Patient Activation and Improved Outcomes in HIV-Infected Patients

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BACKGROUND: The Patient Activation Measure (PAM) assesses several important concepts in chronic care management, including self-efficacy for positive health behaviors. In HIV-infected populations, better self-efficacy for medication management is associated with improved adherence to antiretroviral medications (ARVs), which is critically important for controlling symptoms and slowing disease progression.

OBJECTIVE: To determine 1) characteristics associated with patient activation and 2) associations between patient activation and outcomes in HIV-infected patients.

DESIGN: Cross-sectional survey.

PARTICIPANTS: 433 patients receiving care in four HIV clinics.

METHODS: An interviewer conducted face-to-face interviews with patients following their HIV clinic visit. Survey data were supplemented with medical record abstraction to obtain most recent CD4 counts, HIV viral load and antiretroviral medications.

MAIN MEASURES: Patient activation was measured using the 13-item PAM (possible range 0–100). Outcomes included CD4 cell count>200 cells/mL^3, HIV-1 RNA<400 copies/mL (viral suppression), and patient-reported adherence.

KEY RESULTS: Overall, patient activation was high (mean PAM=72.3 [SD 16.5, range 34.7–100]). Activation was lower among those without vs. with a high school degree (68.0 vs. 74.0, $p<.001$), and greater depression (77.6 lowest, 70.2 middle, 68.1 highest tertile, $p<.001$). There was no association between patient activation and age, race, gender, problematic alcohol use, illicit drug use, or social status. In multivariable models, every 5-point increase in PAM was associated with greater odds of CD4 count>200 cells/mL^3 (aOR 1.10 [95 % CI 1.01, 1.21]), adherence (aOR 1.18 [95 % CI 1.09, 1.29]) and viral suppression (aOR 1.08 [95 % CI 1.00, 1.17]). The association between PAM and viral suppression was mediated through adherence.

CONCULSIONS: Higher patient activation was associated with more favorable HIV outcomes. Interventions to improve patient activation should be developed and tested for their ability to improve HIV outcomes.

Received July 7, 2012
Revised November 12, 2012
Accepted December 6, 2012
Published online January 4, 2013

KEY WORDS: patient activation; HIV; self-efficacy; medication adherence; patient outcomes.
J Gen Intern Med 28(5):668–74
DOI: 10.1007/s11606-012-2307-y

INTRODUCTION

The Chronic Care Model posits that an activated patient is critical to achieving optimal health outcomes.[1] Patient activation has been defined as the knowledge, skill, and confidence an individual has in managing his or her disease.[2] Hibbard et al. have developed an empirically derived measure of patient activation, the Patient Activation Measure (PAM), that assesses several important concepts in chronic care management, including self-efficacy in healthy behaviors (e.g. regular exercise), health locus of control, and readiness to change.[2] Patient activation occurs on a continuum, progressing through four stages. A patient's stage of activation can be identified by their PAM score; each stage corresponds to a range of knowledge levels and health-related behaviors.[2] Patient activation can change;[3] moreover, evidence indicates that targeted behavior-change interventions can increase activation levels[4] and may improve health behaviors and outcomes for patients with chronic illness.[3,5,6]

Increasingly effective antiretroviral regimens have prolonged the life expectancy of HIV-infected patients,[7] transforming the HIV epidemic into one requiring chronic care.[8] As survival continues to improve, clinicians and patients must optimize patients' ability to manage their illness over many years.

A key behavior predicted by patient activation is chronic illness self-management.[2] In HIV-infected populations, better self-management of HIV symptoms and medication side effects is associated with improved adherence to antiretroviral medications (ARVs).[9] Medication adherence is critically important for HIV-infected individuals;[10] however, adherence rates have been shown to range from 42 % to 80 %.[11–13] Improving self-management of HIV symptoms and treatment side effects is also associated with less severe HIV symptoms,[9] increased self-efficacy for controlling symptoms,[9] and increases in CD4 count.[14] Although patient activation has been studied in patients with other chronic illnesses, it has not yet been studied in HIV-infected populations. Improving understanding of the role of patient activation in HIV self-management and outcomes may elucidate mechanisms by which to improve the quality of care for HIV-infected patients.

The objective of this study was to identify characteristics associated with patient activation, and to examine whether patient activation is associated with medication adherence and clinical outcomes in an HIV-infected population.

METHODS

Research Design and Setting

The Enhancing Communication and HIV Outcomes (ECHO) study is a cross-sectional, observational study that assessed 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.[15] The study received Institutional Review Board approval from each site.

Participants

Eligible providers were physicians, nurse practitioners, or physician assistants who provided primary care to HIV-infected patients. All HIV providers practicing at each site were invited to participate, and completed informed consent. Patients were eligible for inclusion if they were HIV-infected, had seen the provider at least once, were over 18 years of age, and spoke English. Research assistants selected potential participants from the providers' scheduled patients to minimize selection bias. Successive patients were approached on the days when a research assistant was present in clinic. Patients were recruited and gave informed consent as they waited for their clinic appointment, with the goal of enrolling a convenience sample of ten patients per provider.

Study Procedures

A trained interviewer conducted face-to-face interviews with patients following their clinic visit, from 2007 to 2008. 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

Patient activation was measured using the 13-item Patient Activation Measure (PAM).[16] Response categories for each item are strongly agree, agree, disagree and strongly disagree. Responses are then scaled and transformed to a score ranging from 0 to 100.[16] The PAM measures an individual's activation level; it has been found to predict self-efficacy for healthy behaviors and positive self-management behaviors, such as regular exercise, for other chronic conditions.[2,16–19] PAM scores have been correlated with four stages of activation.[2,6,16] Stage One (scores < 47): people do not believe they can take an active role in their care. Stage Two (scores 47.1–55.1): people lack knowledge and confidence to take action. Stage Three (scores 55.2–67): people are beginning to take action, but lack confidence or support for change. Stage Four (scores > 67.1): people have adopted new behaviors but may not be able to maintain them in stress or health crises.[2,6] The alpha coefficient for the 13 PAM items in the current study was 0.907.

Independent variables were measured as follows: age; race (white, African American, Latino, 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 Addiction Severity Index Lite.[20] We measured self-reported social status using a validated visual analog scale, where participants mark their perceived social position on a ten-rung "ladder", with the bottom rung being one and the top rung being ten.[21,22] Depressive symptoms were assessed using the 10-item Center for Epidemiologic Studies Depression Scale (CES-D).[23] Length of time with provider was categorized as less than or equal to 5 years or greater than 5 years.

Self-reported antiretroviral adherence was assessed by asking, "(In the last 30 days…) about what percentage of the time would you say you take your anti-HIV medications as prescribed (0, 10, 20…100 %)," and dichotomized as 100 % vs. < 100 %, due to skewed distribution of responses and the clinical importance of 100 % vs. lesser adherence in precipitating antiretroviral resistance.[24] Clinical outcome variables included CD4 cell count>200 cells/mL^3 and HIV-1 RNA<400 copies/mL (viral suppression) abstracted from medical records.

Analysis

We tested associations between patient characteristics and patient activation using univariate and multivariable linear regression. For all models, we included study site as a covariate and adjusted for clustering by provider using population averaged generalized estimating equations. Independent variables were selected for inclusion in the final multivariable model based on a priori hypotheses, prior literature, and statistical associations ($p<.20$) in univariate analyses. We further assessed the contribution of independent variables to the model using likelihood ratio testing and Hosmer-Lemeshow tests for goodness of fit.

We tested associations between patient activation and HIV outcomes (CD4 cell count>200 cells/mL^3, viral suppression, and antiretroviral adherence) using univariate and multivariable logistic regression among participants taking antiretrovirals. We hypothesized that any observed associations between patient activation and viral suppression would be mediated through adherence; so, using the approached recommended by Baron and Kenny,[25] we first constructed a model of adherence, then constructed a model of viral suppression without accounting for adherence (Model A), and added adherence as a covariate to a second model of viral suppression (Model B). We used Sobel's test, to test whether the association between patient activation and viral suppression was consistent with mediation by adherence.[26,27] We assessed associations between a 5-point change in patient activation and outcomes, since persons who engage in healthy behaviors (e.g. regular exercise) have four to five point higher average PAM scores than those not engaged in healthy behaviors.[28] All analyses were conducted with STATA/IC Version 11.1, College Station, TX.

RESULTS

Of 55 eligible providers, 45 (81.8 %) agreed to participate. Two providers declined. The remainder of providers who were not enrolled were not pursued because we reached enrollment targets. Providers had a mean patient panel size of 123 patients, and we enrolled a mean of ten patients per provider. We identified 617 eligible patients. Providers refused to allow 18 patients to be approached for the study, because the provider felt too rushed ($n=12$), or that the patient may be too sick ($n=5$), or the patient was only returning for labs rather than a complete visit ($n=1$). Of the remaining 599 patients approached, 434 agreed to participate and completed all study procedures. Of 165 patients who declined to enroll in the study, the most common reasons were that they didn't have time to complete the interview ($n=106$), that they weren't feeling well ($n=22$), and that they weren't interested in research studies ($n=13$). One participant who did not complete the PAM was excluded from the current analysis, yielding a final analytic sample of 433 patients (72.3 % of those approached).

Table 1 describes participant characteristics. The majority of patients were male (66.0 %), had completed high school (72.3 %),were prescribed antiretrovirals (78.5 %), and were African American (58.7 %). Patients reported a mean age of 45.4 years (SD 9.5), mean Center for Epidemiological Studies Depression scale (CESD) score of 10.9 (SD 6.4), and ranked themselves near the middle of the social ladder mean social status 4.50 (SD 2.0). Substance abuse was common, with 28.1 % reporting current illicit drug use and 9.2 % current problematic alcohol use.

The mean PAM score was 72.3 (SD 16.5, range 34.7–100), and 59.6 % of subjects had a PAM score greater than or equal to 67.1, the threshold used in prior studies to identify patients with the highest stage of patient activation.[6,16,29] In analyses adjusted only for study site and clustering by provider, PAM scores were associated with education having a high school degree or greater compared to less than a high school degree (74.0 for≥high school degree vs. 68.0 for no high school degree, $p<.001$), perceived social status (70.3 lowest, 74.3 middle, and 74.5 highest tertile, $p=.002$), problematic alcohol use (70.1 for current, 70.0 for former, and 76.0 for never problematic alcohol use, $p=.039$), and depressive symptoms (77.6 for lowest, 70.2 for middle, and 68.1 for highest tertile, $p<.001$) (Table 2). In multivariable analysis, education, former problematic alcohol use, and depressive symptoms remained independently associated with patient activation. For every one-point increase in CESD depression score, the PAM score decreased by a half a point in adjusted analysis ($\beta= -0.52$, 95 % confidence interval (CI) -0.77–0.27 for CESD score as continuous variable).

Of 333 patients prescribed antiretrovirals, 262 (78.9 %) had a CD4 count>200 cells/mL^3, 223 (67.2 %)

Table 1. Patient Characteristics ($n=433$)

Mean age in years (SD)	45.4 (9.5)
Race, n (%)	
White	105 (24.3)
African American	254 (58.7)
Latino	62 (14.3)
Other	12 (2.8)
Male gender, n (%)	285 (66.0)
≥ High school degree, n (%)	313 (72.3)
Mean social status (SD)	4.50 (2.0)
Problematic alcohol use, n (%)	
Current	39 (9.2)
Former	209 (49.3)
Never	176 (41.5)
Illicit drug use, n (%)	
Current	121 (28.1)
Former	206 (47.9)
Never	103 (24.0)
Mean CESD Score (SD)	10.9 (6.4)
With provider≥5 years, n (%)	144 (33.4)
Prescribed antiretrovirals, n (%)	333 (78.5)

CESD Center for Epidemiological Studies Depression scale

Table 2. Univariate and Multivariable Associations with Patient Activation (n=433)

	Mean PAM Score (SD)	p -value*	Multivariable β coefficient (95 % CI)†
Age tertile (years)		0.894	
18–42	72.5 (16.3)		–
43–49	72.0 (17.0)		
≥ 50	72.4 (16.4)		
Race:		0.539	
White	71.8 (15.4)		Ref
African American	73.5 (16.6)		2.53 (−1.25, 6.31)
Latino	70.0 (18.0)		4.05 (−1.24, 9.34)
Other	64.7 (13.3)		−5.50 (−14.9, 3.86)
Gender		0.294	
Female	73.8 (15.8)		Ref
Male	71.6 (16.5)		−2.88 (−6.20, 0.45)
High school degree		< 0.001	
No	68.0 (15.9)		Ref
Yes	74.0 (16.5)		6.84 (3.37, 10.3)
Social status tertile		0.039	
Lowest	70.3 (15.8)		Ref
Middle	74.3 (17.1)		2.42 (−1.84, 6.67)
Highest	74.5 (16.9)		1.52 (−2.01, 4.97)
Problematic alcohol use		0.002	
Never	76.0 (15.7)		Ref
Former	70.0 (16.6)		−5.87 (−9.52,−2.23)
Current	70.1 (17.8)		−3.71 (−9.69, 2.26)
Illicit drug use		0.151	
Never	75.1 (15.9)		Ref
Former	72.4 (16.8)		−0.22 (−4.16, 3.68)
Current	70.1 (16.3)		−0.74 (−5.16, 3.68)
Depression tertile		< 0.001	
Lowest	77.6 (16.9)		Ref
Middle	70.2 (15.7)		−5.56 (−9.33,−1.79)
Highest	68.1 (15.1)		−8.26 (−12.1,−4.44)
Time with provider		0.322	
< 5 years	72.7 (16.5)		–
≥ 5 years	71.8 (16.5)		
Prescribed antiretrovirals		0.107	
No	69.9 (15.4)		Ref
Yes	72.9 (16.8)		1.41 (−2.28, 5.09)

**p-values adjusted for site and clustering by provider*
†Multivariable model adjusted for variables in column and also site and clustering by provider

had an HIV-1 RNA<400 copies/mL, and 196 (50.9 %) reported taking about 100 % of antiretroviral doses in the past 30 days. Table 3 reports multivariable associations between patient activation and these clinical outcomes. Every five-point increase in PAM score was associated with a 10 % increase in the odds of having a CD4 count greater than 200 cells/mL (aOR 1.10 [95 % CI 1.01, 1.21]), an 18 % increase in the odds of adherence (aOR 1.18 [95 % CI 1.09, 1.29]), and an 8 % increase in the odds of HIV viral suppression (aOR 1.08 [95 % CI 1.00, 1.17]). When adherence was added to the model of HIV viral suppression, the association between patient activation and viral suppression was attenuated (aOR 1.04 [95 % CI 0.96, 1.13], Sobel p-value for mediation=0.028), indicating that the observed association between patient activation and viral suppression was consistent with partial mediation through improved antiretroviral adherence.

Table 3. Associations Between Patient Activation and HIV Clinical Outcomes Among Patients Prescribed Antiretroviral Therapy* (n=411)

	CD4>200 cells/mL^3	Adherence†	Viral suppression Model A	Viral suppression Model B
	aOR (95 % CI)	aOR (95 % CI)	aOR (95 % CI)	aOR (95 % CI)
5-point change in PAM score	1.10 (1.01, 1.21) p=0.032	1.18 (1.09, 1.29) P<0.001	1.08 (1.00, 1.17) p=0.046	1.04 (0.96, 1.13) p=0.309

**All models adjusted for gender, age, race, education, literacy, self-perceived social status, alcohol abuse, illicit drug use, depression, site, and clustering by provider*
†Defined as "takes antiretroviral medications as prescribed about 100 % of time" vs. less than 100 % of time.
Model A: adjusted for above, but not adherence
Model B: adjusted for above, with adherence added to model
aOR = adjusted odds ratio, PAM = patient activation measure score

DISCUSSION

In this study of HIV-infected patients engaged in care, we found that patient activation scores were higher on average than among other chronically-ill populations, and that activation was lower among those without a high school degree and those who were depressed. Most importantly, higher activation was associated with viral suppression, mediated by greater antiretroviral adherence. Our findings suggest that interventions that improve patient activation may improve HIV clinical outcomes, and provide some insight regarding who would most benefit from such interventions.

To our knowledge, this is the first study of patient activation in HIV-infected patients and thus extends evidence about patient activation from other populations living with chronic illness. Mean patient activation scores in this population were more than 10 % higher than those reported in the general U.S. population, where adults responding to a telephone survey reported a mean 13-item PAM score of 61.9, and substantially higher than in prior studies of patients with other chronic illnesses such as diabetes, chronic obstructive pulmonary disease (COPD), and cardiovascular disease where PAM scores ranged from 56.6 to 65.6.[16,18,30,31] Indeed, more than half of study subjects had patient activation scores identified as "Stage 4" patient activation—those who have adopted new behaviors but may not be able to maintain them in the face of life stressors or health crises.[6,30,32] HIV-infected patients who have engaged in care may be more activated than other populations, including those with other chronic diseases and those with HIV outside of care. We hypothesize that this may in part be due to the availability of adherence counseling, case management, and other social support services typically available in U.S. HIV clinics through the

Ryan White Care Act. Importantly, even patients in the fourth stage of patient activation may need ongoing support and targeted interventions, particularly during times of stress, when medication adherence may be less likely. Despite this, important subgroup variations in the level of patient activation, and strong associations between degree of patient activation and HIV outcomes were observed.

Patients with greater educational attainment reported higher levels of activation compared with those without a high school degree, consistent with findings in non-HIV-infected populations.[16,32,33] Patient activation measures a person's knowledge, skill, and confidence in managing their own health—skills likely promoted through advanced education. Low educational attainment, which is likely correlated with lower health literacy, may serve as a clinical marker for HIV-infected persons in need of additional case management or health education interventions to improve HIV symptom and medication self management.[8]

Depressive symptoms were also strongly associated with patient activation. As depressive symptoms increased, patient activation scores decreased dramatically, with a mean difference of ten points between those with the highest vs. lowest CESD scores—a difference in PAM score capable of crossing clinically significant levels of patient activation.[6,30] Depressed patients with other chronic illnesses have lower activation scores and are less responsive to interventions to improve patient activation.[5] The PAM was recently modified for use in mental health conditions, and higher levels of activation were associated with greater recovery from mental health symptoms.[34] Our findings suggest that lower patient activation may mediate previously demonstrated negative associations between depression and adherence.[35,36] This finding is particularly noteworthy, given the high prevalence of depression and other psychiatric disorders among patients with HIV and the critical importance of antiretroviral adherence.[37] While the causal relationship between patient characteristics and patient activation level is likely complex and not unidirectional, these factors may nonetheless be useful targets both for screening high-risk patients and for behavior modification interventions. Furthermore, patient activation interventions in this population are most likely to be successful if they are tailored for patients with low educational level and recognize the impact of depression.

Our findings are also notable for a lack of association between some participant characteristics and patient activation. While some prior research reports variation in patient activation by age, gender, and race/ethnicity,[33] other studies demonstrate mixed results similar to our findings. For example, a recent study conducted at community health centers found an association between patient activation and age, but not race/ethnicity, gender or education,[4] and a 2010 study conducted at three inner-city health centers found that activation differed according to gender and educational level, but not age or race/ethnicity.[32] While PAM scores were significantly lower in the current study among participants with current or former problematic alcohol use compared with those without any problematic alcohol use in unadjusted analysis, these associations were attenuated in multivariable analysis and no associations between illicit drug use were identified. Though no prior studies have investigated these associations, the lack of association between substance use and patient activation was unanticipated. One hypothesis might be that substance use among HIV-infected patients engaged in HIV care (which often includes on-site adherence counseling and addiction treatment services) are a more highly activated group than substance users in other settings. Further research is required to clarify the associations between these patient characteristics and patient activation.

Higher levels of patient activation were associated with CD4 count>200 cells/mL^3, optimal antiretroviral adherence, and HIV-1 RNA viral suppression. While causal inferences are limited in this cross-sectional study, our findings suggest that interventions to improve patient activation may have favorable effects on HIV clinical outcomes. CD4 cell counts are influenced by a range of immune and other factors,[38] and serve as a crude marker of HIV disease severity. Higher CD4 cell counts in activated patients may reflect health behaviors that led to earlier diagnosis and treatment. However, it is also possible that a person's immune status affects their cognitive and behavioral capacities, and therefore their activation level. High CD4 counts are also associated with greater function and quality of life that may facilitate improved HIV symptom and medication self-management. These hypotheses merit further testing in prospective studies.

Antiretroviral adherence, a key self-management skill, is essential for HIV RNA viral suppression.[39] Patients with high levels of activation have improved self-management skills, including better knowledge, confidence, and ability to take medications as prescribed.[5,6] Patient activation, as measured through the PAM, represents a summary indicator that can potentially be used to predict adherence. The magnitude of association between patient activation and adherence and viral suppression in our study approached that reported in a meta-analysis of 19 adherence interventions,[40] suggesting that structured adherence interventions may improve adherence and viral suppression by improving patient activation. The association between patient activation and viral suppression was partly mediated through adherence in the current study, consistent with our hypothesized causal pathway. This finding extends the previous literature on patient activation by demonstrating its association with outcomes may be mediated through self-management behavior of medication adherence. Future prospective studies should further address other potential

mediators of the relationship between patient activation and viral suppression, such as earlier antiretroviral initiation and history of antiretroviral resistance.

Our findings should be interpreted in light of several important limitations. First, the study's cross-sectional design limits causal inference. While we suspect that patient activation influences outcomes through better self-management and adherence, these findings need to be verified in longitudinal studies. Our finding that adherence partially mediated the association between patient activation and viral suppression, however, supports our hypothesized causal pathway. Second, results in our study population of English-speaking patients engaged in care in highly experienced, high volume, urban HIV treatment centers may not be generalizable to non-English speaking HIV-infected patients or those not currently engaged in treatment in similar centers. HIV-infected subjects not engaged in care likely have lower levels of patient activation and represent a more vulnerable population. Inclusion of these patients in future studies may strengthen observed associations between patient activation and HIV outcomes. Third, adherence data was self-reported and subject to recall bias. While self-reported adherence may overestimate adherence compared with electronic adherence monitoring, it remains strongly associated with HIV-1 RNA viral suppression,[41] thus using an alternate measure would be unlikely to change our findings. Finally, the ECHO study did not include other contributors to chronic illness self-management, such as diet, exercise, and smoking behaviors. Inclusion of these in future studies could additionally strengthen the link between patient activation self-management.

This cross-sectional study of patients receiving care for HIV infection suggests that higher levels of patient activation are associated with higher CD4 counts, better adherence, and greater odds of viral suppression. Importantly, the effect of patient activation on viral suppression was mediated through antiretroviral adherence. While patient activation levels for the overall study population exceeded those reported for other chronic illnesses, activation was lower for those with lower educational attainment and higher levels of depression. Our findings inform the development of interventions to increase patient activation in HIV clinics, and suggest such interventions may improve HIV outcomes through improved self management skills such as adherence.

Acknowledgements:
Contributors: *All authors who contributed to the manuscript meet the criteria for authorship.*

Funders: *This research was supported by a contract from the Health Resources Service Administration and the Agency for Healthcare Research and Quality (AHRQ 290-01-0012). Dr. Korthuis' time was supported by the National Institutes of Health, National Institute on Drug Abuse (K23DA019809). Dr. Beach was supported by the Agency for Healthcare Research and Quality (K08 HS013903-05), and both Dr. Beach and Dr. Saha were supported by Robert Wood Johnson Generalist Physician Faculty Scholars Awards. Dr. Saha is supported by the Department of Veterans Affairs. The contents of the publication are solely the responsibility of the authors and do not necessarily represent the views of the funding agencies or the U.S. government.*

Conflict of Interest: *The authors declare that they do not have a conflict of interest.*

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REFERENCES

1. **Wagner EH.** Chronic disease management: what will it take to improve care for chronic illness? Eff Clin Pract. 1998;1(1):2–4.
2. **Hibbard JH, et al.** Development of the Patient Activation Measure (PAM): conceptualizing and measuring activation in patients and consumers. Heal Serv Res. 2004;39(4 Pt 1):1005–1026.
3. **Hibbard JH, Greene J, Tusler M.** Improving the outcomes of disease management by tailoring care to the patient's level of activation. Am J Manag Care. 2009;15(6):353–360.
4. **Deen D, et al.** Asking questions: the effect of a brief intervention in community health centers on patient activation. Patient Educ Couns. 2011;84(2):257–260.
5. **Hibbard JH, et al.** Do increases in patient activation result in improved self-management behaviors? Heal Serv Res. 2007;42(4):1443–1463.
6. **Mosen DM, et al.** Is patient activation associated with outcomes of care for adults with chronic conditions? J Ambul Care Manag. 2007;30(1):21–29.
7. **Schackman BR, et al.** The lifetime cost of current human immunodeficiency virus care in the United States. Med Care. 2006;44(11):990–997.
8. **Gifford AL, Groessl EJ.** Chronic disease self-management and adherence to HIV medications. J Acquir Immune Defic Syndr. 2002;31(Suppl 3):S163–S166.
9. **Gifford AL, et al.** Pilot randomized trial of education to improve self-management skills of men with symptomatic HIV/AIDS. J Acquir Immune Defic Syndr Hum Retrovirol. 1998;18(2):136–144.
10. **Yeni PG, et al.** Antiretroviral treatment for adult HIV infection in 2002: updated recommendations of the International AIDS Society-USA Panel.[see comment][erratum appears in JAMA. 2003 Jan-Feb;11(1):32]. JAMA. 2002;288(2):222–235.
11. **Haubrich RH, et al.** The value of patient-reported adherence to antiretroviral therapy in predicting virologic and immunologic response. California Collaborative Treatment Group. AIDS. 1999;13(9):1099–1107.
12. **Muma RD, et al.** Zidovudine adherence among individuals with HIV infection. AIDS Care. 1995;7(4):439–447.
13. **Rodriguez-Rosado R, et al.** Virological failure and adherence to antiretroviral therapy in HIV-infected patients. AIDS. 1998;12(9):1112–1113.
14. **Ironson G, et al.** The impact of improved self-efficacy on HIV viral load and distress in culturally diverse women living with AIDS: the SMART/EST Women's Project. AIDS Care. 2005;17(2):222–236.
15. **Gebo KA, Moore RD, Fleishman JA.** The HIV Research Network: a unique opportunity for real time clinical utilization analysis in HIV. Hopkins HIV Rep. 2003;15(6):5–6.
16. **Hibbard JH, et al.** Development and testing of a short form of the patient activation measure. Heal Serv Res. 2005;40(6 Pt 1):1918–1930.
17. **Skolasky RL, et al.** Psychometric properties of the patient activation measure among multimorbid older adults. Heal Serv Res. 2011;46(2):457–478.
18. **Skolasky RL, et al.** Psychometric properties of the Patient Activation Measure among individuals presenting for elective lumbar spine surgery. Qual Life Res. 2009;18(10):1357–1366.
19. **Stepleman L, et al.** Validation of the patient activation measure in a multiple sclerosis clinic sample and implications for care. Disabil Rehabil. 2010;32(19):1558–1567.
20. **Cacciola JS, et al.** Initial evidence for the reliability and validity of a "Lite" version of the Addiction Severity Index. Drug Alcohol Depend. 2007;87(2–3):297–302.

21. **Adler NE, et al.** Relationship of subjective and objective social status with psychological and physiological functioning: preliminary data in healthy white women. Heal Psychol. 2000;19(6):586–592.
22. **Ostrove JM, et al.** Objective and subjective assessments of socioeconomic status and their relationship to self-rated health in an ethnically diverse sample of pregnant women. Heal Psychol. 2000;19(6):613–618.
23. **Radloff LS.** The CES-D Scale: A self-report depression scale for research in the general population. Appl Psychol Meas. 1977;1(3):385–401.
24. **Lu M, et al.** Optimal recall period and response task for self-reported HIV medication adherence. AIDS Behav. 2008;12(1):86–94.
25. **Baron RM, Kenny DA.** The moderator-mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations. J Personal Soc Psychol. 1986;51:1173–1182.
26. **MacKinnon DP, Fairchild AJ, Fritz MS.** Mediation analysis. Annu Rev Psychol. 2007;58:593–614.
27. **Sobel ME, ed.** Asymptotic confidence intervals for indirect effects in structural equation models. In: Leinhardt S, ed. Sociological Methodology. Washington, D.C: American Sociological Association; 1982.
28. **Fowles JB, et al.** Measuring self-management of patients' and employees' health: further validation of the Patient Activation Measure (PAM) based on its relation to employee characteristics. Patient Educ Couns. 2009;77(1):116–122.
29. **Donald M, et al.** The role of patient activation in frequent attendance at primary care: a population-based study of people with chronic disease. Patient Educ Couns. 2011;83(2):217–221.
30. **Hibbard JH, et al.** Assessing activation stage and employing a "next steps" approach to supporting patient self-management. J Ambul Care Manag. 2007;30(1):2–8.
31. **Wong ST, Peterson S, Black C.** Patient activation in primary healthcare: a comparison between healthier individuals and those with a chronic illness. Med Care. 2011;49(5):469–479.
32. **Lubetkin EI, Lu WH, Gold MR.** Levels and correlates of patient activation in health center settings: building strategies for improving health outcomes. J Health Care Poor Underserved. 2010;21(3):796–808.
33. **Hibbard JH, et al.** How engaged are consumers in their health and health care, and why does it matter? Res Briefs. 2008;8:1–9.
34. **Green CA, et al.** Development of the Patient Activation Measure for mental health. Adm Policy Ment Health. 2010;37(4):327–333.
35. **Grenard JL, et al.** Depression and medication adherence in the treatment of chronic diseases in the United States: a meta-analysis. J Gen Intern Med. 2011;26(10):1175–1182.
36. **van Servellen G, et al.** Individual and system level factors associated with treatment nonadherence in human immunodeficiency virus-infected men and women. AIDS Patient Care Stds. 2002;16(6):269–281.
37. **Angelino AF, Treisman GJ.** Management of psychiatric disorders in patients infected with human immunodeficiency virus. Clin Infect Dis. 2001;33(6):847–856.
38. **Florence E, et al.** Factors associated with a reduced CD4 lymphocyte count response to HAART despite full viral suppression in the EuroSIDA study. HIV Med. 2003;4(3):255–262.
39. **Gifford AL, et al.** Predictors of self-reported adherence and plasma HIV concentrations in patients on multidrug antiretroviral regimens. J Acquir Immune Defic Syndr. 2000;23(5):386–395.
40. **Simoni JM, et al.** Efficacy of interventions in improving highly active antiretroviral therapy adherence and HIV-1 RNA viral load. A meta-analytic review of randomized controlled trials. J Acquir Immune Defic Syndr. 2006;43(Suppl 1):S23–S35.
41. **Arnsten JH, et al.** Antiretroviral therapy adherence and viral suppression in HIV-infected drug users: comparison of self-report and electronic monitoring. Clin Infect Dis. 2001;33(8):1417–1423.