ASSOCIATIONS BETWEEN PATIENT ACTIVATION AND OUTCOMES IN HIV-INFECTED PATIENTS

by

Rebecca Marshall

A THESIS

Presented to the Department of Public Health and Preventive Medicine
and the Oregon Health & Science University
School of Medicine
in partial fulfillment of
the requirements for the degree of

Master of Public Health

March 2009

Department of Public Health and Preventive Medicine

School of Medicine

Oregon Health & Science University

CERTIFICATE OF APPROVAL

This is to certify that the Master's thesis of

Rebecca Marshall

has been approved

Motomi Mori, PhD

P. Todd Korthuis, MD, MPH

Mark Loveless, MD

TABLE OF CONTENTS

Acknowledgements …… ….. iii

Abstract…… …. iv

Introduction…… 1

The Evolution of HIV Disease in the US…….. 1

Managing Chronic Disease…… 3

Patient Activation…….. 5

Patient Activation and HIV……..... 8

Material and Methods……..... 11

Research Design and Setting……. 11

Subjects……. 11

Data Sources……..... 11

Measures…… 12

Analysis……..... 13

Results…… 16

Discussion…….. 20

A Model for the Role of Patient Activation in HIV Clinical Outcomes……. 20

Limitations……. 29

Future directions…… 30

Summary and Conclusions……. 32

References…….. 34

Appendix…… 43

Tables…….. 44

Tables

Table 1: Descriptive Statistics of Patient Characteristics

Table 2: Univariate and Multivariate Associations with Patient Activation

Table 3: Multivariate Associations between Patient Characteristics and Clinical Outcomes

Table 4: Adjusted OR of PAM for Clinical Outcomes among Patients on ART

Acknowledgements

Thank you to my thesis committee: Tomi Mori, for your consistent encouragement, support, and willingness to make time for me despite your own hectic schedule; Todd Korthuis, for going far beyond the requirements of mentor in coordinating with the ECHO team, guiding my thinking and analysis, and being tirelessly enthusiastic; and Mark Loveless, for providing your invaluable perspective and insights into the nuances of HIV disease and care.

Thanks to the Department of PHPM, especially Katie Riley for administrative guidance and general encouragement about work and life, John Stull for many thought-provoking and supportive talks over the past six years, and Bill Lambert for helping hone my epidemiologic understanding and consistently reminding us all of the human dimension of public health.

Thanks to my parents: my mom for many cross-country trips to help us juggle children and work, and my dad for ungrudgingly fielding panicked calls about statistical uncertainties and reading numerous drafts of the thesis-in-progress.

Thanks to my parents-in-law for providing child care, crisis management and good humor during the last hectic weeks of thesis preparation.

Thanks to my children, Theo and Henry, who don't yet understand what I'm doing when I'm up at school but who always make me happy to come home. And finally, thanks to Dan, for unwaveringly sharing the difficulties and the joys of the past six years with me.

Abstract

Background: Patient activation has been defined as “a broad range of elements including the knowledge, skills, beliefs, and behaviors that a patient needs to manage a chronic illness" (Hibbard et al., 2004). The Patient Activation Measure (PAM) has been used to measure patient activation in several chronic diseases (Hibbard et al., 2004, 2005) but has not yet been applied among populations with the human immunodeficiency virus (HIV). We investigated factors associated with patient activation in an HIV-positive population: demographic factors, self-perceptions of social status, substance abuse, and depression. We also assessed the association between patient activation and the outcomes of CD4-cell counts, adherence to highly-active antiretroviral therapy (HAART), and viral suppression.

Methods: We used data from the Enhancing Communication and Health Outcomes (ECHO) trial, a cross-sectional study conducted at four clinical sites in the US. Using linear and logistic regression, we assessed the relationships, respectively, between demographic variables and PAM score, and between PAM score and clinical outcomes.

Results: Patient activation is statistically significantly ($p < .05$) associated with educational level, self-perceived social status, current problematic alcohol use, and depression. Patient activation is also significantly associated with CD4 count and patient adherence when adjusted for gender, age, race, education, self-perceived social status, alcohol abuse, illicit drug use, depression, location and provider. Patient activation is significantly associated with viral suppression prior to controlling for adherence, but the association is not significant when controlling for adherence.

Conclusions: PAM represents a promising means of assessing the self-management of patients with HIV, and for improving their clinical outcomes.

I. Introduction

With the availability of effective antiretroviral regimens in the US and other wealthy nations, Human Immunodeficiency Virus (HIV) has shifted from being a rapidly debilitating illness with high mortality to a treatable chronic illness (Gifford and Groessl, 2002). This shift necessitates a different approach to the care of HIV-infected patients, one in which patients are empowered to collaboratively engage with their health care team and take a greater role in managing their illness.

A central concept related to the care of patients with chronic disease is patient activation—how much knowledge, skill, and confidence an individual has in managing his or her disease. This thesis investigates the role of patient activation in a cohort of individuals infected with HIV. Specifically, it asks which patient characteristics are most associated with patient activation and whether patient activation is associated with clinical outcomes. The answers to these questions have important implications for the long-term care of patients with HIV.

The Evolution of HIV Disease in the US

Acquired immunodeficiency syndrome, or AIDS, results from infection with HIV. A retrovirus, HIV attacks the immune system, killing $CD4^+$ T helper lymphocytes and other immune cells that allow the body to fight infections. When an individual's CD4 cells decrease to a critical value—200 cells per μL of blood—he or she is susceptible to infections that the body can normally resist.

When AIDS was first identified in the early 1980s, there was no known treatment. Within an average of nine to ten years after infection with HIV (Morgan et al., 2002), individuals would lose cellular immunity and develop "opportunistic infections," or infections associated specifically with compromised immune status; this signaled the development of AIDS. The average survival time after developing AIDS 9.2 months (Morgan et al., 2002). Therefore, patients' medical care was generally acute, in hospital settings, and focused on treating opportunistic infections.

The first antiretroviral medication, Zidovudine, or AZT, became available in 1986 and showed initial promise in targeting HIV. However, the virus proved able to quickly mutate and develop resistance against individual agents. Not until the late 1990s, when three- or four-drug regimens known as highly active antiretroviral treatment (HAART) became available, was it possible to control the proliferation of viral cells and maintain immune function. This has increased the average length of survival of a patient diagnosed with HIV from seven years in 1993 to 24 years in 2006 (Schackman et al., 2006).

However, for HAART to be effective in suppressing viral replication, supporting immune function, and slowing progression to AIDS, patients must consistently follow their medication regimens (Yeni et al., 2002); this is generally referred to as "adherence." One commonly used definition of adherence is the percentage of prescribed doses taken (Ickovics, 1997). At least 95 percent adherence is needed for virologic success; failure rates increase in a dose-response effect as adherence decreases (Paterson et al., 2000).

Yet studies suggest that up to 30 percent of patients report missing at least one dose over the prior two to three days (Chesney, 1997). Other studies report adherence rates ranging from 42 percent (Muma et al., 1995) to 80 percent (Haubrich et al., 1999; Rodriguez-Rosado et al., 1998). Further, individual adherence often declines over time (Stone et al., 1998). Factors consistently associated with non-adherence include adverse side effects, complexity of the regimen, inconvenience of treatment, psychological distress, lack of social or family support, low patient self-efficacy, and substance abuse (Ammassari et al., 2002).

Given the life-prolonging potential of HAART and its attendant difficulties, HIV has become similar to chronic diseases such as diabetes and hypertension. These diseases can be controlled and managed over long time periods; however, health optimization depends on a patient's ability to maintain often complicated treatment regimens, which may cause significant lifestyle disruptions and have severe side-effects. The ability of patients and providers to manage these issues has become a critical and formidable challenge in healthcare.

Managing Chronic Disease

Over 100 million Americans have one or more chronic diseases (CDC, 2008); given the enormous burden this places on the US healthcare system, the management of chronic disease has become a critical issue for practitioners, researchers, and policymakers. Traditionally, health care models have focused on the treatment of acute illness (Mosen et al., 2007). Acute illness is time-limited, with endpoints of recovery or death. Patients are generally in a passive role; they may be incapacitated and unfamiliar with their illness and its treatment. Providers are the experts: they identify problems and direct both patient

behavior and treatment until there is a resolution (Gifford and Groessl, 2002). The care of chronic disease is significantly different. Symptoms and treatments may be lifelong; patients are the experts about the disease's manifestations in their lives (Gifford and Groessel, 2002). To be effective, clinicians must provide more than clinical directives: they must collaborate with their patients to define problems, goals, and treatment, as well as provide education, motivation and support.

The Chronic Care Model (Figure 1), developed by Edward Wagner in 1998, posits that optimal chronic care is achieved when a prepared, proactive practice team interacts with an informed, activated patient. Various factors within the community and health systems support and enable these two key players to achieve improved outcomes.

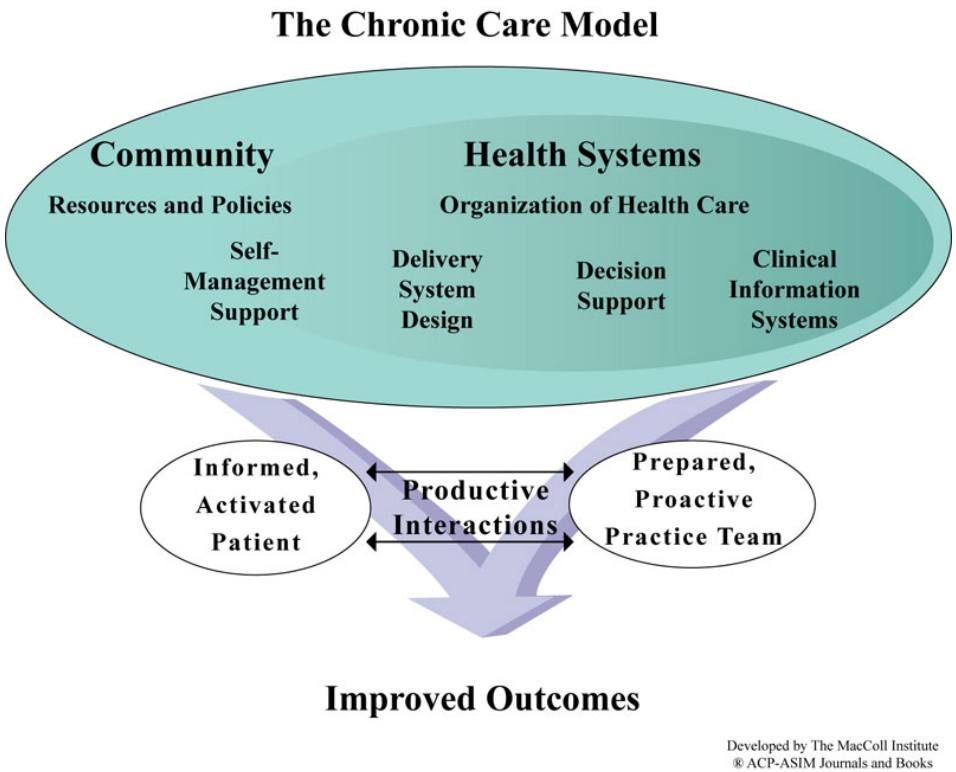

Figure 1: The Chronic Care Model (Wagner, 1998).

A patient's ability to be a productive member of this dyad depends in part on his or her ability, with the support of the community, to self-manage his or her disease. Self-management has been defined by Gifford and Groessl as being the sum of information, motivation, and behavioral skills (Gifford and Groessel, 2002). Importantly, several studies have shown that patients who are educated about and actively participate in the management of their disease have better health outcomes (Von Korff et al. 1997; Lorig et al. 1999; Von Korff et al. 1998; Bodenheimer et al. 2002). Further, training patients with chronic diseases in self-management strategies can increase functioning, reduce pain, and decrease health care costs (Lorig et al. 1999).

However, while self-management has been well-explored in the literature, until recently the concept of what it means to be an "activated patient"—a critical part of the Chronic Care Model—remained both conceptually and empirically underdeveloped (Hibbard et al., 2004).

Patient Activation

A series of publications by Judith Hibbard and colleagues has defined, quantified, and applied the concept of patient activation as it relates to chronic diseases including diabetes, heart disease, asthma, and chronic pain. Through a process involving literature searches, an expert consensus process and patient focus groups, Hibbard and colleagues defined patient activation as "a broad range of elements including the knowledge, skills, beliefs, and behaviors that a patient needs to manage a chronic illness" (Hibbard 2004).

More specifically, patients who are activated "*believe* that they have important roles to play in self-managing care, collaborating with providers and maintaining their health; *know* how to manage their condition, maintain functioning and prevent health declines; and have the *skills and behavioral repertoire* to manage their condition, collaborate with their providers, maintain their health functioning, and access appropriate and high-quality care" (Hibbard et al., 2004).

Theoretical components of patient activation include several critical concepts in chronic care, many of which have specific tools by which they can be measured. These concepts include self-efficacy, or a patient's beliefs about his or her ability to make changes (Lorig et al 1999); health locus of control, or a person's belief that his or her health is determined by his or her own behavior (Wallston et al., 1994); and readiness to change, or a patient's readiness to make changes related to health (Prochaska et al., 1997).

Patient activation occurs in four stages:

Stage 1: Believing the patient role is important

Stage 2: Having the confidence and knowledge necessary to take action

Stage 3: Eventually taking action to maintain and improve one's health

Stage 4: Staying the course even under stress (Hibbard et al., 2004).

Patient activation occurs on a continuum; what is needed to change an individual's stage of activation depends on where he or she is on the continuum. Patients at the low end of activation may not have fundamental knowledge about their illness, or may not believe

that they can improve their own health. Patients at the high end of activation generally will have this fundamental knowledge and confidence, although they may not be able to maintain healthy behaviors during stressful periods (Hibbard et al., 2004).

The Patient Activation Measure (PAM) was developed to identify individual patient activation levels and to assess the effectiveness of interventions to increase activation. The PAM is a 21-question survey with a 13-question version (Appendix 1) that measures patient activation in those with chronic disease. Both the long and short versions have been extensively tested and shown to be valid and highly reliable (Hibbard et al, 2004; Hibbard et al, 2005). Each stage of activation occurs within a range of PAM score. Stage one includes PAM scores of less than 47, stage two includes scores between 47 and 55, stage three includes scores between 55 and 67, and stage four includes scores of greater than 67 (Mosen et al., 2008).

The PAM thus facilitates the identification of an individual's specific location on the activation continuum. This information is particularly important because a patient's activation level has been shown to be associated with self-management behaviors (Hibbard et al., 2008). For example, patients assessed as highly activated (Stage 4) are more likely, even under stress, to obtain preventive care; to engage in health-promoting activities such as eating a healthy diet and exercising; to engage in self-management behaviors such as monitoring their condition and adhering to treatment; and to practice health information seeking behaviors such as asking their provider questions about their illness and treatment (Hibbard, 2008; Mosen, 2007).

Perhaps even more importantly, a patient's activation level can change over time. A recent clinical trial randomized patients to interventional and control groups to study the effects of a behavior-modification program. The study found that activation levels can change over time, and that increases in activation level are accompanied by improvements in self-management behaviors (Mosen, 2007).

In summary, the PAM is an important tool in the care of chronic disease for several reasons. First, the PAM measures patient activation, a fundamental concept within the chronic care model; this model has been widely used in research, education, and practice to improve outcomes of care in chronic disease since its development in 1998. Second, the PAM allows patient activation to be easily and quickly assessed; patients can complete the 13-question PAM in only a few minutes. Third, patient activation levels can improve; therefore, once a patient's PAM score has been identified, interventions can be focused to the patient's current stage of activation. Finally, the PAM allows for the assessment of the effectiveness of interventions. This is important both to identify which interventions are generally effective at improving patient activation and to identify whether specific interventions aimed at specific individuals are meeting their goals.

Patient Activation and HIV

For patients with HIV, effective self-management hinges on strict adherence to HAART. As with many chronic diseases, strict adherence is difficult for most patients to achieve.

However, HIV presents additional difficulties, both for patients attempting to self-manage and for clinicians attempting to optimize their care. These difficulties include the lack of a mechanism for patients to self-monitor their disease status on a daily basis (Gifford et al., 2001); the inaccuracy of self-reports of adherence and the lack of a "gold standard" for measuring adherence (Farmer et al., 1999); the stigma of living with HIV (Herek et al., 2003); high rates of depression and other psychiatric comorbidities (Rabkin, 2008); and high rates of substance abuse (Kapadia et al., 20008). Further, within the United States, new cases of HIV have been found in increasing percentages in non-white, female, and injection-drug using populations (CDC 2008, Osmond). These demographics have been associated with worse outcomes in managing chronic disease (Williams, Chalmers et al.; Chen et al.).

Not surprisingly, given the particular difficulties related to adherence to HAART, as well as the inherent and contextual factors that make HIV a difficult disease to self-manage and treat, results of interventions to improve adherence to HAART have been mixed (American Public Health Association, 2004). However, interventions that focus on self-management skills have shown promise. Specifically, adherence has been improved by programs focusing on improving literacy, self-efficacy, skills and education around HIV and HIV management (Wolf et al., 2005; Wolf et al., 2007; Johnson et al., 2003; Rueda et al., 2006; Gifford et al., 2001); addressing logistical barriers, substance use, and attitudes (Simoni et al., 2006; Kapadia et al., 2008); and treating depression (Horberg et al., 2006). Further, improved self-management skills have been associated not only with improved adherence, but improved symptoms and outcomes (Gifford et al., 1998; Gifford et al, 2001).

In other chronic diseases, patient activation has been shown to predict self-management behaviors. However, patient activation—specifically, the PAM—has not yet been studied in HIV-infected populations. If patient activation is associated with self-management behaviors, including adherence, in this population, the PAM represents a promising tool to assess an individual's level of activation and related self-management behaviors, to identify patients who need additional support, and to target and measure interventions to improve these behaviors.

Toward this end, the objective of this thesis was, first, to identify characteristics associated with patient activation, both to better understand patient activation in this population and to assist clinicians in focusing their interventions. The second objective was to assess whether there are relationships between patient activation in this population and clinical outcomes, specifically CD4 count, adherence to HAART, and viral load suppression. The outcomes of these questions have potentially important implications for the care of those with HIV.

II. Materials and Methods

Research Design and Setting

This analysis was conducted as part of the Enhancing Communication and HIV Outcomes (ECHO) study. ECHO is a cross-sectional, non-interventional study designed to assess associations between patient-provider communication and clinical outcomes at four ambulatory HIV clinics in Baltimore, MD, Detroit, MI, New York, NY, and Portland, OR that participate in the HIV Research Network (Beach and Moore, 2006).

Subjects

All HIV providers practicing at each site were invited to participate, and 82% of the providers agreed. Patients of participating providers were recruited as they waited for their clinic appointment. Patients were eligible for inclusion if they were HIV-infected, had seen the provider at least once previously, were age 20 years or older, and spoke English.

Each day, study research assistants selected potential participants from the providers' scheduled patients to minimize selection bias. Overall, 73% of approached eligible patients participated.

Data Sources

A trained interviewer conducted face-to-face interviews with selected patients following their clinic visit. Surveys included data on patient demographics, social and behavioral characteristics, and clinical characteristics. Survey data were supplemented with medical record abstraction to obtain most recent CD4 counts, HIV viral load and antiretroviral medications.

Measures

Independent variables were measured as follows: self-reported age in years (categories); race (white, black, Hispanic, other); gender (male, female); and education (having graduated from high school, yes/no). Problematic alcohol use (never, former, current) and illicit drug use (never, former, current) were obtained using the previously validated ASI-lite index (McClellan 1997). Patient literacy level was determined using the Rapid Estimate of Adult Literacy in Medicine (REALM), a validated screening tool to estimate patient reading levels (Davis, 1991). Self-reported social status was based on a tool found in prior studies to be a significant predictor of self-rated health, after controlling for the effects of objective indicators (Adler, 2000; Ostrove 2000). The tool uses a ten-rung ladder, with the bottom rung being one and the top rung being ten : each patient reported his or her perceived social status by placing an "X" on the rung of a diagrammed "social ladder" corresponding to his or her perceived position on that ladder. If a mark was between two rungs, the value was given to the higher-value rung. Depression score was determined using the previously-validated CES-D tool (Radloff 1977), which calculates a score of 1-4 based on averages of responses to 20 questions. Length of time with provider was described as less than or equal to five years or greater than five years.

Patient activation was measured using the previously validated 13-item Patient Activation Measure (PAM), which generates a score from 0-100 (Hibbard et al., 2005) (Appendix I). Response categories are strongly agree, agree, disagree and strongly disagree; responses are scaled using established PAM methodology (Hibbard et al., 2005). The PAM, initially

designed as a 21-question tool based on qualitative methods, Rasch analysis, and classical test theory psychometric methods, is a valid, highly reliable, unidimensional, probabilistic Guttman-like scale; it has also been validated for its prediction of self-management behaviors (Hibbard et al., 2004). The short, 13-question version of the tool reduces the number of items in the measure but maintains its precision; it has also been shown to be both reliable and valid (Hibbard et al., 2005). Each stage of activation corresponds with the following range of scores (Mosen et al., 2006):

Stage 1: Does not yet understand an active role is important (score <47.0)

Stage 2: Lacks knowledge and confidence to take action (score >47.1 and <=55.1)

Stage 3: Beginning to take action (score >55.2 and <=67.0)

Stage 4: Maintaining behaviors over time (score >67.1)

Outcome measures of CD4 cell count and viral suppression were abstracted from chart data as described above. The measure of adherence was self-reported; adherence was defined as no missed doses of medication over the past three days based on data extracted from the ACTG Adherence Follow Up Questionnaire (Chesney et al., 2000).

Analysis

Data were analyzed with Stata. First, we computed descriptive statistics to describe characteristics of the study population. This analysis included the mean, median, range and standard deviation for continuous variables and frequencies for discrete variables.

To understand the relationship between independent variables and PAM score, we first conducted univariate analysis by linear regression between each variable and PAM score,

using PAM score as a continuous variable. For each of these regressions, we controlled for location and for provider using a random-effects model. Continuous independent variables were age, self-perceived social status, and depression. Categorical independent variables were race, gender, education, high-school literacy level, problematic alcohol use, illicit drug use, and length of time with provider.

We used backwards stepwise procedure to develop a final model of the independent variables associated with PAM score, using a cutoff p-value of 0.25. We included all independent variables in the stepwise regression, with PAM score measured continuously as the outcome variable. We then performed a final multivariate analysis on all independent variables remaining after the stepwise procedure, controlling for both location and provider using a random-effects model.

Next, we conducted logistic regression between each independent variable and each outcome of interest (CD4 cell count, medication adherence, and viral suppression), again controlling for location and provider using a random-effects model. For these regressions, each outcome was coded as a binary variable: CD4 count was coded as greater than 200 (yes/no), adherence was coded as “having missed no doses over the past 3 days” (yes/no), and viral load suppression was coded as less than 400 (yes/no).

Finally, we analyzed associations between patient activation and outcome variables using logistic regression. In addition to associations between PAM score and outcome variables of CD4 count, adherence and viral suppression, we added an additional outcome category

of viral suppression controlled for adherence, to assess whether there was an association between patient activation and viral suppression independent of adherence. For all outcome variables, we controlled for independent variables that had been significantly associated with either PAM score or with the outcome variables, or that we judged to be important based on associations identified in other research: gender, age, race, education, self-perceived social status, alcohol abuse, illicit drug use, drug use, depression, location, and provider (random effect). PAM score was measured continuously, and outcome variables were coded as described above. For the analysis of patient activation and clinical outcomes, only patients on HAART were included in the final model because the populations on HAART and not on HAART have such different courses of disease and clinical outcomes.

III. Results

The ECHO study population is described in Table 1, with a total of 435 patients. The mean age in years is 45, with a standard deviation of 9 years. Patients are disproportionately minorities (83 percent) and men (66 percent). Roughly three-fourths completed a high school education, and slightly under three-fourths (69 percent) have at least high-school literacy levels. The majority of patients regard themselves as being in the low-middle range of the social ladder, with a mean score of 4.5 out of ten and a standard deviation of 2. Patients have high rates of substance abuse: almost half (49 percent) have a history of alcohol abuse, nine percent have current problematic alcohol use, 48 percent are former illicit drug users and 28 percent are current illicit drug users. Patients had a mean depression score of 2.1 out of four; eight percent scored from three to four. Roughly two-thirds of patients report having been with their current provider for five years or less. Over three-fourths (79 percent) of patients are currently on HAART. Eighty-two percent of these patients report not having missed any doses of ARVs over the past three days. Eighty percent of patients have CD4 counts greater than 200, with a mean score of 538, and 57 percent of patients have a viral load of less than 400. In terms of patient activation: the population is left-skewed, with a mean score of 72 out of 100 and range of 34.7 to 100, and 57 patients (13 percent) scoring 100.

Associations between patient characteristics and patient activation are reported in Table 2. Patient activation in this population is not associated with demographic variables of age, race, or gender. Factors associated with PAM in univariate analysis are educational

level, high school literacy level, self-perceived social status, former and current problematic alcohol use, former drug use, and depression.

In the final multivariate model, factors associated with patient activation, when adjusted for the other variables in the model, location, and provider, are educational level, self-perceived social status, current problematic alcohol use, and depression. REALM score, which was initially included in the stepwise regression, was no longer significant when educational level was included in the model. Educational level is positively associated with patient activation: when controlling for other significant factors, those who graduated from high school have an average PAM score that is six points higher than the score of individuals who did not graduate from high school. Self-perceived social status and patient activation are also positively associated: for each one-unit increase in self-perceived social status (measured as one rung on the "social ladder") there is an average increase of one point in PAM score. This computes to a PAM score that, on average, is nine points higher for those who rate themselves on the highest rung of the social ladder compared to those on the lowest rung. Current problematic alcohol use is negatively associated with PAM score: when adjusted for other variables, PAM score decreases by approximately six points on average for those who currently abuse alcohol, compared with those with no alcohol abuse history. Finally, depression is highly associated with patient activation. For each one-unit increase in depression score, PAM score decreases by 4.6 points; this computes to an average difference of 14 points in PAM score between those who rated themselves a "1" versus a "4" on the depression scale.

Associations between patient characteristics and clinical outcomes are reported in Table 3. Only self-perceived social status is associated with CD4 count >200 (OR 1.212, 95% CI 1.054 – 1.393). The following characteristics are significantly associated with adherence: age is associated with increased likelihood of adherence (OR 1.03, 95% CI 1.002 – 1.066); the racial category "other" is associated with decreased likelihood of adherence (OR 0.061, 95% CI 0.012 – 0.310); former illicit drug use is associated with decreased likelihood of adherence (OR 0.331, 95% CI 0.130 – 0.842); current illicit drug use is associated with decreased likelihood of adherence (OR 0.424, 95% CI 0.180 – 1.000); and increased depression score is associated with decreased likelihood of adherence (OR 0.637, 95% CI 0.180 – 1.000). Only former illicit drug use is associated with viral suppression, with those formerly using illicit drugs less likely to have viral suppression (OR 0.359, 95% CI 0.177 – 0.729).

In Table 4, the associations between patient activation and clinical outcomes are described. First, for patients on antiretroviral therapy (82 percent of the study population), patient activation is significantly associated with the outcome variable of CD4 count, with an OR of 1.019 (95% CI 1.000 - 1.037), when adjusting for gender, age, race, education, self-perceived social status on a national level, alcohol abuse, illicit drug use, alcohol abuse, depression, location and provider. Thus for every one-point increase in PAM score, the odds of having a CD4 count over 200 increase by 1.9 percent; for a ten-point increase in PAM score, this translates into a 21 percent increased odds of having a CD4 count over 200. Adjusting for all the above factors, patient activation is associated with patient activation with an OR of 1.028 (95% CI 1.007 - 1.049); therefore,

odds of adherence increase by 2.8 percent for every one-point increase in PAM score, and increase by 32 percent for every ten-point increase in PAM score. Finally, again adjusting for the above factors, the association between patient activation and viral suppression, not adjusted for adherence, is 1.016 (95% CI 1.000 - 1.032), which suggests an increased odds of viral suppression of 1.6 percent for each one-point increase in PAM score, or a 17 percent increased odds for a ten-point increase in PAM score. When adjusted for adherence, the OR decreases slightly to 1.014, with a 95% CI that crosses one (95% CI 0.998 – 1.031).

IV. Discussion

To contextualize the scale of the associations we found between patient characteristics and patient activation and between patient activation and clinical outcomes, we will briefly review the point span associated with the different stages of activation. Patients in the first stage of activation (do not yet understand an active role is important) have a PAM score of less than 47. Patients in the second stage (lacks knowledge and confidence to take action), have a score between 47 and 55. Patients in the third stage (beginning to take action) have a score between 55.1 and 67, and patients in the fourth stage have a score of greater than 67. Thus, an increase of only ten points in PAM score could represent a change from the first stage of activation to the third. This highlights the importance of even small changes in patient activation score: they may predict marked improvements in health-related behaviors.

A Model for the Role of Patient Activation in HIV Clinical Outcomes

We found four patient characteristics to be associated with patient activation: educational level, self-perceived social status, current alcohol use, and depression. We also found patient activation to be associated with the clinical outcomes of CD4 count, adherence to ARVs, and viral suppression prior to controlling for adherence. Using these data, in conjunction with other research regarding patient activation, we have developed a model for the role of patient activation in HIV-related outcomes (Figure 2).

Hypothesized Role of Patient Activation in HIV Clinical Outcomes

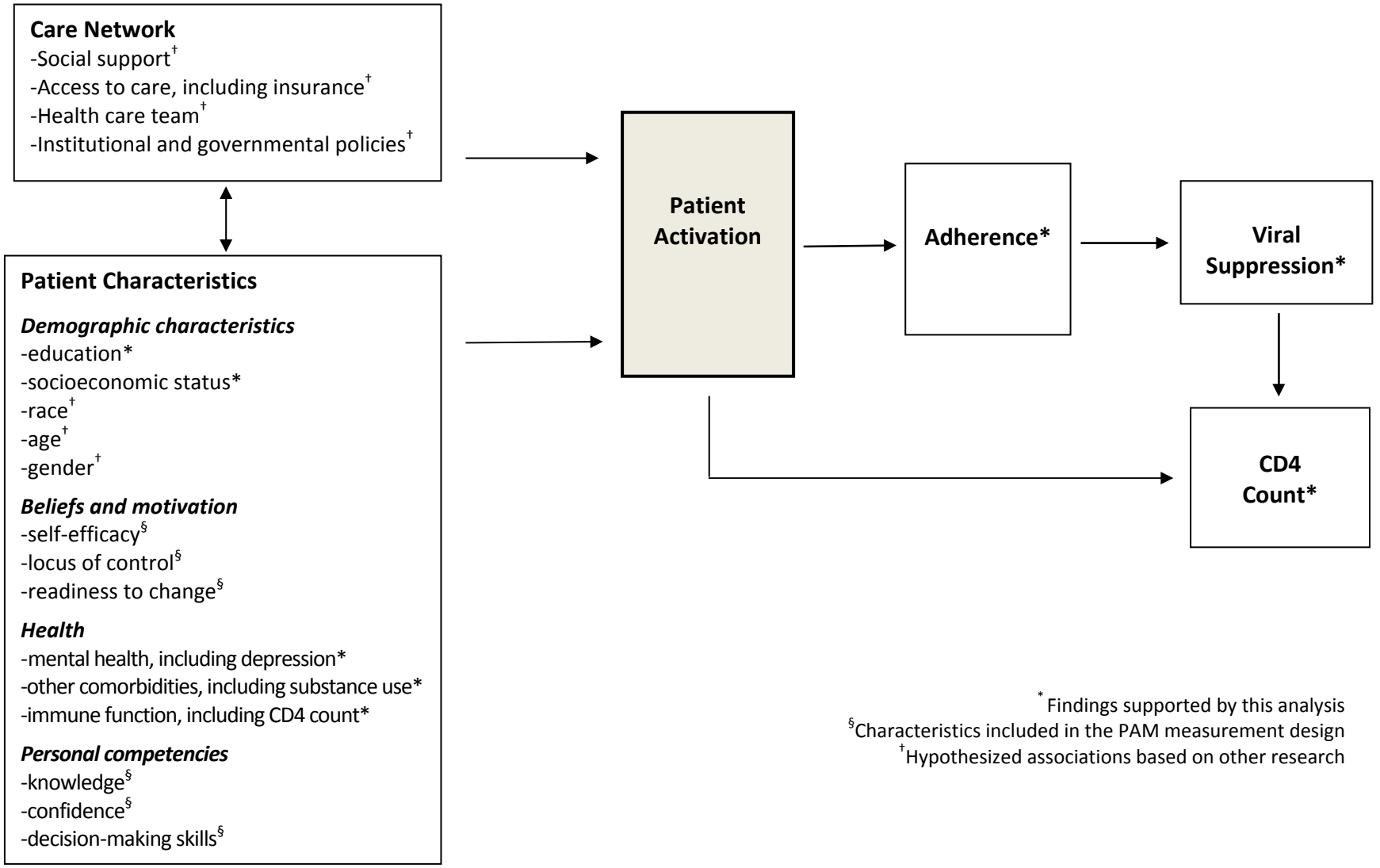

Figure 2: Hypothesized Role of Patient Activation in HIV Clinical Outcomes

In this model, there are two major categories that contribute to a patient's level of activation. The first category, the patient's care network, includes concepts from the Chronic Care Model and addresses the contextual factors that support a patient's ability to self-manage. The second category, patient characteristics, includes characteristics we found to be associated with patient activation in our research, characteristics such as self-efficacy that are explicitly incorporated by the PAM into the measurement of patient activation, and characteristics such as race that was not associated with patient activation in our research but that we would expect to be associated based on other research.

First, we found no statistically significant associations between PAM score and the variables of race, gender and age. However, at least one other study of patient activation in other chronic diseases has observed such associations (Hibbard and Cunningham, 2008). Further, these demographic characteristics have been found to be associated with adherence and other self-management behaviors in an HIV-infected population. While it is possible that there is truly no association between these characteristics and patient activation in this study population, we hypothesize that our findings may have been skewed by the fact that our analysis was conducted on patients with access to care. Those patients who have not established care or inconsistently access care are likely to be among the more vulnerable in the population, and it is likely that they have demographic characteristics that were not accurately reflected in this analysis.

The socioeconomic factors of educational level and self-perceived social standing did have a measurable effect on patient activation. Those who graduated from high school

on average have a PAM score that is six points higher than those who did not graduate from high school. Interestingly, in comparing high school education level with high school literacy level, education level is more highly associated with patient activation and has a greater beta-coefficient, or a greater effect size. This may suggest that the importance of achieving a high school degree is related to more than strictly functional status; it may also be related to self-perceptions, to later opportunities related to having a high school diploma, or to the contextual factors that influence a person's ability to finish high school. Self-perceived social standing also has an important association with patient activation, with patients rating themselves on the top rung of the social ladder averaging a PAM score that is nine points higher than the score of those rating themselves on the bottom rung. Both of these associations are consistent with research on patient characteristics and patient activation among populations with other chronic diseases (Hibbard 2008). If patient activation reflects the degree to which a person feels in control of his or her own health, it is not surprising that patients who have more resources, in the form of education and self-perceived social status, tend to be more activated.

The category of health-related beliefs and motivation represents another set of personal characteristics related to patient activation. Self-efficacy, locus of control, and readiness to change health-related behaviors are individual components of patient activation that are measured by the PAM (Hibbard et al., 2004). As discussed in the introduction, there is a significant body of literature related to the associations between these measures and health-related behaviors, as well as their relationship to patient activation. The PAM also measures a patient's personal competencies, defined by their disease-specific knowledge,

confidence, and decision-making skills (Hibbard et al., 2006), which is the next category of patient characteristics in the model.

The final category of patient characteristics in our proposed model is health, which includes mental health. We hypothesize that an individual's baseline health—functional immune status, the presence of other chronic diseases, and the presence of psychiatric illness such as depression or anxiety—both influences and is influenced by his or her level of patient activation.

Our research found that both depression and current alcohol abuse are associated with patient activation. First, we found that depression is associated with decreased PAM score, with an average difference of 14 points between those at the two extremes of the depression scale. This difference is particularly important because it alone bridges two stages of patient activation. If, as we hypothesize, depression has a causative effect on patient activation, our research suggests that effectively treating an individual's depression could, in itself, advance his or her activation level by two stages. Our findings are supported by research reporting a negative association between depression and patient activation in other chronic diseases (Hibbard, 2007), as well as research supporting a negative association between depression and adherence (Van Servellen et al 2002). Given the high prevalence of depression and other psychiatric disorders among patients with HIV (Angelino and Treisman 2001), screening and treating patients for depression is particularly important for patient activation, adherence, and outcomes.

Our model also includes alcohol abuse as a health factor affecting patient activation. We found that patients currently abusing alcohol have, on average, a PAM score that is six points lower than the score of those with no alcohol abuse history. While our research did not support an independent association between alcohol use and adherence or viral suppression, other research has found these association (Chander et al, 2006), which would be consistent with the causal pathway proposed in our model. We did not find that drug use is associated with patient activation; this is unexpected, given the associations we found between patient activation and alcohol abuse, as well as the well-established relationship between illicit drug use, adherence, and other clinical outcomes (Lucas et al, 2001; Arnsten et al., 002). This may be related to sample size, or to the heterogenicity of the variable, which included marijuana, methadone, heroine, other opiates, cocaine, and methamphetamine use. It is also possible that there are characteristics of drug abuse as distinct from alcohol abuse that are less likely to translate into patient activation. This is an important question to address in future research.

Finally, in the category of health, we included the characteristic of a patient's immune function, including CD4 count. An individual's CD4 count on first infection has been found to affect his or her subsequent course of disease. While the neurobiology and psychobiology of HIV are incompletely understood, it is plausible that a person's immune status may affect their cognitive and behavioral capacities, which could be related to their capacity for activation. While our analysis considered CD4 count as an outcome variable, given the cross-sectional nature of the study, it is possible that the

association we found between CD4 count and patient activation is one in which CD4 count is the predictor and patient activation the outcome variable.

Each of the four characteristics we considered as independent variables and found to be associated with patient activation could be used as a screening tool to identify patients likely to benefit from interventions to increase patient activation. In addition, each of these factors is potentially modifiable. While a characteristic such as whether a patient graduated from high school may not in itself be easily modified, other characteristics potentially related to the patient's educational status—such as self-confidence, literacy, and access to informational resources—may be modifiable. Self-perceived social status, similarly, may be improved by involving patients in self-management programs that focus on enhancing individual self-esteem, developing coping strategies, and establishing or enhancing social support networks. Depression and alcohol abuse may be modifiable for some individuals. While the causal relationship between these four variables and patient activation level is likely complex, and not entirely unidirectional, nonetheless these factors may be useful targets both for screening high-risk patients and for behavior modification interventions. More specifically, we conclude that patient activation interventions in this population are most likely to be successful if they address factors associated with low educational level and low self-perception of social status, as well as screen for and treat depression and alcohol abuse.

The right-hand side of Figure 2 represents the associations we found between patient activation and outcomes: namely, that patient activation is directly associated with both

CD4 count (OR 1.019, 95% CI 1.000 - 1.037) and adherence (OR 1.028, 95% CI 1.007 - 1.049), and associated with viral load suppression through the effect of adherence (unadjusted OR 1.016, 95% CI 1.000 - 1.032; adjusted OR 1.014, 95% CI 0.998 – 1.031). While the ORs are small, they represent the odds associated with *each point* in patient activation. Given the range of patient activation scores in our study population (34 to 100), it is conceivable that interventions that could successfully increase patient activation levels could have a large effect on a patient's clinical outcomes. For example, if a patient increased his or her activation level from the first to the fourth stage of activation—for example, from a score of 38 to 68—the odds of this patient having a CD4 count over 200 would increase by 76%, and the odds of this patient being adhering to HAART would more than double.

The finding of a stronger association between patient activation and CD4 count than between patient activation and viral suppression may reflect the complex nature of the CD4 measurement relative to viral suppression. While viral suppression is influenced primarily by adherence to antiretrovirals, CD4 counts are influenced by a range of immune and other factors (Florence et al 2003). The mechanism for the hypothesized effect of patient activation on CD4 count is not clear, and may be a combination of neurobiological factors as well as the effect of viral suppression mediated by adherence. Further, as discussed previously, it is possible that the causal pathway runs from CD4 count to patient adherence rather than from patient adherence to CD4 count, or that there is a more complex bi-directional relationship. Given the central role of adherence on viral suppression, it is not surprising that the effect of patient activation on viral load appears

to be mediated by adherence. While the change from the unadjusted OR to the adjusted OR is quite small, adding adherence to the model takes away the significance of the association.

As discussed in the introduction, adherence is also a complex phenomenon; it is affected by many factors, including patient-related factors, provider-related factors, and factors related to the patient's medication regimen (APHA, 2004). Patient activation represents one domain that appears to be related to adherence; as depicted in Figure 2, there are various factors that affect adherence through patient activation. Some of these factors, such as depression, also affect adherence independently; and there are likely many additional factors that contribute to adherence separate from patient activation. Nonetheless, patient activation, as measured through the PAM, represents a summary indicator that can potentially be used both to predict adherence and as a measure of the effectiveness of interventions to improve adherence.

Research with other chronic diseases has found that activation levels can improve over time. It appears likely that activation levels among this population can also improve over time. Our research provides some data regarding the type of interventions that may be most successful at improving activation levels; however, additional research needs to be done. Further, given that activation represents a broad continuum, different interventions may be needed for patients at different levels of activation. Finally, the pathways by which patient activation may affect health outcomes in this population, through the

body's immunologic response, adherence, and viral suppression, are incompletely understood and warrant further investigation.

Limitations

The primary limitation of this research is the cross-sectional nature of the study, which limits temporal or causal conclusions, particularly about the relationship between independent variables and patient activation. We hypothesize that the relationships between demographic variables and patient activation are not strictly unidirectional: that is, patient activation both affects and is affected by these variables. Regardless, the demographic variables associated with patient activation can be used as potential screening tools to identify patients at risk of low activation. The causal relationship between patient activation and outcome measures, similarly, is not able to be specified based on the findings from this study. While we suspect that more activated patients are less likely to develop severe clinical disease, due to better self management and adherence, this will need to be verified by a longitudinal study.

Selection bias may have influenced the findings in the following ways. First, the study population involved patients who had established care and shown up for their appointments; this in itself would predispose toward more highly-activated and less vulnerable patients. Second, subjects were paid a small amount, which may have selected for a population in increased economic need. This could have skewed the observed association between socioeconomic status and patient activation.

Information bias may have influenced the findings as well. While bias was limited by the use of a trained research assistant who was unfamiliar with the patients and used a scripted questionnaire consisting of validated tools, we anticipate that there was some recall bias, particularly related to adherence. As there is evidence that adherence is overestimated by patients, actual associations may be less strong than those reported. Finally, our analysis was limited by the variables that were included in the ECHO study questionnaire. As ECHO was primarily a study focused on communication, not behavior change, some data that may have been pertinent to patient activation were not collected. This might have included diet and exercise behavior, smoking patterns, and more specific and objective socioeconomic data. The ECHO study did not collect data on patient sexual orientation; based on past research, it is likely that the gay male subset of the population have high activation levels relative to the general population. Further, we did not include any measures related to the care network (the first box in our hypothesized model) in our analysis; we suspect these factors also influence patient activation, as well influencing patient characteristics, and should be studied further.

Future Directions

The population of those with HIV in the US is substantially different from the populations of those with other chronic diseases in which the PAM has been applied. This study has added some insights into characteristics associated with patient activation in a population infected with HIV; however, there are many areas that need further exploration. These include the behavioral patterns of activated patients, additional

characteristics associated with activation, and the mechanisms by which patient activation may affect clinical outcomes.

Another critical area for future research involves interventions to improve patient activation in this population. What types of intervention will be most effective; are they the same interventions found to be effective in other chronic diseases? How can these interventions be tailored to the activation level of the individual patient? How long do interventions need to last, what type of follow-up will be most effective, and do the effects of interventions last? All of these questions will help further our understanding of the role of patient activation in a population with HIV, and the answers may provide important guidelines for how to improve clinical outcomes in this population.

V. Summary and Conclusions

Our research found that in an HIV-infected population, patient activation is associated with the patient characteristics of educational level, self-perceived social status, current problematic alcohol use, and depression. Patient activation is also significantly associated with CD4 count and patient adherence; it is associated with viral suppression, but this association goes away when controlling for adherence, suggesting that adherence may be in the causal pathway between patient activation and viral suppression.

Patient activation has been posited to be a critical pillar of the Chronic Care Model. In addition to its theoretical importance, it has been found to be significantly associated with improved self-management behaviors, which are associated with improved outcomes in chronic disease. Further, an individual's patient activation level has been shown to be modifiable.

The PAM provides an easy and quick way to measure an individual's level of activation. Thus, it can be used for baseline assessments of patients; this data can provide information on what type of intervention may be most appropriate for individual patients. The PAM can also be used to assess the effectiveness of these interventions and to gauge whether other efforts are warranted.

The concept of patient activation—specifically, the PAM—had not been applied to an HIV-infected population prior to this analysis. Our findings suggest that patient activation is a useful concept and that the PAM is a useful tool in this population.

Perhaps even more than in other chronic diseases, patient self-management—particularly adherence—is dramatically linked to outcomes in HIV disease. However, adherence is difficult both for patients to achieve and for clinicians to assess. Our research suggests that patient activation is associated with adherence, in addition to the potential outcome measure of CD4 counts. Therefore, the PAM represents a useful tool for clinicians in quickly identifying which patients need additional support in adhering to HAART. Further, the PAM can be used to tailor interventions to these patients and to gauge these interventions' effectiveness. Our research suggests that patients with lower educational levels, low socioeconomic status, substance abuse problems and depression are particularly vulnerable. This suggests that patients with these characteristics should be screened for; it also suggests that these may be particularly effective areas for targeted interventions.

Despite the limitations of this research, we believe that it preliminarily supports the use of the PAM in an HIV-infected population, and suggests important areas for further research.

References

Adler, N. E., E. Epel, G. Castellazzo, J. Ickovics, J. *Relationship of subjective and objective social status with psychological and physical health: Preliminary data in healthy white women.* Health Psychology 2000: 19, 585–591.

American Public Health Association. *Adherence to HIV Treatment Regimens*. Recommendations for Best Practices 2004. Accessed online at http://www.apha.org/programs/resources/HIV++AIDS/reshivregimens.htm

Ammassari A., Trotta MP, Murri R, Castelli F, Narciso P, et al. (2002) *Correlates and predictors of adherence to highly active antiretroviral therapy: overview of published literature*. J Acquir Immune Defic Syndr 31: Suppl 3S123–S127.

Angelino, AF, Treisman, GJ. *Management of psychiatric disorders in patients infected with human immunodeficiency virus*. Clin Infect Dis 2001:33,847.

Arnsten J.H., P.A. Demas, R.W. Grant, et al. *Impact of active drug use on antiretroviral therapy adherence and viral suppression in HIV-infected drug users.* J Gen Intern Med 2002:17,377–81.

Bakken, S., W. Holzemer, M.Brown, G. Powell-Cope, J. Turner, J. Inouye, K. Nokes, I. Corless. *Relationships between Perception of Engagement with Health Care Provider and Demographic Characteristics, Health Status, and Adherence to Therapeutic Regimen in Persons with HIV/AIDS.* AIDS Patient Care and STDs:2000, 14 (4), 189-197.

Bandura A. *Self-efficacy: The Exercise of Control*. New York, NY: WH Freeman Co; 1997.

Beach, M.C., R. Moore. The Enhancing Communication and HIV Outcomes (ECHO) Study Protocol, 2006. Unpublished document.

Bodenheimer, T., K. Lorig, H. Holman, and K. Grumbach. *Patient Self-management of Chronic Disease in Primary Care.* JAMA 2002: 288 (19), 2469-75.

Bodenheimer T, Wagner EH, Grumbach K. *Improving primary care for patients with chronic illness.* JAMA 2002;288,1775-1779.

Bodenheimer T, Wagner EH, Grumbach K. *Improving primary care for patients with chronic illness: the chronic care model, part 2*. JAMA 2002: 288, 1909-1914.

Bond, T., and C. Fox. 2001. *Applying the Rasch Model: Fundamental Measurement in the Human Sciences.* Mahwah, NJ: Erlbaum.

Centers for Disease Control, "HIV/AIDS among Women," August 2008: http://www.cdc.gov/hiv/topics/women/resources/factsheets/women.htm

Centers for Disease Control, "Chronic Disease Prevention and Health Promotion," 2008: http://www.cdc.gov/NCCdphp/overview.htm

Chalmers J, Capewell S. *Deprivation, disease, and death in Scotland: graphical display of survival of a cohort*. BMJ 2001: 323, 967-968.

Chander, G., B. Lau, R.D. Moore. *Hazardous Alcohol Use: A Risk Factor for Non-Adherence and Lack of Suppression in HIV Infection.* J Acquir Immune Defic Syndr. 2006: 43(4), 411-417.

Chen Y, Tang M, Krewski D. *Relationship between asthma prevalence and income among Canadians. JAMA* 2001: 286, 919-920

Chesney, MA. *New antiviral therapies: Adherence challenges and strategies.* Clinical Care Options for HIV Treatment 1997. Available online: www.healthcg.com/hiv/treatment/icacac97/adherence

Chesney MA, JR Ickovics , DB Chambers, AL Gifford, J Neidig, B Zwickl, AW Wu. *Self-reported adherence to antiretroviral medications among participants in HIV clinical trials: the AACTG adherence instruments.* Patient Care Committee & Adherence Working Group of the Outcomes Committee of the Adult AIDS Clinical Trials Group (AACTG). AIDS Care 2000: 12(3), 255-66.

Chesney MA. *Factors affecting adherence to antiretroviral therapy.* Clin Infect Dis. 2000;30(suppl 2):S171-S176.

Davis TC, Crouch MA, Long SW, et al. Rapid assessment of literacy levels of adult primary care patients. Fam Med 1991: 23,433–35

Eldred LJ, AW Wu, RE Chaisson, RD Moore. *Adherence to antiretroviral and pneumocystis prophylaxis in HIV disease*. J Acquir Immune Defic Syndr Hum Retrovirol 1998: 18,117–25.

Farmer KC. Methods for measuring and monitoring medication regimen adherence in clinical trials and clinical practice. Clin Ther 1999: 21(6),1074–1090

Florence, E., J. Lundgren, C. Dreezen, M. Fisher, O. Kirk, A. Blaxhult, G. Panos, C. Katlama, S. Vella, A. Phillips for the EuroSIDA Study Group. *Factors associated with a reduced CD4 lymphocyte count response to HAART despite full viral suppression in the EuroSIDA study.* HIV Medicine 2003: 4, 255–262

Gifford AL, Bormann JE, Shively MJ, Lee M, Capparelli EV, Richman DD & Bozzette SA *Effects of Group HIV Patient Education on Adherence to Antiretrovirals: A Randomized Controlled Trial.* Paper presented at the 8th Conference on Retroviruses and Opportunistic Infections, Chicago IL, 2001.

Gir E, R. Pratt, EH Bunch, WL Holzemer. *Adherence to anti-retroviral therapy: a four country comparison* [abstract 60129]. In: Program and abstracts of the 12th World AIDS Conference. Geneva: Marathon Multimedia, 1998.

Glasgow, R. E., M. Funnell, A. Bonomi, C. Davis, V. Beckham, E. Wagner. *Self-Management Aspects of the Improving Chronic Illness Care Breakthrough Series: Implementation With Diabetes and Heart Failure Teams.* Annals of Behavioral Medicine 2002: 24(2), 80-87.

Greenfield, S., S. Kaplan, J. Ware. *Expanding Patient Involvement in Care: Effects on Patient Outcomes*. Annals of Internal Medicine 1985: 102, 520-538.

Haubrich RH, Little SJ, Currier JS, et al. The value of patient-reported adherence to antiretroviral therapy in predicting virologic and immunologic response. California Collaboration Treatment Group. AIDS 1999: 13, 1099–107.

Herek GM, JP Capitano, KF Widaman. *HIV-related stigma and knowledge in the United States: prevalence and trends, 1991-1999.* Am J Public Health 2002: 92(3), 371-7.

Hibbard, JH, PJ Cunningham. *How engaged are consumers in their health and health care, and why does it matter?* Center for Studying health System Change Research Brief (8): 2008. Can be viewed online at: http://www.hschange.com/CONTENT/1019/1019.pdf

Hibbard, J., J. Stockard, E. R. Mahoney, and M. Tusler. *Development of the Patient Activation Measure (PAM): Conceptualizing and Measuring Activation in Patients and Consumers.* Health Services Research Aug. 2004: 39 (4 pt 1). Can be viewed online at: http://www.pubmedcentral.nih.gov/tocrender.fcgi?iid=127005

Hibbard JH. Mahoney ER. Stockard J. Tusler M. *Development and testing of a short form of the patient activation measure.* Health Services Research 2005: 40(6 Pt 1),1918-30.

Hibbard JH, Mahoney ER, Stock R, Tusler M. *Do increases in patient activation result in improved self-management behaviors?* Health Services Research 2007.

HRSA Care Action, *Self-Management and the Chronic Care Model"* March 2007. Can be viewed online at: http://hab.hrsa.gov/publications/march2006/

Johnson, M., M. Chesney, R. Goldstein, R. Remien, S. Catz, C. Gore-Felton, E. Charleboid, S. Morin, the NIMH Healthy Living Project Team. *Positive Provider Interactions, Adherence Self-Efficacy, and Adherence to Antiretroviral Medications Among HIV-Infected Adults: A Mediation Model.* AIDS Patient Care and STDs: 2006, 20 (4) 258-268.

Khouzam HR, Donnelly NJ, Ibrahim NF. Psychiatric morbidity in HIV patients. Can J Psychiatry 1998: 43, 51–56.

Lorig, K., D. Sobel, A. Stewart, B. Brown, A. Bandura, P Ritter, V. Gonzalez, D. Laurent, H. Holman. *Evidence Sgesting That a Chronic Disease Self-Management Program Can Improve Health Status While Reducing Hospitalization: A Randomized Trial.* Med Care 1999: 37 (1),5-14.

Lucas G.M., L.W. Cheever, R.E. Chaisson, et al. *Detrimental effects of continued illicit drug use on the treatment of HIV-1 infection.* J Acquir Immune Defic Syndr 2001: 27,251–9.

McLellan, A.T., J.S. Cacciola, D. Zanis. *The Addiction Severity Index-"Lite" (ASI-"Lite"*), Center for the Studies of Addiction, University of Pennsylvania/Philadelphia VA Medical Center, 1997.

Morgan D, Mahe C, Mayanja B, Okongo JM, Lubega R, Whitworth JA. *HIV-1 infection in rural Africa: is there a difference in median time to AIDS and survival compared with that in industrialized countries?* AIDS 2002: 16 (4), 597–632.

Mosen DM. J. Schmittdiel, J. Hibbard, D. Sobel, C. Remmers, J. Bellows. *Is patient activation associated with outcomes of care for adults with chronic conditions?* Journal of Ambulatory Care Management 2007: 30(1),21-9.

Muma, RD., MW Ross, G. Parcel, P. Pollard. *Zidovudine adherence among individuals with HIV infection.* AIDS Care 1995: 7, 439-447.

Osmond, Dennis H. *Epidemiology of HIV/AIDS in the United States.* HIV InSite Knowledge Base Chapter: March 2003. Accessed 11/28 at http://hivinsite.ucsf.edu/InSite?page=kb-01-03#S1.5X

Ostrove, JM, NE Adler, M.Kuppermann, AE Washington. *Objective and subjective assessments of socioeconomic status and their relationship to self-rated health in an ethnically diverse sample of pregnant women.* Health Psychology 2000: 19(6), 613-618.

Otto-Salaj, L.L. and L.Y. Stevenson. *Influence of psychiatric diagnoses and symptoms on HIV risk behavior in adults with serious mental illness*. AIDS Read, 200: 11(4),197-208.

Oxman, A.. M. Thomson, D. Davis, B. Haynes. *No Magic Bullets: A Systematic Review of 102 Trials of Interventions to Improve Professional Practice.* CMAJ 1995: 153 (10), 1423-1431.

Paterson D, Swindells S, Mohr J, et al. *Adherence to protease inhibitor therapy and outcomes in patients with HIV infections.* Ann Intern Med 2000; 133:21-30.

Radloff LS. *The CES-D scale: A self-report depression scale for research in the general population*. Applied Psychological Measurement, 1, 1977: 385-401.

Rodriguez-Rosado R, Jimenez-Nacher I, Soriano V, Anton P, Gonzalez-Lahoz J. Virological failure and adherence to antiretroviral therapy in HIV-infected patients. AIDS 1998: 12,1112–3.

Roter, D., M. Stewart, S. Putnam, M. Lipkin, W. Stiles, T. Inui. *Communication Patterns of Primary Care Physicians.* JAMA 1997: 277(4), 350-356.

Rueda S, Park-Wyllie LY, Bayoumi AM, Tynan AM, Antoniou TA, Rourke SB, Glazier RH. *Patient support and education for promoting adherence to highly active antiretroviral therapy for HIV/AIDS.* Cochrane Database of Systematic Reviews 2006, Issue 3.

Samet, JH, H. Libman, K.A. Steger, R.K. Dhawan, J. Chen, A.H. Shevitz, R. Dewees-Dunk, S. Levenson, D. Kufe, D.E. Craven. *Adherence with zidovudine therapy in patients infected with human immunodeficiency virus, type1: a cross-sectional study in a municipal hospital clinic.* American Journal of Medicine 1992: 92(5), 495-502.

Schackman B.R., K.A. Gebo, R.P. Walensky, E. Losina, T. Muccio, P.E. Sax, M.C. Weinstein, G.R. Seage, R.D. Moore, K.A. Freedberg. The Lifetime Cost of Current Human Immunodeficiency Virus Care in the United States. Medical Care 2006: 44(11),990-997.

Siegel, K., H.Lekas. *AIDS as a chronic illness: psychosocial implications.* AIDS 2002: 16(suppl4),S69-S76.

Stewart AL, Napoles-Springer A. Perez-Stable EJ. *Interpersonal Processes of Care in Diverse Populations.* Milbank Quarterly 1999: 77(3),305-309.

Stone VE, Clarke J, Lovell J, et al. HIV/AIDS patients' perspectives on adhering to regimens containing protease inhibitors. J Gen Intern Med 1998: 13,586–93.

Treisman, G.J., A.F. Angelino, and H.E. Hutton, *Psychiatric issues in the management of patients with HIV infection.* JAMA 2001: 286(22), 2857-64.

US Center for Disease Control. *Cases of HIV Infection and AIDS in the United States, 2004.* http://www.cdc.gov/hiv/topics/surveillance/resources/reports/2004report/commentary.htm

Van Korff, M., J. Gruman, J. Schaefer S.J. Curry, and E. H. Wagner. *Collaborative Management of Chronic Illness.* Annals of Internal Medicine 1997: 127 (12), 1097-102.

Van Servellen, G, Chang, B, Garcia, L, Lombardi, E. *Individual and system level factors associated with treatment nonadherence in human immunodeficiency virus-infected men and women.* AIDS Patient Care STDS 2002: 16, 269.

Wagner, EH. "Chronic Disease Management: *What Will It Take To Improve Care for Chronic Illness?* Effective Clinical Practice 1998: 1, 2-4.

Walensky, B. *The Survival Benefits of AIDS Treatment in the United States*. J Infectious Disease 2006: 194(1):11-19

Wallston, K. A., M. J. Stein, and C. A. Smith. *Form C of the MHLC Scales: A Condition-Specific Measure of Locus of Control.* Journal of Personality Assessment 1994:63 (3), 534–53.

Williams DR. *Race, socioeconomic status, and health. The added effects of racism and discrimination.* Ann N Y Acad Sci 1999:896, 173-18

Yeni P, Hammer S, Carpenter C, et al. *Antiretroviral treatment for adult HIV infection in 2002: updated recommendations of the International AIDS Society*-USA Panel. JAMA 2002: 288,222-35.

Zimmerman, G.L., C.G. Olsen, M.F. Bosworth. *A 'stages of change' approach to helping patients change behavior.* Am Fam Physician. 2000 Mar 1;61(5):1409-16.

Appendix 1: Short Form of the Patient Activation Measure

For each of these statements, please tell me whether you: strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, or not applicable.		Strongly agree	Agree	Disagree	Strongly disagree	Not applicable
1	When all is said and done, I am the person who is responsible for managing my health condition(s).	1	2	3	4	5
2	Taking an active role in my own health care is the most important factor in determining my health and ability to function.	1	2	3	4	5
3	I am confident that I can take actions that will help prevent or minimize some symptoms or problems associated with my health condition(s).	1	2	3	4	5
4	I know what each of my prescribed medications does.	1	2	3	4	5
5	I am confident that I can tell when I need to go get medical care and when I can handle a health problem myself.	1	2	3	4	5
6	I am confident I can tell a doctor the concerns I have even when he or she does not ask.	1	2	3	4	5
7	I am confident that I can follow through on medical treatments I need to do at home.	1	2	3	4	5
8	I understand the nature and causes of my health condition(s).	1	2	3	4	5
9	I know the different medical treatment options available for my health condition(s).	1	2	3	4	5
10	I have been able to maintain the lifestyle changes for my health condition(s) that I have made.	1	2	3	4	5
11	I know how to prevent further problems with my health condition(s).	1	2	3	4	5
12	I am confident I can figure out solutions when new situations or problems arise with my health condition(s).	1	2	3	4	5
13	I am confident that I can maintain lifestyle changes, like diet and exercise, even during times of stress.	1	2	3	4	5

Table 1: Descriptive Statistics of Patient Characteristics

Patient Characteristic	**Mean (std), Median (range)**	**Frequency (%) N=435**
Age in years	45.37 (9.44), 45 (20-77)	-----
Race		
White	-----	106 (24.42)
Black	-----	254 (58.53)
Latino	-----	62 (14.29)
Other	-----	12 (2.76)
Gender		
Male	-----	286 (66.05)
Female	-----	147 (33.95)
Education (high school degree)		
Yes	-----	314 (72.35)
No	-----	120 (27.65)
Literacy (high school level)		
Yes	-----	299 (68.89)
No	-----	135 (31.11)
Self-perceived social status on scale from 1-10	4.51 (2.00), 4 (1-10)	-----
Problematic alcohol use		
Current	-----	39 (9.18)
Former	-----	210 (49.41)
Never	-----	176 (41.46)
Illicit drug use		
Current	-----	122 (28.31)
Former	-----	206 (47.80)
Never	-----	103 (23.90)
Depression on scale from 1-4	2.11 (0.64), 2.10 (1-4)	-----
Length of time with provider		
Less than or equal to five years	-----	288 (66.67)
Greater than five years	-----	144 (33.33)
On HAART		
Yes	-----	334 (78.59)
No	-----	91 (21.41)
Adherent (patients on HAART)		
Yes	-----	275 (82.34)
No	-----	59 (17.66)
CD4 (cells/mL^3)	537.73 (866.93), 417 (4-2500)	-----
Viral load <400		
Yes	-----	241 (57.52)
No	-----	178 (42.48)
Patient activation on scale from 1-100	72.28 (16.51), 70.80 (34.70-100)	-----
Patient activation by stage:		
Stage 1	-----	22 (5.07)
Stage 2	-----	34 (7.83)
Stage 3	-----	120 (27.65)
Stage 4	-----	258 (59.45)

Table 2: Univariate and Multivariate Associations with Patient Activation

Patient Characteristic	Univariate* Associations		Multivariate** Associations	
	β-coefficient (std err)	P-value	β-coefficient (std err)	P-value
Age	-0.057 (.085)	.502	---	---
Race:				
White	Ref		Ref	
Black	1.468 (1.947)	.451	2.386 (1.909)	.211
Latino	0.839 (2.701)	.756	2.543 (2.630)	.334
Other	-5.306 (4.981)	.287	-5.339 (4.735)	.260
Male gender	-1.786 (1.674)	.286	-2.578 (1.667)	.122
Education (high school degree, yes or no)	5.979 (1.725)	.001	6.749 (1.748)	.000
Literacy (high school, yes or no)	3.394 (1.680)	.043	---	---
Self-perceived social status	1.582 (.385)	.000	1.004 (.391)	.010
Problematic alcohol use				
Current	Ref	Ref	Ref	Ref
Former	-6.317 (3.046)	.038	-3.786 (3.013)	.209
Never	-6.486 (1.853)	.000	-5.840 (1.831)	.001
Drug use				
Current	Ref	Ref	Ref	Ref
Former	-4.418 (2.220)	.047	-1.034 (2.193)	.637
Never	-2.557 (1.995)	.200	-0.271 (1.962)	.890
Depression	-5.947 (1.191)	.000	-4.604 (1.263)	.000
Length of time with provider > 4 years	-1.626 (1.679)	0.333	---	---

*Univariate associations adjusted for provider and site

**Multivariate model adjusted for race, gender, education, social status, alcohol abuse, illicit drug use, depression, provider, and site

Table 3: Multivariate Associations between Patient Characteristics and Clinical Outcomes *

Patient characteristic	CD4 > 200 cells/ mL^3 OR (95% CI)	Adherence† OR (95% CI)	Viral suppression OR (95% CI)
Age	1.017 (0.988 – 1.046)	1.03 (1.002 – 1.066)	1.020 (0.995 – 1.046)
Race:			
White	Ref	Ref	Ref
Black	0.760 (0.387 – 1.492)	0.444 (0.193 – 1.022)	0.693 (0.377 – 1.272)
Latino	0.605 (0.461 – 1.222)	0.522 (0.170 – 1.597)	0.837 (0.374 – 1.873)
Other	1.534 (0.171 – 13.753)	0.061 (0.012 – 0.310)	1.448 (0.276 – 7.615)
Male gender	1.042 (0.606 – 1.792)	1.794 (0.999 – 3.224)	0.842 (0.503 – 1.409)
Education (high school degree, y/n)	0.914 (0.499 – 1.676)	1.597 (0.863 – 2.953)	0.944 (0.553 – 1.612)
Literacy (high school, y/n)	1.136 (0.649 – 1.988)	1.072 (0.581 – 1.977)	1.193 (0.722 – 1.971)
Self-perceived social status	1.212 (1.054 – 1.393)	1.038 (0.898 – 1.200)	0.998 (0.885 – 1.126)
Problematic alcohol use			
Current	Ref	Ref	Ref
Former	0.571 (0.225 – 1.446)	0.545 (0.208 – 1.425)	1.190 (0.485 – 2.916)
Never	1.063 (0.567 – 1.993)	1.480 (0.732 – 2.993)	1.079 (0.619 – 1.882)
Illicit drug use			
Current	Ref	Ref	Ref
Former	0.536 (0.245 – 1.171)	0.331 (0.130 – 0.842)	0.359 (0.177 – 0.729)
Never	0.839 (0.415 – 1.696)	0.424 (0.180 – 1.000)	0.619 (0.325 – 1.181)
Depression.	0.723 (0.478 – 1.095)	0.637 (0.406 – 1.000)	0.968 (0.665 – 1.409)
Length of time with provider > 4 years	1.093 (0.657 – 1.820)	0.721 (0.409 – 1.268)	1.041 0.624 – 1.737)

* Adjusted for location and provider

† Defined as "no missed doses of antiretroviral medications for 3 days"

Table 4: Adjusted OR of PAM for Clinical Outcomes among Patients on ART* (n = 334)

Patient activation	**CD4 > 200 cells/mL^{3}OR (95% CI)**	**Adherence† OR (95% CI)**	**Viral suppression OR (95% CI)**	**Viral suppression OR adjusted for adherence (95% CI)**
PAM score	1.019 (1.000 – 1.037)	1.028 (1.007 – 1.049)	1.016 (1.000 – 1.032)	1.014 (0.998 – 1.031)

*Adjusted for gender, age, race, education, literacy, self-perceived social status on national level, alcohol abuse, illicit drug use, depression, location, and provider

†Defined as "no missed doses of antiretroviral medications for 3 days"