status, health care use, medication use, and medication adherence among homeless and housed people living with HIV/AIDS. *Am J Public Health.* Dec 2007;97(12):2238-2245.
71. Palacio H, Li X, Wilson TE, et al. Healthcare use by varied highly active antiretroviral therapy (HAART) strata: HAART use, discontinuation, and naivety. *AIDS.* Mar 5 2004;18(4):621-630.
72. Knowlton AR, Hoover DR, Chung SE, Celentano DD, Vlahov D, Latkin CA. Access to medical care and service utilization among injection drug users with HIV/AIDS. *Drug Alcohol Depend.* Sep 1 2001;64(1):55-62.
73. Cunningham CO, Sohler NL, Wong MD, et al. Utilization of health care services in hard-to-reach marginalized HIV-infected individuals. *AIDS Patient Care STDS.* Mar 2007;21(3):177-186.
74. Wolitski RJ, Kidder DP, Pals SL, et al. Randomized trial of the effects of housing assistance on the health and risk behaviors of homeless and unstably housed people living with HIV. *AIDS Behav.* Jun 2010;14(3):493-503.
75. Kang SY, Goldstein MF, Deren S. Health care utilization and risk behaviors among HIV positive minority drug users. *J Health Care Poor Underserved.* May 2006;17(2):265-275.
76. Palepu A, Tyndall MW, Leon H, et al. Hospital utilization and costs in a cohort of injection drug users. *CMAJ.* Aug 21 2001;165(4):415-420.
77. Sullivan G, Kanouse D, Young AS, Han X, Perlman J, Koegel P. Co-location of health care for adults with serious mental illness and HIV infection. *Community Ment Health J.* Aug 2006;42(4):345-361.
78. Kraemer KL, McGinnis KA, Skanderson M, et al. Alcohol problems and health care services use in human immunodeficiency virus (HIV)-infected and HIV-uninfected veterans. *Med Care.* Aug 2006;44(8 Suppl 2):S44-51.
79. Small LF. Determinants of physician utilization, emergency room use, and hospitalizations among populations with multiple health vulnerabilities. *Health.* Sep 2011;15(5):491-516.
80. Bailey JE, Van Brunt DL, Somes GW, Dorko CS, Wan JY. Impact of a statewide Medicaid managed care system on healthcare utilization and outcomes for people living with HIV. *Am J Med Sci.* Dec 2004;328(6):305-314.
81. Kolman M, DeCoster M, Proeschold-Bell RJ, Hunter GA, Bartlett J, Sena AC. The increasing impact of human immunodeficiency virus infections, sexually

transmitted diseases, and viral hepatitis in Durham County, North Carolina: a call for coordinated and integrated services. *North Carolina medical journal.* Nov-Dec;72(6):439-446.

82. Fairbairn N, Milloy MJ, Zhang R, et al. Emergency department utilization among a cohort of HIV-positive injecting drug users in a Canadian setting. *J Emerg Med.* Aug 2012;43(2):236-243.

83. Venkat A, Shippert B, Hanneman D, et al. Emergency department utilization by HIV-positive adults in the HAART era. *Int J Emerg Med.* Dec 2008;1(4):287-296.

84. Pantalone DW, Hessler DM, Bankoff SM, Shah BJ. Psychosocial correlates of HIV-monoinfection and HIV/HCV-coinfection among men who have sex with men. *J Behav Med.* Oct 2012;35(5):520-528.

85. Gardner EM, Maravi ME, Rietmeijer C, Davidson AJ, Burman WJ. The association of adherence to antiretroviral therapy with healthcare utilization and costs for medical care. *Appl Health Econ Health Policy.* 2008;6(2-3):145-155.

86. Nosyk B, Li X, Sun H, Anis AH. The effect of homelessness on hospitalisation among patients with HIV/AIDS. *AIDS Care.* Apr 2007;19(4):546-553.

87. Box TL, Olsen M, Oddone EZ, Keitz SA. Healthcare access and utilization by patients infected with human immunodeficiency virus: does gender matter? *J Womens Health (Larchmt).* May 2003;12(4):391-397.

88. Horberg MA, Hurley LB, Silverberg MJ, Kinsman CJ, Quesenberry CP. Effect of clinical pharmacists on utilization of and clinical response to antiretroviral therapy. *J Acquir Immune Defic Syndr.* Apr 15 2007;44(5):531-539.

89. Barash ET, Hanson DL, Buskin SE, Teshale E. HIV-infected injection drug users: health care utilization and morbidity. *J Health Care Poor Underserved.* Aug 2007;18(3):675-686.

90. Keitz SA, Box TL, Homan RK, Bartlett JA, Oddone EZ. Primary care for patients infected with human immunodeficiency virus: a randomized controlled trial. *J Gen Intern Med.* Sep 2001;16(9):573-582.

91. Linas BP, Wang B, Smurzynski M, et al. The impact of HIV/HCV co-infection on health care utilization and disability: results of the ACTG Longitudinal Linked Randomized Trials (ALLRT) Cohort. *J Viral Hepat.* Jul 2011;18(7):506-512.

92. Norton BL, Park L, McGrath LJ, Proeschold Bell RJ, Muir AJ, Naggie S. Health care utilization in HIV-infected patients: assessing the burden of hepatitis C virus coinfection. *AIDS Patient Care STDS.* Sep 2012;26(9):541-545.

93. Sansom SL, Anthony MN, Garland WH, et al. The costs of HIV antiretroviral therapy adherence programs and impact on health care utilization. *AIDS Patient Care STDS.* Feb 2008;22(2):131-138.

94. Kim TW, Kertesz SG, Horton NJ, Tibbetts N, Samet JH. Episodic homelessness and health care utilization in a prospective cohort of HIV-infected persons with alcohol problems. *BMC Health Serv Res.* 2006;6:19.

95. Masson CL, Sorensen JL, Phibbs CS, Okin RL. Predictors of medical service utilization among individuals with co-occurring HIV infection and substance abuse disorders. *AIDS Care.* Aug 2004;16(6):744-755.

96. Leserman J, Whetten K, Lowe K, Stangl D, Swartz MS, Thielman NM. How trauma, recent stressful events, and PTSD affect functional health status and

health utilization in HIV-infected patients in the south. *Psychosom Med.* May-Jun 2005;67(3):500-507.
97. Meade CS, Hansen NB, Kochman A, Sikkema KJ. Utilization of medical treatments and adherence to antiretroviral therapy among HIV-positive adults with histories of childhood sexual abuse. *AIDS Patient Care STDS.* Apr 2009;23(4):259-266.
98. Whetten K, Reif S, Ostermann J, et al. Improving health outcomes among individuals with HIV, mental illness, and substance use disorders in the Southeast. *AIDS Care.* 2006;18 Suppl 1:S18-26.
99. Lundgren JD, Phillips AN, Vella S, et al. Regional differences in use of antiretroviral agents and primary prophylaxis in 3122 European HIV-infected patients. EuroSIDA Study Group. *J Acquir Immune Defic Syndr Hum Retrovirol.* Nov 1 1997;16(3):153-160.
100. Kushel MB, Colfax G, Ragland K, Heineman A, Palacio H, Bangsberg DR. Case management is associated with improved antiretroviral adherence and CD4+ cell counts in homeless and marginally housed individuals with HIV infection. *Clin Infect Dis.* Jul 15 2006;43(2):234-242.
101. Palepu A, Horton NJ, Tibbetts N, Dukes K, Meli S, Samet JH. Substance abuse treatment and emergency department utilization among a cohort of HIV-infected persons with alcohol problems. *J Subst Abuse Treat.* Jul 2003;25(1):37-42.
102. Gordon AJ, McGinnis KA, Conigliaro J, Rodriguez-Barradas MC, Rabeneck L, Justice AC. Associations between alcohol use and homelessness with healthcare utilization among human immunodeficiency virus-infected veterans. *Med Care.* Aug 2006;44(8 Suppl 2):S37-43.
103. Wolitski RJ, Kidder DP, Pals SL, et al. Randomized trial of the effects of housing assistance on the health and risk behaviors of homeless and unstably housed people living with HIV. *AIDS Behav.* Jun;14(3):493-503.
104. Kim YK, Stoskopf CH, Glover SH. Factors affecting total hospital charges and utilization for South Carolina inpatients with HIV/AIDS in 1994-1996. *AIDS Patient Care STDS.* May 2001;15(5):277-287.
105. Eisenman DP, Cunningham WE, Zierler S, Nakazono TT, Shapiro MF, Consortium H. Effect of violence on utilization of services and access to care in persons with HIV. *J Gen Intern Med.* Feb 2003;18(2):125-127.
106. Liebschutz JM, Feinman G, Sullivan L, Stein M, Samet J. Physical and sexual abuse in women infected with the human immunodeficiency virus: increased illness and health care utilization. *Arch Intern Med.* Jun 12 2000;160(11):1659-1664.
107. Joyce GF, Chan KS, Orlando M, Burnam MA. Mental health status and use of general medical services for persons with human immunodeficiency virus. *Med Care.* Aug 2005;43(8):834-839.
108. Mathews WC, May S. EuroQol (EQ-5D) measure of quality of life predicts mortality, emergency department utilization, and hospital discharge rates in HIV-infected adults under care. *Health Qual Life Outcomes.* 2007;5:5.
109. Liebschutz JM, Geier JL, Horton NJ, Chuang CH, Samet JH. Physical and sexual violence and health care utilization in HIV-infected persons with alcohol problems. *AIDS Care.* Jul 2005;17(5):566-578.

110. Magnus M, Schmidt N, Kirkhart K, et al. Association between ancillary services and clinical and behavioral outcomes among HIV-infected women. *AIDS Patient Care STDS.* Mar 2001;15(3):137-145.

111. Metsch LR, Pereyra M, Brewer TH. Use of HIV health care in HIV-seropositive crack cocaine smokers and other active drug users. *J Subst Abuse.* 2001;13(1-2):155-167.

112. Pantalone DW, Hessler DM, Simoni JM. Mental health pathways from interpersonal violence to health-related outcomes in HIV-positive sexual minority men. *J Consult Clin Psychol.* Jun 2010;78(3):387-397.

113. daCosta DiBonaventura M, Gupta S, Cho M, Mrus J. The association of HIV/AIDS treatment side effects with health status, work productivity, and resource use. *AIDS Care.* 2012;24(6):744-755.

114. Whetten K, Leserman J, Whetten R, et al. Exploring lack of trust in care providers and the government as a barrier to health service use. *Am J Public Health.* Apr 2006;96(4):716-721.

115. Cunningham WE, Andersen RM, Katz MH, et al. The impact of competing subsistence needs and barriers on access to medical care for persons with human immunodeficiency virus receiving care in the United States. *Med Care.* Dec 1999;37(12):1270-1281.

116. Katz MH, Cunningham WE, Fleishman JA, et al. Effect of case management on unmet needs and utilization of medical care and medications among HIV-infected persons. *Ann Intern Med.* Oct 16 2001;135(8 Pt 1):557-565.

117. Penniman TV, Taylor SL, Bird CE, Beckman R, Collins RL, Cunningham W. The associations of gender, sexual identity and competing needs with healthcare utilization among people with HIV/AIDS. *J Natl Med Assoc.* Apr 2007;99(4):419-427.

118. Morales LS, Cunningham WE, Galvan FH, Andersen RM, Nakazono TT, Shapiro MF. Sociodemographic differences in access to care among Hispanic patients who are HIV infected in the United States. *Am J Public Health.* Jul 2004;94(7):1119-1121.

119. Schackman BR, Leff JA, Botsko M, et al. The cost of integrated HIV care and buprenorphine/naloxone treatment: results of a cross-site evaluation. *J Acquir Immune Defic Syndr.* Mar 2011;56 Suppl 1:S76-82.

120. Schoenbaum EE, Lo Y, Floris-Moore M. Predictors of hospitalization for HIV-positive women and men drug users, 1996-2000. *Public Health Rep.* 2002;117 Suppl 1:S60-66.

121. Paul S, Gilbert HM, Ziecheck W, Jacobs J, Sepkowitz KA. The impact of potent antiretroviral therapy on the characteristics of hospitalized patients with HIV infection. *AIDS.* Feb 25 1999;13(3):415-418.

122. Paul S, Gilbert HM, Lande L, et al. Impact of antiretroviral therapy on decreasing hospitalization rates of HIV-infected patients in 2001. *AIDS Res Hum Retroviruses.* May 1 2002;18(7):501-506.

123. Buchacz K, Baker RK, Moorman AC, et al. Rates of hospitalizations and associated diagnoses in a large multisite cohort of HIV patients in the United States, 1994-2005. *AIDS.* Jul 11 2008;22(11):1345-1354.

124. Crum-Cianflone NF, Grandits G, Echols S, et al. Trends and causes of hospitalizations among HIV-infected persons during the late HAART era: what is the impact of CD4 counts and HAART use? *J Acquir Immune Defic Syndr.* Jul 2010;54(3):248-257.
125. Floris-Moore M, Lo Y, Klein RS, et al. Gender and hospitalization patterns among HIV-infected drug users before and after the availability of highly active antiretroviral therapy. *J Acquir Immune Defic Syndr.* Nov 1 2003;34(3):331-337.
126. Laine C, Markson LE, Fanning TR, Turner BJ. Relationship between ambulatory care accessibility and hospitalization for persons with advanced HIV disease. *J Health Care Poor Underserved.* Aug 1999;10(3):313-327.
127. Cunningham CO, Li X, Ramsey K, Sohler NL. A comparison of HIV health services utilization measures in a marginalized population: self-report versus medical records. *Med Care.* Mar 2007;45(3):264-268.
128. Gourevitch MN, Chatterji P, Deb N, Schoenbaum EE, Turner BJ. On-site medical care in methadone maintenance: associations with health care use and expenditures. *J Subst Abuse Treat.* Mar 2007;32(2):143-151.
129. Turner BJ, Laine C, Yang CP, Hauck WW. Effects of long-term, medically supervised, drug-free treatment and methadone maintenance treatment on drug users' emergency department use and hospitalization. *Clin Infect Dis.* Dec 15 2003;37 Suppl 5:S457-463.
130. Fleishman JA, Gebo KA, Reilly ED, et al. Hospital and outpatient health services utilization among HIV-infected adults in care 2000-2002. *Med Care.* Sep 2005;43(9 Suppl):III40-52.
131. Zingmond DS, Ettner SL, Cunningham WE. The impact of managed care on access to highly active antiretroviral therapy and on outcomes among Medicaid beneficiaries with AIDS. *Med Care Res Rev.* Feb 2007;64(1):66-82.
132. Sherer R, Pulvirenti J, Stieglitz K, et al. Hospitalization in HIV in Chicago. *J Int Assoc Physicians AIDS Care (Chic).* Winter 2002;1(1):26-33.
133. Gardner LI, Klein RS, Szczech LA, et al. Rates and risk factors for condition-specific hospitalizations in HIV-infected and uninfected women. *J Acquir Immune Defic Syndr.* Nov 1 2003;34(3):320-330.
134. Gebo KA, Diener-West M, Moore RD. Hospitalization rates differ by hepatitis C satus in an urban HIV cohort. *J Acquir Immune Defic Syndr.* Oct 1 2003;34(2):165-173.
135. Laine C, Hauck WW, Gourevitch MN, Rothman J, Cohen A, Turner BJ. Regular outpatient medical and drug abuse care and subsequent hospitalization of persons who use illicit drugs. *JAMA.* May 9 2001;285(18):2355-2362.
136. Sax PE, Meyers JL, Mugavero M, Davis KL. Adherence to antiretroviral treatment and correlation with risk of hospitalization among commercially insured HIV patients in the United States. *PLoS One.* 2012;7(2):e31591.
137. Weiser SD, Hatcher A, Frongillo EA, et al. Food insecurity is associated with greater acute care utilization among HIV-infected homeless and marginally housed individuals in San Francisco. *J Gen Intern Med.* Jan 2013;28(1):91-98.
138. Edelman EJ, Gordon K, Justice AC. Patient and provider-reported symptoms in the post-cART era. *AIDS Behav.* May 2011;15(4):853-861.

139. Berry SA, Manabe YC, Moore RD, Gebo KA. Hospitalization risk following initiation of highly active antiretroviral therapy. *HIV Medicine.* May 2010;11(5):289-298.
140. Roberts RR, Kampe LM, Hammerman M, et al. The cost of care for patients with HIV from the provider economic perspective. *AIDS Patient Care STDS.* Dec 2006;20(12):876-886.
141. Fleishman JA, Hellinger FH. Recent trends in HIV-related inpatient admissions 1996-2000: a 7-state study. *J Acquir Immune Defic Syndr.* Sep 1 2003;34(1):102-110.
142. Hellinger FJ. The changing pattern of hospital care for persons living with HIV: 2000 through 2004. *J Acquir Immune Defic Syndr.* Jun 1 2007;45(2):239-246.
143. Himelhoch S, Chander G, Fleishman JA, Hellinger J, Gaist P, Gebo KA. Access to HAART and utilization of inpatient medical hospital services among HIV-infected patients with co-occurring serious mental illness and injection drug use. *Gen Hosp Psychiatry.* Nov-Dec 2007;29(6):518-525.
144. Pence BW, Mugavero MJ, Carter TJ, et al. Childhood trauma and health outcomes in HIV-infected patients: an exploration of causal pathways. *J Acquir Immune Defic Syndr.* Apr 1 2012;59(4):409-416.
145. Hill-Briggs F, Gemmell L, Kulkarni B, Klick B, Brancati FL. Associations of patient health-related problem solving with disease control, emergency department visits, and hospitalizations in HIV and diabetes clinic samples. *J Gen Intern Med.* May 2007;22(5):649-654.
146. Palepu A, Horton NJ, Tibbetts N, Meli S, Samet JH. Substance abuse treatment and hospitalization among a cohort of HIV-infected individuals with alcohol problems. *Alcohol Clin Exp Res.* Mar 2005;29(3):389-394.
147. Kerr CA, Neeman N, Davis RB, et al. HIV quality of care assessment at an academic hospital: outcomes and lessons learned. *Am J Med Qual.* Jul-Aug 2012;27(4):321-328.
148. Fleishman JA, Yehia BR, Moore RD, Gebo KA, Agwu AL, Network HIVR. Disparities in receipt of antiretroviral therapy among HIV-infected adults (2002-2008). *Med Care.* May 2012;50(5):419-427.
149. Wilson IB, Landon BE, Marsden PV, et al. Correlations among measures of quality in HIV care in the United States: cross sectional study. *Brit Med J.* Nov 24 2007;335(7629):1085-1088B.
150. Horberg M, Hurley L, Towner W, et al. HIV quality performance measures in a large integrated health care system. *AIDS Patient Care STDS.* Jan 2011;25(1):21-28.
151. Hanna DB, Buchacz K, Gebo KA, et al. Trends and disparities in antiretroviral therapy initiation and virologic suppression among newly treatment-eligible HIV-infected individuals in North America, 2001-2009. *Clin Infect Dis.* Apr 2013;56(8):1174-1182.
152. Oramasionwu CU, Koeller JM, Lawson KA, Brown CM, Morse GD, Frei CR. The state of disparities in opportunistic infection prophylaxis for blacks with HIV/AIDS. *Med Care.* Nov 2012;50(11):920-927.

153. Palacio H, Kahn JG, Richards TA, Morin SF. Effect of race and/or ethnicity in use of antiretrovirals and prophylaxis for opportunistic infection: a review of the literature. *Public Health Rep.* May-Jun 2002;117(3):233-251; discussion 231-232.
154. Teshale EH, Hanson DL, Wolfe MI, et al. Reasons for lack of appropriate receipt of primary Pneumocystis jiroveci pneumonia prophylaxis among HIV-infected persons receiving treatment in the United States: 1994-2003. *Clinical Infectious Diseases.* Mar 15 2007;44(6):879-883.
155. Buchacz K, Baker RK, Palella FJ, et al. AIDS-defining opportunistic illnesses in US patients, 1994-2007: a cohort study. *AIDS.* Jun 19 2010;24(10):1549-1559.
156. Asch SM, Gifford AL, Bozzette SA, et al. Underuse of primary Mycobacterium avium complex and Pneumocystis carinii prophylaxis in the United States. *J Acquir Immune Defic Syndr.* Dec 1 2001;28(4):340-344.
157. Gebo KA, Fleishman JA, Reilly ED, Moore RD, Network HIVR. High rates of primary Mycobacterium avium complex and Pneumocystis jiroveci prophylaxis in the United States. *Med Care.* Sep 2005;43(9 Suppl):III23-30.
158. Brooks JT, Song R, Hanson DL, et al. Discontinuation of primary prophylaxis against Mycobacterium avium complex infection in HIV-infected persons receiving antiretroviral therapy: observations from a large national cohort in the United States, 1992-2002. *Clin Infect Dis.* Aug 15 2005;41(4):549-553.
159. Sena AC, Mertz KJ, Thomas D, Wells D, Costa S, Levine WC. A survey of sexually transmitted diseases/HIV coinfection testing and reporting practices among health care providers in New Jersey. *Sex Transm Dis.* Jul 2005;32(7):406-412.
160. Berry SA, Ghanem KG, Page KR, Thio CL, Moore RD, Gebo KA. Gonorrhoea and chlamydia testing rates of HIV-infected men: low despite guidelines. *Sex Transm Infect.* Nov 2010;86(6):481-484.
161. Hamlyn E, McAllister J, Winston A, et al. Is screening for sexually transmitted infections in men who have sex with men who receive non-occupational HIV post-exposure prophylaxis worthwhile? *Sex Transm Infect.* Feb 2006;82(1):21-23.
162. Tai E, Sanchez T, Lansky A, Mahle K, Heffelfinger J, Workowski K. Self-reported syphilis and gonorrhoea testing among men who have sex with men: national HIV behavioural surveillance system, 2003-5. *Sex Transm Infect.* Nov 2008;84(6):478-482.
163. Teague R, Mijch A, Fairley CK, et al. Testing rates for sexually transmitted infections among HIV-infected men who have sex with men attending two different HIV services. *Int J STD AIDS.* Mar 2008;19(3):200-202.
164. Hoover KW, Butler M, Workowski K, et al. STD screening of HIV-infected MSM in HIV clinics. *Sex Transm Dis.* Dec 2010;37(12):771-776.
165. Page KR, Moore RD, Wilgus B, Gindi R, Erbelding EJ. Neisseria gonorrhoeae and Chlamydia trachomatis among human immunodeficiency virus-infected women. *Sex Transm Dis.* Oct 2008;35(10):859-861.
166. Marx R, Katz MH, Barreto AI, Park MS, Black T, Welch M. Receipt of Recommended Medical-Care in HIV-Infected and at-Risk Persons. *Journal of General Internal Medicine.* Feb 1995;10(2):92-95.

167. Sheth AN, Moore RD, Gebo KA. Provision of general and HIV-specific health maintenance in middle aged and older patients in an urban HIV clinic. *AIDS Patient Care STDS.* May 2006;20(5):318-325.

168. Korthuis PT, Asch SM, Anaya HD, et al. Lipid screening in HIV-infected veterans. *J Acquir Immune Defic Syndr.* Mar 1 2004;35(3):253-260.

169. Koethe JR, Moore RD, Wagner KR. Physician specialization and women's primary care services in an urban HIV clinic. *AIDS Patient Care STDS.* May 2008;22(5):373-380.

170. Rebeiro P, Althoff KN, Buchacz K, et al. Retention among North American HIV-infected persons in clinical care, 2000-2008. *J Acquir Immune Defic Syndr.* Mar 1 2013;62(3):356-362.

171. Hsu LC, Chen M, Kali J, Pipkin S, Scheer S, Schwarcz S. Assessing receipt of medical care and disparity among persons with HIV/AIDS in San Francisco, 2006-2007. *AIDS Care.* Mar 2011;23(3):383-392.

172. Sullivan PS, Denniston M, Mokotoff E, Buskin S, Broyles S, McNaghten AD. Quality of care for HIV infection provided by Ryan White Program-supported versus Non-Ryan White Program-supported facilities. *PLoS One.* 2008;3(9):e3250.

173. Marx R, Katz MH, Barreto AI, Park MS, Black T, Welch M. Receipt of recommended medical care in HIV-infected and at-risk persons. *Journal of general internal medicine.* 1995;10:92-95.

174. Kaplan JE, Parham DL, Soto-Torres L, et al. Adherence to guidelines for antiretroviral therapy and for preventing opportunistic infections in HIV-infected adults and adolescents in Ryan White-funded facilities in the United States. *J Acquir Immune Defic Syndr.* Jul 1 1999;21(3):228-235.

175. Solomon L, Flynn C, Lavetsky G. Managed care for AIDS patients: is bigger better? *J Acquir Immune Defic Syndr.* Mar 1 2005;38(3):342-347.

176. Hirschhorn LR, McInnes K, Landon BE, et al. Gender differences in quality of HIV care in Ryan White CARE Act-funded clinics. *Womens Health Issues.* May-Jun 2006;16(3):104-112.

177. Gebo KA, Fleishman JA, Reilly ED, Moore RD. High rates of primary Mycobacterium avium complex and Pneumocystis jiroveci prophylaxis in the United States. *Med Care.* Sep 2005;43(9 Suppl):III23-30.

178. Goldstein RB, Rotheram-Borus MJ, Johnson MO, et al. Insurance coverage, usual source of care, and receipt of clinically indicated care for comorbid conditions among adults living with human immunodeficiency virus. *Med Care.* Apr 2005;43(4):401-410.

179. Teshale EH, Hanson DL, Wolfe MI, et al. Reasons for lack of appropriate receipt of primary Pneumocystis jiroveci pneumonia prophylaxis among HIV-infected persons receiving treatment in the United States: 1994-2003. *Clinical infectious diseases : an official publication of the Infectious Diseases Society of America.* 2007;44:879-883.

180. Wilson IB, Landon BE, Hirschhorn LR, et al. Quality of HIV care provided by nurse practitioners, physician assistants, and physicians. *Ann Intern Med.* Nov 15 2005;143(10):729-736.

181. Kazi S, Boroumand S. Assessing quality of primary care provided to the HIV-infected Ryan White population in the Baltimore Eligible Metropolitan Area. *American journal of medical quality : the official journal of the American College of Medical Quality.*23:484-491.

182. Grace C, Kutzko D, Alston WK, Ramundo M, Polish L, Osler T. The Vermont model for rural HIV care delivery: eleven years of outcome data comparing urban and rural clinics. *J Rural Health.* Summer 2010;26(2):113-119.

183. Murphy EL, Assmann SF, Collier AC, et al. Determinants of antimicrobial prophylaxis use and treatment for wasting among patients with advanced human immunodeficiency virus disease in the United States, 1995-1998. *Clin Infect Dis.* Jan 2001;32(1):116-123.

184. Kitahata MM, Dillingham PW, Chaiyakunapruk N, et al. Electronic human immunodeficiency virus (HIV) clinical reminder system improves adherence to practice guidelines among the University of Washington HIV Study Cohort. *Clin Infect Dis.* Mar 15 2003;36(6):803-811.

185. Berry SA, Ghanem KG, Page KR, Thio CL, Moore RD, Gebo KA. Gonorrhoea and chlamydia testing rates of HIV-infected men: low despite guidelines. *Sex Transm Infect.* Nov;86(6):481-484.

186. Solomon L, Stein M, Flynn C, et al. Health services use by urban women with or at risk for HIV-1 infection: the HIV Epidemiology Research Study (HERS). *J Acquir Immune Defic Syndr Hum Retrovirol.* Mar 1 1998;17(3):253-261.

187. Farley TA, Cohen DA, Wu SY, Besch CL. The value of screening for sexually transmitted diseases in an HIV clinic. *J Acquir Immune Defic Syndr.* Aug 15 2003;33(5):642-648.

188. Klausner JD, Stanley H, Stansell J. STD screening among HIV-infected patients in care, San Francisco. *AIDS Patient Care STDS.* Feb 2001;15(2):73-76.

189. Ferrand RA, de Silva S, Cartledge JD. Tackling STI epidemics through the HIV clinic: is sex high enough on the agenda? *Int J STD AIDS.* Oct 2008;19(10):711-712.

190. Statistics NCfH. Health, United States 2012 With Special Feature on Emergency Care. 2013; http://www.cdc.gov/nchs/data/hus/hus12.pdf#086. Accessed 7/19/2013, 2013.

191. Shih TY, Chen KF, Rothman RE, Hsieh YH. US national estimation of emergency department utilization by patients given 'HIV/AIDS-related illness' as their primary diagnosis. *HIV Med.* Jul 2011;12(6):343-351.

192. Garcia TB, Amy; Bush, Mary. Emergency Department Visitors and Visits: Who Used the Emergency Room in 2007? *Data Briefs* 2010; http://www.cdc.gov/nchs/data/databriefs/db38.pdf. Accessed 4-8-2013, 38.

193. Frankel MR, McNaghten A, Shapiro MF, et al. A probability sample for monitoring the HIV-infected population in care in the U.S. and in selected states. *Open AIDS J.* 2012;6:67-76.

194. McNaghten AD, Wolfe MI, Onorato I, et al. Improving the representativeness of behavioral and clinical surveillance for persons with HIV in the United States: the rationale for developing a population-based approach. *PLoS One.* 2007;2(6):e550.

195. Blair JM, Fagan JL, Frazier EL, et al. Behavioral and clinical characteristics of persons receiving medical care for HIV infection - Medical Monitoring Project,

United States, 2009. *Morbidity and mortality weekly report. Surveillance summaries (Washington, D.C. : 2002).* Jun 20 2014;63 Suppl 5:1-22.
196. Code F. Code of Federal Regulations: Title 45 Part 46 Protection of Human Subjects 7/14/2009; http://www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.html. Accessed 3/22, 2015.
197. Control Cfd. Distinguishing public health research and public health nonresearch. *CDC Guidelines* 2010; http://stacks.cdc.gov/view/cdc/24235. Accessed 3/22, 2015.
198. Services DoHaH. Poverty Guidelines for 2013. 2013.
199. Alcoholism NIooAAa. Helping Patients Who Drink Too Much A Clinicians Guide. 2007; http://pubs.niaaa.nih.gov/publications/Practitioner/CliniciansGuide2005/guide.pdf . Accessed 7/8/2013, 2013.
200. Bieler GS, Brown GG, Williams RL, Brogan DJ. Estimating model-adjusted risks, risk differences, and risk ratios from complex survey data. *Am J Epidemiol.* Mar 1 2010;171(5):618-623.
201. LaCalle E, Rabin E. Frequent users of emergency departments: the myths, the data, and the policy implications. *Ann Emerg Med.* Jul 2010;56(1):42-48.
202. Siemieniuk RA, Krentz HB, Miller P, Woodman K, Ko K, Gill MJ. The clinical implications of high rates of intimate partner violence against HIV-positive women. *J Acquir Immune Defic Syndr.* Sep 1 2013;64(1):32-38.
203. Development DoHaU. HIV/AIDS Housing. 2013; http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/aidshousing. Accessed 10/28/2013, 2013.
204. Menchaca M ML, Stewart J, Treherne L, Vicic W, Audain G, Post P Adapting Your Practice: Treatment and Recommendations for Homeless Patients with HIV/AIDS. 2. Accessed 10/28/2013, 2013.
205. Thompson MA, Aberg JA, Hoy JF, et al. Antiretroviral treatment of adult HIV infection: 2012 recommendations of the International Antiviral Society-USA panel. *JAMA.* Jul 25 2012;308(4):387-402.
206. Bing EG, Burnam MA, Longshore D, et al. Psychiatric disorders and drug use among human immunodeficiency virus-infected adults in the United States. *Arch Gen Psychiatry.* Aug 2001;58(8):721-728.
207. Blashill AJ, Perry N, Safren SA. Mental health: a focus on stress, coping, and mental illness as it relates to treatment retention, adherence, and other health outcomes. *Curr HIV/AIDS Rep.* Dec 2011;8(4):215-222.
208. Do AN, Rosenberg ES, Sullivan PS, et al. Excess burden of depression among HIV-infected persons receiving medical care in the united states: data from the medical monitoring project and the behavioral risk factor surveillance system. *PLoS One.* 2014;9(3):e92842.
209. Boudreaux ED, Cagande C, Kilgannon H, Kumar A, Camargo CA. A prospective study of depression among adult patients in an urban emergency department. *Primary care companion to the Journal of clinical psychiatry.* 2006;8(2):66-70.

210. Himelhoch S, Weller WE, Wu AW, Anderson GF, Cooper LA. Chronic medical illness, depression, and use of acute medical services among Medicare beneficiaries. *Med Care.* Jun 2004;42(6):512-521.
211. Moraska AR, Chamberlain AM, Shah ND, et al. Depression, healthcare utilization, and death in heart failure: a community study. *Circ Heart Fail.* May 2013;6(3):387-394.
212. Screening for depression in adults: U.S. preventive services task force recommendation statement. *Ann Intern Med.* Dec 1 2009;151(11):784-792.
213. Bradley H, Hall HI, Wolitski RJ, et al. Vital Signs: HIV diagnosis, care, and treatment among persons living with HIV--United States, 2011. *MMWR. Morbidity and mortality weekly report.* Nov 28 2014;63(47):1113-1117.
214. Hernan MA, Hernandez-Diaz S, Robins JM. A structural approach to selection bias. *Epidemiology.* Sep 2004;15(5):615-625.
215. Soong TR, Jung JJ, Kelen GD, et al. Is inadequate human immunodeficiency virus care associated with increased ED and hospital utilization? A prospective study in human immunodeficiency virus-positive ED patients. *Am J Emerg Med.* Oct;30(8):1466-1473.
216. Kerr J, Duffus WA, Stephens T. Relationship of HIV care engagement to emergency department utilization. *AIDS Care.* Oct 10 2013.
217. Gelberg L, Andersen RM, Leake BD. The Behavioral Model for Vulnerable Populations: application to medical care use and outcomes for homeless people. *Health Serv Res.* Feb 2000;34(6):1273-1302.
218. Bozzette SA, Berry SH, Duan N, et al. The care of HIV-infected adults in the United States. HIV Cost and Services Utilization Study Consortium. *N Engl J Med.* Dec 24 1998;339(26):1897-1904.
219. Wilkinson JD, Zhao W, Arnsten JH, et al. Longitudinal correlates of health care-seeking behaviors among HIV-seropositive injection drug users: how can we intervene to improve health care utilization? *J Acquir Immune Defic Syndr.* Nov 1 2007;46 Suppl 2:S120-126.
220. Kroenke K, Strine TW, Spitzer RL, Williams JB, Berry JT, Mokdad AH. The PHQ-8 as a measure of current depression in the general population. *Journal of affective disorders.* Apr 2009;114(1-3):163-173.
221. Corp S. Stata Manuals 2012;12(1).
222. Kupek E. Beyond logistic regression: structural equations modelling for binary variables and its application to investigating unobserved confounders. *BMC Med Res Methodol.* 2006;6:13.
223. Ford MA, Spicer CM, Institute of Medicine (U.S.). Committee to Review Data Systems for Monitoring HIV Care. *Monitoring HIV care in the United States : a strategy for generating national estimates of HIV care and coverage.* Washington, D.C.: National Academies Press; 2012.
224. Ford MA, Spicer CM, Institute of Medicine (U.S.). Committee to Review Data Systems for Monitoring HIV Care. *Monitoring HIV care in the United States : indicators and data systems.* Washington, D.C.: National Academies Press; 2012.
225. Korthuis PT, Fiellin DA, McGinnis KA, et al. Unhealthy alcohol and illicit drug use are associated with decreased quality of HIV care. *J Acquir Immune Defic Syndr.* Oct 1 2012;61(2):171-178.

226. Reeves D, Campbell SM, Adams J, Shekelle PG, Kontopantelis E, Roland MO. Combining multiple indicators of clinical quality - An evaluation of different analytic approaches. *Medical Care.* Jun 2007;45(6):489-496.

227. Chow W, Hirschhorn LR, Ng DW, Wells CG, Schneider KL, Agins BD. Improved quality of HIV care over time among participants in a national quality improvement initiative. *J Health Care Poor Underserved.* Aug 2012;23(3 Suppl):67-80.

228. Ohl ME, Richardson KK, Goto M, Vaughan-Sarrazin M, Schweizer ML, Perencevich EN. HIV quality report cards: impact of case-mix adjustment and statistical methods. *Clin Infect Dis.* Oct 15 2014;59(8):1160-1167.

229. Korthuis PT, Fiellin DA, Fu R, et al. Improving adherence to HIV quality of care indicators in persons with opioid dependence: the role of buprenorphine. *J Acquir Immune Defic Syndr.* Mar 1 2011;56 Suppl 1:S83-90.

230. Keller SC, Yehia BR, Momplaisir FO, Eberhart MG, Share A, Brady KA. Assessing the overall quality of health care in persons living with HIV in an urban environment. *AIDS Patient Care STDS.* Apr 2014;28(4):198-205.

231. Althoff KN, Rebeiro P, Brooks JT, et al. Disparities in the quality of HIV care when using US Department of Health and Human Services indicators. *Clin Infect Dis.* Apr 2014;58(8):1185-1189.

232. Shahar E, Shahar DJ. Causal diagrams and the cross-sectional study. *Clinical epidemiology.* 2013;5:57-65.

233. Mor V, Fleishman JA, Dresser M, Piette J. Variation in health service use among HIV-infected patients. *Med Care.* Jan 1992;30(1):17-29.

234. VanderWeele TJ. Invited commentary: structural equation models and epidemiologic analysis. *Am J Epidemiol.* Oct 1 2012;176(7):608-612.

235. Yehia BR, Schranz AJ, Momplaisir F, et al. Outcomes of HIV-Infected Patients Receiving Care at Multiple Clinics. *AIDS Behav.* Sep 28 2013.