

Patient Activation Mediates Health Literacy Associated with Hospital Utilization Among Whites

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ABSTRACT

Background: Reducing the 30-day hospital readmission rate is a national priority, and patient activation has emerged as a modifiable target to reduce hospital readmissions. **Objective:** Prior studies demonstrate that low patient activation and low health literacy are each associated with higher rates of hospital utilization. The aim of this study was to use path analysis methods to assess if patient activation mediates the relationship between health literacy and hospital utilization in the 30 days after discharge. **Methods:** We performed a secondary analysis of data from a randomized controlled trial of patients receiving care at an urban safety net hospital. Path analyses were used to assess patient activation as a mediator of the relationship of education and health literacy with 30-day hospital utilization. The final model was stratified by race and ethnicity. **Key Results:** In the overall study sample, a patient activation measure (PAM) score that was one standard deviation (SD) higher was associated with 18% reduced odds of hospital utilization (odds ratio [OR] 0.82; 95% confidence interval [CI] [0.73, 0.91]; $p < .001$). PAM mediated the relationship between education level and health literacy and hospital utilization. When stratified by race, the mediating effect of PAM was evident among Whites, but not among non-Whites. Specifically, a one SD higher PAM score was significantly associated with a 33% reduced odds of utilization among Whites (OR 0.67, 95% CI [0.57, 0.79], $p < .001$). With the inclusion of PAM in the model, there was no direct relationship between either health literacy or education and 30-day hospital utilization. **Conclusions:** Patient activation is only associated with hospital utilization among Whites. Further research is needed to assess if this selective protection is seen in other cohorts. Potential interventions to reduce hospital readmissions may need to consider other modifiable factors in racially and ethnically diverse populations. [*Health Literacy Research and Practice*. 2017;1(3):e128-e135.]

Plain Language Summary: In this study, among White patients, the relationship between health literacy and hospital utilization within 30 days after discharge was due to patient activation. However, for non-White patients, the relationship between health literacy and hospital utilization within 30 days after discharge was not due to patient activation.

Hospital readmissions are common, costly, and have emerged as a fee for performance quality metric under Medicare (Blumenthal, Abrams, & Nuzum, 2015; Jencks, Williams, & Coleman, 2009; Joynt & Jha, 2012). Approximately 18% of Medicare beneficiaries are rehospitalized within 30 days after hospital discharge (Blumenthal et al., 2015). Under the federal Hospital Readmissions Reduction Program, hospitals with 30-day readmission

rates that are significantly higher than the average are subject to reduced Medicare payments for hospital services (Centers for Medicare & Medicaid Services, 2016). Safety net hospitals are particularly vulnerable to these financial penalties because they serve a higher proportion of low-income and ethnic minority populations considered high-risk for readmission (Barnett, Hsu, & McWilliams, 2015; Joynt & Jha, 2012; Joynt, Orav, & Jha, 2011). These financial

penalties may also exacerbate existing racial and socioeconomic health disparities (Joynt et al., 2011; Werner, Goldman, & Dudley, 2008).

Reducing hospital readmissions and health disparities are national priorities, and patient activation has emerged as an important modifiable target for reducing unnecessary hospital readmissions and addressing unequal access to care (Hibbard & Greene, 2013; Smith, Curtis, Wardle, von Wagner, & Wolf, 2013). Activation is a person's knowledge, skills, and confidence in managing his or her health and health care and can be measured using the patient activation measure (PAM) (Hibbard, Stockard, Mahoney, & Tusler, 2004). Higher activation has been associated with a reduced rate of hospitalizations, and activation can be increased through various interventions including self-management training (Hibbard & Greene, 2013).

Health literacy may be related to patient activation (Smith et al., 2013). Health literacy relies on a person's ability to understand health information and make appropriate health decisions, and it is influenced by both patient-level and system-level factors (Paasche-Orlow & Wolf, 2007). Low health literacy is linked to poorer health outcomes and rehospitalizations. Factors that influence health literacy skills include older age, race and ethnicity, socioeconomic status, and education level. These same factors have also been shown to influence patient activation (Gwynn et al., 2016; Paasche-Orlow & Wolf, 2007). The knowledge and skill set that potentiate patient activation may largely depend on a person's health literacy. Understanding the relationship among health literacy, patient activation, and race and ethnicity may help identify targeted interventions

to improve hospital readmissions among diverse patient populations.

We have previously published work demonstrating that health literacy and patient activation are each independent predictors of hospital utilization at a large, urban, academic safety net hospital (Mitchell et al., 2014; Mitchell, Sadikova, Jack, & Paasche-Orlow, 2012). However, little is known about the role of health literacy or education on the relationship between patient activation and hospital utilization. The aim of this study was to use path analyses in the same data set to model the interactions between patient activation, health literacy, education, and hospital utilization.

METHODS

Study Participants

We conducted a secondary analysis of data from the Project RED (Re-Engineered Discharge) randomized control clinical trial data sets (clinicaltrials.gov identifier: NCT00252057; (Jack et al., 2009; Mitchell et al., 2014; Mitchell, Sadikova, Jack, & Paasche-Orlow, 2012). The total number of participants in these studies was 1,540. These trials were designed to improve patient education and safety in the transition from hospital discharge to home. A detailed description of the study population has been previously described (Jack et al., 2009; Mitchell et al., 2014; Mitchell et al., 2012) All participants were English-speaking patients age 18 years or older admitted to the general medicine service at Boston Medical Center, a large, urban, academic safety net hospital. Participants were required to be able to understand study procedures and consent in English. Participants were excluded if they

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were admitted for planned hospitalization or admitted from a skilled nursing facility, another hospital, on hospital precautions, suicide watch, deaf, or blind. We used a final sample of 570 participants for this analysis identified from the control arms of these trials with complete data on education, health literacy, and patient activation. Boston University's institutional review board approved all study activities.

Study Variables

Sociodemographic variables. Self-reported race/ethnicity, age, gender, marital status, and highest level of education attained were obtained from all study participants. Data on insurance came from the electronic health record (EHR).

Comorbidity score. Data on chronic medical conditions were obtained from the EHR and were used to construct the comorbidity score. A simple count of comorbid diseases was used to create the categories "0", "1", and "2+", which refer to the number of chronic diseases at the time of trial enrollment (Schneeweiss & Maclure, 2000).

Patient activation. Patient activation was assessed at baseline during the index hospitalization using an adapted 8-item version of the 13-item PAM, as previously described (Mitchell et al., 2014). The PAM score is a continuous variable ranging from 0 to 100, with higher scores representing more activation.

Health literacy. We used the 66-item validated word pronunciation test, Rapid Estimate of Adult Literacy in Medicine (REALM) (Davis et al., 1993), to assess health literacy. REALM scores range from 0 to 66, with scores from 0 to 18 corresponding to literacy of third grade or below, 19 to 44 to literacy of 4th to 6th grade, 45 to 60 to literacy of 7th to 8th grade, and 61 to 66 to literacy of 9th grade or above. We analyzed the REALM score as a continuous variable.

Hospital utilization. Hospital utilization was defined as any visit to an emergency department, hospital admissions, and observation stays occurring after discharge from the index hospital admission. These data were collected from the Boston Medical Center EHRs or self-reported during a follow-up telephone call to participants 30 days after discharge. Utilization events to Boston Medical Center as well as other hospitals and emergency departments were included.

Statistical Analysis

Descriptive statistics. Analyses were conducted using MPlus Software version 7.1 (Muthén & Muthén, 1985-2015) and SAS/STAT Version 9.3 of the SAS System (SAS Institute Inc., Cary, NC) for Microsoft Windows. Descriptive statistics (means and percentages) were used to examine patient characteristics overall and by race/ethnicity. Bivariate analyses comparing patient characteristics by race/ethnicity were conducted using chi-square tests for categorical variables and analysis of variance or Kruskal-Wallis tests for continuous variables.

Path analysis. We employed a path analysis with linear and logistic regression components using maximum likelihood estimation with education level and health literacy, measured by REALM, as exogenous variables, and patient activation measured by PAM score (continuous) and hospital utilization (dichotomous) as endogenous variables. We allowed for correlation between REALM and educational level. Model fit was evaluated using root mean square error of approximation (RMSEA) (Browne & Cudeck, 1993), comparative fit index (CFI), and Tucker Lewis index (TLI) (Bentler, 1990). Models with RMSEA < 0.08, CFI > 0.9, and TLI > 0.9 were considered to have acceptable fit. Additional models were tested by adding exogenous variables one at a time: age, sex, marital status, Charlson comorbidity index, and insurance status. The final model was stratified by race/ethnicity.

RESULTS

Of the 570 patients, 309 (54%) were self-reported non-Hispanic Blacks, 189 (33%) non-Hispanic Whites, and 72 (13%) Hispanics (**Table 1**). Average age was 48 years and 50% of the patients were women. Education level and health literacy measures were significantly different by race/ethnicity. Blacks and Hispanics were less often college educated (11% and 6%, respectively) compared to Whites (21%), and median REALM scores were lower among Blacks and Hispanics, (60 and 61, respectively) compared to Whites (65). Median and average PAM score did not differ significantly by race/ethnicity. The Cronbach alpha values for PAM were 0.74 for overall study population, 0.75 for Blacks, 0.72 for Whites, and 0.72 for Hispanics. Comorbidity score and insurance status also differed by race and ethnicity. Blacks were more likely to have two or more comorbidities compared to Whites. Payer sources for Blacks and Hispanics were mostly Medicaid and "free care" compared to Whites, who had a higher percentage of private insurance and Medicare. Utilization rate of any

TABLE 1
Patient Characteristics Overall and by Race/Ethnicity

| Characteristic | Overall (n = 570) | Black (n = 309) | Hispanic (n = 72) | White (n = 189) | p Value |
|-------------------------------|-------------------|-------------------|-------------------|-------------------|----------------------|
| <i>Gender</i> | | | | | |
| Female | 287 (50.4%) | 160 (51.9%) | 44 (61.1%) | 83 (43.9%) | .03 ^a |
| Male | 282 (49.6%) | 148 (48.1%) | 28 (38.9%) | 106 (56.1%) | |
| Missing | 1 | 1 | | | |
| <i>Age (y)</i> | | | | | |
| Range | 18-90 | 18-90 | 20-68 | 20-89 | < .0001 ^b |
| Median (IQR) | 48 (40, 57) | 50 (41, 59) | 42 (33.5, 46) | 49 (40, 58) | |
| Mean (SD) | 48.4 (14) | 49.4 (14) | 40.3 (9.9) | 49.9 (14.3) | |
| Missing | 1 | 1 | | | |
| <i>Education level</i> | | | | | |
| < High school | 109 (19.4%) | 63 (20.6%) | 21 (30.4%) | 25 (13.3%) | .001 ^a |
| High school/vocational | 234 (41.5%) | 128 (41.8%) | 28 (40.6%) | 78 (41.5%) | |
| Some college | 143 (25.4%) | 82 (26.8%) | 16 (23.2%) | 45 (23.9%) | |
| College graduate + | 77 (13.7%) | 33 (10.8%) | 4 (5.8%) | 40 (21.3%) | |
| Missing | 7 | 3 | 3 | 1 | |
| <i>REALM score</i> | | | | | |
| Range | 0-66 | 0-66 | 0-66 | 0-66 | < .0001 ^c |
| Median (IQR) | 63 (55, 66) | 60 (53, 65) | 61 (51, 65) | 65 (63, 66) | |
| Mean (SD) | 55.7 (17) | 53.6 (17.9) | 54.3 (16.2) | 59.7 (15.1) | |
| <i>Marital status</i> | | | | | |
| Single or single with partner | 288 (51.2%) | 155 (50.8%) | 44 (62.9%) | 89 (47.6%) | .18 ^a |
| Divorced/separated/widowed | 160 (28.5%) | 90 (29.5%) | 12 (17.1%) | 58 (31%) | |
| Married | 114 (20.3%) | 60 (19.7%) | 14 (20%) | 40 (21.4%) | |
| Missing | 8 | 4 | 2 | 2 | |
| <i>Comorbidity score</i> | | | | | |
| 0 | 198 (34.7%) | 92 (29.8%) | 41 (56.9%) | 65 (34.4%) | .0003 ^a |
| 1 | 141 (24.7%) | 76 (24.6%) | 12 (16.7%) | 53 (28%) | |
| 2+ | 231 (40.5%) | 141 (45.6%) | 19 (26.4%) | 71 (37.6%) | |
| <i>Insurance</i> | | | | | |
| Private | 154 (27%) | 81 (26.2%) | 12 (16.7%) | 61 (32.3%) | .04 ^a |
| Medicare | 76 (13.3%) | 42 (13.6%) | 5 (6.9%) | 29 (15.3%) | |
| Medicaid | 241 (42.3%) | 130 (42.1%) | 41 (56.9%) | 70 (37%) | |
| Free care | 99 (17.4%) | 56 (18.1%) | 14 (19.4%) | 29 (15.3%) | |
| <i>PAM</i> | | | | | |
| Range | 32.2-86.3 | 32.2-86.3 | 37.3-86.3 | 32.2-86.3 | .61 ^b |
| Median (IQR) | 63.2 (49.9, 75.3) | 63.2 (49.9, 75.3) | 56.4 (49.9, 70.8) | 63.2 (49.9, 75.3) | |
| Mean (SD) | 62.5 (13.5) | 62.7 (13.6) | 61.0 (12.8) | 62.7 (13.7) | |
| <i>Hospital utilization</i> | | | | | |
| None | 427 (74.9%) | 236 (76.4%) | 51 (70.8%) | 140 (74.1%) | .59 ^a |
| Any | 143 (25.1%) | 73 (23.6%) | 21 (29.2%) | 49 (25.9%) | |

Note. IQR = interquartile range; PAM = patient activation measure; REALM = Rapid Estimate of Adult Literacy in Medicine; SD = standard deviation.

^aChi-square test.

^bAnalysis of variance.

^cKruskal-Wallis test.

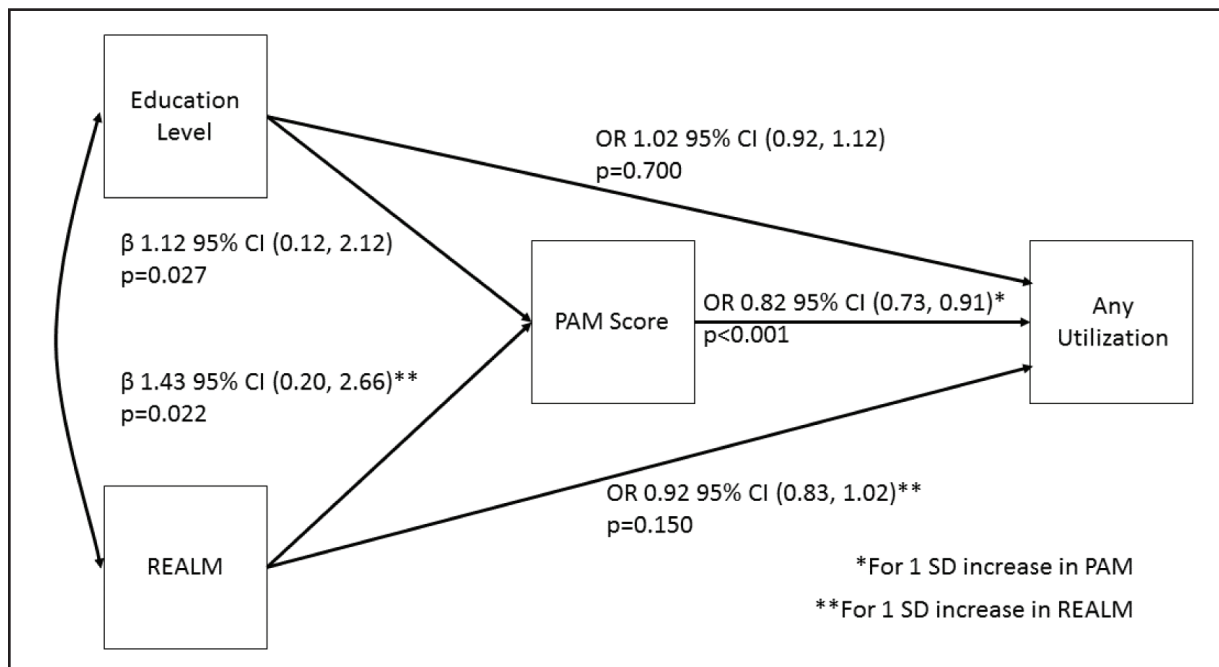


Figure 1. Path model of education, health literacy, patient activation, and hospital utilization. CI = confidence interval; OR = odds ratio; PAM = patient activation measure; REALM = Rapid Estimate of Adult Literacy in Medicine; SD = standard deviation.

hospital services within 30 days after discharge was 25% among all participants and did not differ significantly by race/ethnicity.

Path Analysis

The final path model was the base model with REALM and educational level as exogenous variables and PAM score and any utilization as endogenous variables. Adding the potential covariates one at a time did not result in any significant improvement in the model fit indices or in any differences in the main model path coefficients. The base model was stratified by intervention group and there were no appreciable differences in path coefficients between treatment and control groups.

In the overall study sample, a one SD higher PAM score was associated with 18% reduced odds of hospital utilization (odds ratio [OR], 95% confidence interval [CI] 0.82 [0.73, 0.91], $p < .001$) (Figure 1). PAM mediated the effect of education level with hospital utilization (beta 95% CI 1.12 [0.12, 2.12], $p = .03$); participants with higher education levels had higher PAM, which led to less hospital utilization compared to those with lower education levels (Table 2). PAM also mediated the effect of REALM on hospital utilization (beta 95% CI 1.43 [0.20, 2.66], $p = .02$); participants with higher health literacy had higher PAM, which led to less hospital utilization compared to those with lower health literacy.

When this model was stratified by race, the mediating role of PAM was evident solely for Whites. Specifically, a one SD higher PAM score was significantly associated with a 33% reduced odds of utilization (OR [95% CI] 0.67 [0.57, 0.79], $p < .001$) among Whites (Table 3). There was no direct association with education level or REALM with hospital utilization among Whites. Among Blacks and Hispanics, there was no association between PAM and hospital utilization ($p = .129$ and $p = .888$, respectively). No substantial associations were found for education, REALM, and PAM among Blacks and Hispanics.

DISCUSSION

This study examined the relationship between health literacy, patient activation, and hospital utilization in a diverse sample of adults receiving care at a large, urban safety net hospital. Using path analysis, we demonstrate that the relationship between health literacy and 30-day hospital utilization is fully mediated by patient activation. Health literacy was no longer directly related to hospital utilization after accounting for patient activation. In the path analyses stratified by race, the association of patient activation and hospital utilization was observed in White patients but not in Black and Hispanic patients. In Whites, higher patient activation was associated with decreased utilization, but this was not observed for non-White participants.

TABLE 2
Path Model for Hospitalization

| Path | Beta (95% CI) | Odds Ratio (95% CI) | p Value |
|--------------------------------------|-------------------------|---------------------|---------|
| PAM (1 SD increase) to utilization | -0.203 (-0.308, -0.097) | 0.82 (0.73, 0.91) | < .001 |
| EDUC to utilization | 0.019 (-0.078, 0.117) | 1.02 (0.92, 1.12) | .7 |
| REALM (1 SD increase) to utilization | -0.085 (-0.185, 0.015) | 0.92 (0.83, 1.02) | .15 |
| EDUC to PAM | 1.123 (0.124, 2.121) | – | .027 |
| REALM (1 SD increase) to PAM | 1.428 (0.195, 2.661) | – | .022 |

Note. Root mean square error of approximation = 0, comparative fit index = 1, and Tucker Lewis index = 1. CI = confidence interval; EDUC = education level; PAM = patient activation measure; REALM = Rapid Estimate of Adult Literacy in Medicine; SD = standard deviation.

TABLE 3
Path Model for Hospitalization Utilization Stratified by Race

| Race | Path | Beta (95% CI) | Odds Ratio (95% CI) | p Value |
|-------------------|--------------------------------------|-------------------------|---------------------|---------|
| Black (n = 309) | PAM (1 SD increase) to utilization | -0.109 (-0.269, 0.051) | 0.90 (0.76, 1.05) | .129 |
| | EDUC to utilization | -0.043 (-0.196, 0.109) | 0.96 (0.82, 1.12) | .578 |
| | REALM (1 SD increase) to utilization | -0.054 (-0.229, 0.122) | 0.95 (0.80, 1.13) | .504 |
| | EDUC to PAM | 1.343 (-0.080, 2.766) | – | .064 |
| | REALM (1 SD increase) to PAM | 1.343 (-0.306, 2.991) | – | .113 |
| Hispanic (n = 72) | PAM (1 SD increase) to utilization | 0.026 (-0.275, 0.327) | 1.03 (0.76, 1.39) | .888 |
| | EDUC to utilization | 0.070 (-0.196, 0.109) | 1.07 (0.81, 1.41) | .619 |
| | REALM (1 SD increase) to utilization | -0.227 (-0.513, 0.059) | 0.80 (0.60, 1.06) | .11 |
| | EDUC to PAM | 0.991 (-1.988, 3.970) | – | .514 |
| | REALM (1 SD increase) to PAM | 3.353 (-0.362, 7.068) | – | .077 |
| White (n = 189) | PAM (1 SD increase) to utilization | -0.397 (-0.558, -0.236) | 0.67 (0.57, 0.79) | < .001 |
| | EDUC to utilization | 0.068 (-0.196, 0.109) | 1.07 (0.93, 1.24) | .36 |
| | REALM (1 SD increase) to utilization | -0.091 (-0.268, 0.087) | 0.91 (0.76, 1.09) | .279 |
| | EDUC to PAM | 0.985 (-0.653, 2.623) | – | .239 |
| | REALM (1 SD increase) to PAM | 0.846 (-1.196, 2.888) | – | .412 |

Note. Root mean square error of approximation = 0, comparative fit index = 1, and Tucker Lewis index = 1. CI = confidence interval; EDUC = education level; PAM = patient activation measure; REALM = Rapid Estimate of Adult Literacy in Medicine; SD = standard deviation.

Our findings suggest that patient activation is selectively protective for Whites. This observation is not simply due to racial differences in PAM scores. Although this has been previously reported (Cunningham, Hibbard, & Gibbons, 2011; Gwynn et al., 2016; Hibbard et al., 2008), no racial difference in PAM was observed in the current cohort. A possible explanation for the selective protection of patient activation observed among Whites could be related to the activation measure itself. The PAM instrument was

developed in a predominately White population (88%) that included only 8% Blacks (Hibbard, Mahoney, Stockard, & Tusler, 2005). Although PAM has been used across multiple racial, ethnic, and language groups to assess patient engagement, it is unknown if the contextual components of PAM are race or culturally specific. One study found no racial/ethnic differences in mean PAM scores, but when comparing PAM by survey language, differences in PAM were apparent, with English speakers having higher PAM scores

than non-English speakers (Lubetkin, Zabor, Brennessel, Kemeny, & Hay, 2014). The authors from that study contend that cultural translation of PAM should be considered given certain elements of PAM may conflict with traditional beliefs (Lubetkin, Zabor, Brennessel, Kemeny, & Hay, 2014). This highlights the importance of not only evaluating variations in PAM across racial and ethnic groups but also assessing PAM variations within groups. Even though our study population included only participants who were able to speak English, it is unknown if there were cultural differences within the racial groups that could potentially lead to the differences in the effect of PAM on hospital utilization. Understanding why activation is protective for Whites and not for non-Whites merits further research. Our findings may be unique to our study population; thus, future studies should also evaluate the effects of PAM on outcomes by race and ethnicity.

Although we were able to demonstrate racial and ethnic variations in the effect of patient activation on hospital utilization, there were limitations. First, we did not have a measure for avoidable or inappropriate hospital utilization. Our study excluded planned admissions but did not have an indicator variable for an avoidable or inappropriate admission. Even though the 30-day hospital readmission quality metric is only applied to certain medical conditions, it would be hard to tease out others. For example, if a patient is discharged with pneumonia but returns with congestive heart failure within 30 days of the index hospitalization, should that readmission be considered avoidable. Safety net hospitals serve patients with a high burden of comorbidities, have higher readmission rates, and, therefore, are more likely to receive payment cuts from Medicare (Joynt & Jha, 2013). Therefore, it is important for future studies as well as hospital systems to assess if rehospitalizations are avoidable given the financial implications. Secondly, the subgroup of Hispanic patients was too small to draw any conclusions about the effect of PAM on hospital utilization. In addition, insurance status, which was evaluated but was not retained in the final model, differed by race and ethnicity. We did not have other variables relating to income; future research is warranted to further differentiate how outcomes like hospital readmissions may be due to disparities in health resources or health literacy. Lastly, our findings may be unique to our institution and may not be generalizable to patients receiving care at other safety net institutions. Further research on determinants of hospital utilization in other hospitals serving vulnerable populations are needed given the financial penalties and the potential to lower the quality of care at these institutions and worsen health disparities.

CONCLUSION

We demonstrate that patient activation mediates the relationship between health literacy and hospital utilization and that this relationship is evident for White patients but not for Black and Hispanic patients. These findings have implications on identifying targets for interventions to reduce hospital readmissions at institutions serving ethnic minority populations. Understanding the mechanism of patient activation across and within diverse populations is important given the provisions under the Patient Protection and Affordable Care Act (2010) to engage patients in managing their health care. Our findings imply that interventions to reduce hospital readmissions will need to address factors beyond patient activation to succeed with racially and ethnically diverse populations.

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