The Association between Health Literacy and Preventable Hospitalizations in Missouri: Implications in an Era of Reform

Robert J. Cimasi, Anne P. Sharamitaro, and Rachel L. Seiler

Objective: To evaluate the association between health literacy and preventable hospitalizations on a population level in Missouri, and the extent to which differing levels of health literacy are associated with county preventable hospitalization rates and associated charges.
Data Sources/Study Setting: Secondary data from the 2008 Missouri Information for Community Assessment and Missouri Health Literacy Mapping Tool was used to determine health literacy and preventable hospitalization rates for the 114 counties and city of St. Louis comprising Missouri.
Study Design: Using correlation analysis, simple hierarchical regression models and nonparametric analysis, we investigated whether lower health literacy rates were associated with increased levels of preventable hospitalizations and charges, by county.
Principal Findings: Health literacy was found to be inversely associated with preventable hospitalization rates on a population level, accounting for 21 percent of the variation in preventable hospitalization rates. Preventable hospitalization rates significantly differed for counties with the highest and lowest health literacy levels.
Conclusions: Lower levels of health literacy are significantly associated with increased rates of preventable hospitalizations and charges in a population-level analysis of Missouri counties. Additional research is needed to quantify the effects of successful community health literacy interventions.
Key words: *health literacy, preventable hospitalization, access to care, health care costs, health outcomes*

Robert J. Cimasi, MHA, ASA, FRICS, MCBA, AVA, CM&AA, *serves as Chief Executive Officer of Health Capital Consultants (HCC), a nationally recognized health care financial and economic consulting firm headquartered in St. Louis, Missouri, serving clients in 49 states since 1993. Mr. Cimasi has over 30 years of experience in serving clients, with a professional focus on the financial and economic aspects of health care service sector entities including: valuation consulting and capital formation services; health care industry transactions including joint ventures, mergers, acquisitions, and divestitures; and certificate-of-need and other regulatory and policy planning consulting.*

Mr. Cimasi holds a Masters in Health Administration from the University of Maryland, as well as several professional designations. He is a nationally known speaker on health care industry topics, the author of several books, the latest of which include Accountable Care Organizations: Value Metrics and Capital Formation (Taylor & Francis, a division of CRC Press, 2013), The Adviser's Guide to Healthcare, Vols. I, II & III (AICPA, 2010), and The U.S. Healthcare Certificate of Need Sourcebook (Beard Books, 2005). His most recent book entitled Healthcare Valuation: The Financial Appraisal of Enterprises, Assets, and Services will be published by John Wiley & Sons in the Fall of 2013. Mr. Cimasi is the author of numerous additional chapters in anthologies; books, and legal treatises; published articles in peer reviewed and industry trade journals; research papers and case studies; and, is often quoted by health care industry press.

Anne P. Sharamitaro, Esq.*, is the Executive Vice President & General Counsel of Health Capital Consultants (HCC), where she focuses on the areas of Certificate of Need (CON); regulatory compliance, managed care, and antitrust consulting. Ms. Sharamitaro is a member of the Missouri Bar and holds a J.D. and Health Law Certificate from Saint Louis University School of Law, where she served as an editor for the Journal of Health Law, published by the American Health Lawyers Association. Ms. Sharamitaro has co-authored articles in peer reviewed and trade journals, research papers, and chapters in books and anthologies.*

Rachel L. Seiler, MPH, *is a Senior Research Associate at Health Capital Consultants (HCC). Ms. Seiler obtained her Masters in Public Health—Epidemiology & Environmental and Occupational Health from St. Louis University. She has published articles in peer reviewed journals and has presented before Academy Health in 2009 and 2011.*

J Health Care Finance 2013; 40(2):1–16

Introduction

With the implementation of health care reform, it has become more important to understand not only how much is being spent on health care, but also where those funds are spent. The Medicaid budget increase that is set to roll out in 2013 under the Patient Protection and Affordable Care Act of 2010 elevates the need to try. The health care reform legislation has received criticism for attempting to provide universal health care coverage by relying heavily on state Medicaid programs.[1] Medicaid spending historically has varied by region, with states differing in the amount spent on both the volume of services, as well as the price of those services.[2] In this new era of health care reform, the distribution of monetary resources to support various health care programs will likely become integral to an individual state's ability to provide adequate universal coverage.

From 2001 to 2005, Missouri's state budget was slashed by $2.4 billion dollars. These cuts significantly impacted Missouri Medicaid by implementing additional restrictions on Medicaid enrollee eligibility and spending, resulting in a 10.8 percent increase in the number of uninsured.[3] Despite the new enrollee eligibility restrictions, the continuing economic recession has resulted in increases in Medicaid enrollee numbers and thus, ongoing budget constraints related to increasing Medicaid costs in recent years.[4] Although Missouri Medicaid spending has noticeably increased from 2006 through 2010, the proportion of the state-funded Medicaid budget in 2006 through 2008 (approximately 37-38 percent) decreased to only 28 percent of the total budget in 2009,[5] a change that has been sustained through 2011.[6]

When Medicaid eligibility is expanded in January 2014, the eligible income limit for nonelderly and nondisabled citizens will be raised from 18 percent to 133 percent of the federal poverty level, resulting in a drastic increase in the number of individuals covered by Medicaid.[7] In addition, Missouri will also be required to provide coverage for childless adults.[8] This influx of patients, despite increased federal funds during the first years of implementation, will result in additional financial strain on a system already strapped for cash.

In an effort to reduce health care costs and save money, research in 2009 has considered the cost savings afforded by investing in public health. One investment model posits that investing $10 per person per year into proven community-based disease prevention programs would result in a substantial return on investment. For Missouri, a $10 per payer investment was estimated to result in state Medicaid savings of more than $2 million within one to two years and more than $12 million in five years.[9] Missouri has ranked 43rd in the nation for federal public health funding since 2009, in 2011 receiving just over $100 billion, or $17.12 per capita, which is more than $3 under the national average. In addition, Missouri's state public health budget for FY 2010-2011 was just above $35 million or $5.90 per capita, ranking 50th in the nation for the third year running.[10] Given the fiscal challenges Missouri is facing in a time of economic recession and budget constraints, policymakers are presented with the challenge of considering how to most appropriately allocate funds to enact the most effective changes in health care utilization, cost, and quality.

Among the major objectives of health care reform legislation—for example, the

Patient Protection and Affordable Care Act and the Health Education and Reconciliation Act, enacted in March 2010—are several provisions that address health care costs, quality, and access, with the ultimate goal of improving health outcomes and health status among the US population. Many of these provisions reflect a patient-centered, consumer-driven approach to health, and place essential health care decision-making and management responsibilities in the hands of patients. However, informed health care decision-making and management necessitates adequate levels of functional health literacy. Research has indicated that patients with inadequate levels of functional health literacy are consistently more likely to report poor health status when compared to patients with adequate levels of health literacy.[11] Moreover, research has well established the association of low health literacy with higher costs, as well as poorer health outcomes and quality—two major issues addressed by health care reform. Accordingly, improving health literacy may play an important role in the success of some of health care reform's major objectives by lowering health care costs, advancing high quality coverage, and ultimately improving health outcomes in society. Health literacy's association with the other main issue of reform, access to care, is less understood.

The National Assessment of Adult Literacy (NAAL), a commonly used measurement of health literacy, defines health literacy as the ability to use health-related *"printed and written information to function in society, to achieve one's goals, and to develop one's knowledge and potential."*[12] Health literacy refers to the degree to which people have the ability to obtain, process, and understand health information and services in order to make appropriate and informed health decisions.[13] Health literacy impacts an individual's capacity to identify health-related information, to recognize the importance of prevention and screening, and to comprehend health information and services commonly available in everyday society to facilitate the incorporation of healthy behaviors into patients' lifestyles and manage health conditions and chronic diseases. According to the 2003 NAAL, 36 percent of adults had "*Basic*" or "*Below Basic*" health literacy, and between 57 percent and 60 percent of adults covered by Medicare or Medicaid had "*Basic*" or "*Below Basic*" health literacy, respectively.[14] This pervasiveness of low health literacy portends a significant public health problem, which may have serious societal implications—especially in light of the recently passed health care reform legislation.

This study considers the importance of understanding health literacy to include not only individual-level education, but also population- or community-level involvement. This concept of community or public health literacy considers not only consumer understanding of health literature to improve utilization of health care services when needed, but also the "*social, political, environmental, and economic forces*" that influence prevention.[15] In the 2010 *Action Plan to Improve Health Literacy*, the US Department of Health & Human Services notes the importance of eliminating barriers to health literacy using various channels of communication among individuals, families, and communities, and the necessity of spanning socioeconomic barriers and communication mediums across populations to address deficits in health literacy in the United States.[16] This study addresses consumer access to

care by using preventable hospitalizations as a representative indicator.

On a basic level, preventable hospitalizations are defined as inpatient treatment of certain conditions, that is, Ambulatory Care Sensitive Conditions (ACSC) for which "*timely and effective*" use of primary care (outpatient care) should have reduced the likelihood of hospital admission.[17] ACSCs, as a type of preventive quality indicator, function best as a general measure of health care quality from a community, or population level.[18] Because these hospitalizations could have potentially been avoided with effective prevention, diagnosis, treatment, or management of a disease or condition on an outpatient basis or with effective primary care, the number of preventable hospitalizations is a commonly used measure of access to this care.[19] Although hospitalization for preventable conditions also serves as an indicator of poor quality of care and increased treatment costs, quality and cost of treatment for preventable hospitalizations become issues that arise only after health care has been accessed. Accordingly, preventable hospitalizations fundamentally function as an indicator of access.

Previous studies have reported conflicting findings regarding whether access to care is detrimentally influenced by inadequate health literacy.[20] Some studies have indicated that patients with low health literacy have been averted from accessing health care due to intimidation, fear of embarrassment, or problems navigating the system or facility.[21] Other studies have examined the relationship between health literacy and outpatient physician services.[22] Quantitative research studies about health literacy have used various outcome variables, for example, morbidity, mortality, hospital admissions and readmissions, and increased hospital and emergency care access.[23] However, few studies have evaluated the influence that factors outside the direct control of the clinical setting, such as health literacy, may have on preventable hospitalizations, and none, to the authors' knowledge, have done so on an aggregate, population-level analysis. Additionally, systematic reviews have found a dearth of literature concerning health literacy within the context of policy interventions related to health care reform.[24]

In light of the recently passed health care reform legislation, this study highlights the potential importance of a patient's health literacy with regard to a quality health care outcome, that is, preventable hospitalizations. Prior to the passage of recent health care reform legislation, research found that approximately 75 percent of those who had low health literacy were already insured.[25] Without the adequate health literacy necessary to make appropriate health care decisions, simply providing access to health care coverage may be an insufficient step towards achieving health care reform goals. How to achieve necessary health literacy levels remains a concern, and recent research has found a need for future studies regarding the effectiveness of health literacy programs and interventions.[26] Additionally, health care reform invests significant resources in primary care and prevention efforts, but low health literacy might adversely impact the understanding of the importance and benefits of these preventive services, and consequently, the utilization of them. Moreover, the vast prevalence of low health literacy in the United States may result in unintended consequences and an unexpected burden on the health care system, as an estimated 34 million uninsured individuals will be

entering the health care system over the next several years,[27] many of whom will have difficulty making appropriate health care decisions. Accordingly, this study aims to inform policymakers, practitioners, patients, and other stakeholders of the potential importance of health literacy with regard to its association with access to care in this time of reform, which necessitates an informed and engaged patient population to increase accessibility, quality, and safety of health care, and ultimately to improve the quality of life of millions of people.

In addition to the societal implications of low health literacy, as federal and state policymakers face significant budgetary constraints during this time of economic downturn, low health literacy and preventable hospitalizations represent significant burdens to financially strapped health care systems. Among all types of insurance nationwide, Medicaid recipients represent the highest percentage of individuals with inadequate health literacy.[28] Studies have shown that Medicaid recipients with low reading skills have fewer primary care physician visits, poor compliance with prescribed treatment regimens, more hospitalizations, and higher medical costs and health care charges in comparison to people with higher literacy.[29] Additionally, the disproportionally high number of Medicaid beneficiaries with low health literacy has been shown to cost states a significant amount in Medicaid expenditures.[30]

In the state of Missouri, research findings indicate that approximately 1.6 million or 36 percent of the adult population, has inadequate health literacy.[31] The annual cost attributable to low health literacy in Missouri is estimated between $3.3 billion and $7.5 billion.[32] In 2008, the state of Missouri had approximately 78,000 preventable hospitalizations, which cost the state an estimated $3.1 billion, or a charge of nearly $35,000 per preventable hospitalization incident.[33] If increased rates of health literacy can be associated with a reduction in preventable hospitalizations then investment in state efforts to improve health literacy and reduce the prevalence of preventable hospitalizations in Missouri may be an effective means to improving quality of care and patient outcomes, while concurrently lowering health care expenditures.

Research Objectives

In this study, we evaluated the association between population-level health literacy and preventable hospitalizations in Missouri. We hope to provide a better understanding of whether access to health care, represented by preventable hospitalization rates, is negatively related to inadequate levels of community health literacy. Although many studies have examined the association between health literacy, as well as various health outcomes and quality outcome indicators—for example, diabetes, heart disease, and hospital readmissions—few have considered a population-level association between health literacy and access to care. This research seeks to fill that gap by using preventable hospitalizations as an indicator for health care access, considered within the context of changes brought about by health care reform policy. To accomplish these objectives, we attempted to answer the following research questions: (1) is there an association between health literacy scores and preventable hospitalizations on a population level, and (2) what proportion of preventable hospitalizations in the Mis-

souri population are accounted for by below-average health literacy levels?

Methods

This study uses aggregate level data to evaluate the association between health literacy level and preventable hospitalizations on a population level. The study analyzes county-level data for health literacy as a predictor of preventable hospitalizations in the 114 counties of Missouri and the city of St. Louis.

Health literacy was divided into four levels for the purpose of this analysis: *Below Basic* (NAAL scores 0-184), which indicates no more than the most simple and concrete literacy skills; *Basic* (NAAL scores 185-225), indicating skills necessary to perform simple and everyday literacy activities; *Intermediate* (NAAL scores 226-309), indicating skills necessary to perform moderately challenging literacy activities; and *Proficient* (NAAL scores 310-500), indicating skills necessary to perform more complex and challenging literacy activities (see Figure 1. Selected Health Tasks by Health Literacy Score).[34] The main predictor variables in our analysis were mean health literacy scores by county and the percentage

Figure 1. Selected Health Tasks by Health Literacy Score

National Research Council Performance Levels and Corresponding NAAL	Examples of Activities
Proficient (310-500)	• Calculating one's personal share of employer health costs using a table. • Finding definitions for complex medical terms. • Interpreting legal documents and applying the information to specific health care situations.
Intermediate (226-309)	• Determining a healthy weight range for one's height based on a BMI graph. • Finding the age range for certain childhood vaccines using a recommendation chart. • Determining the times at which one can take a medication, based on instructions on the prescription label. • Identifying three substances that may interact negatively with an over-the-counter drug to produce side effects, based on the information provided on the package.
Basic (185-225)	• Interpreting a clearly written pamphlet to determine two reasons a person should be tested for a disease even without symptoms. • Explaining how a chronic disease may be asymptomatic based on a one-page article about the medical condition.
Below Basic (0-184)	• Interpreting a clearly written pamphlet to determine how often one should have a certain medical test. • Identifying what one can and cannot drink before a medical test based on a short set of instructions. • Circling the date of a medical appointment on an appointment slip.

of residents by county with *Basic* or *Below Basic* health literacy scores. The outcome variables in our analysis were preventable hospitalization rates (stratified by age and gender) and charges per preventable hospitalizations. Relevant demographic and socioeconomic characteristics of each county were also included in this analysis, that is, insurance status, poverty level, education, race, age, and gender.

County-specific health literacy data was obtained by using the Missouri Health Literacy Mapping Tool. The tool is an interactive, Web-based, mapping prototype based on data from the NAAL that predicts and estimates levels of health literacy in small geographic areas, such as census tracts and counties.[35] Using the county-level geographic setting, we obtained an estimated mean literacy score per county, as well as the percentage and number of individuals with *Basic* or *Below Basic* health literacy skills.

County-specific preventable hospitalization data for the 22 preventable hospitalization categories utilized in 2008 was obtained from the Missouri Information for Community Assessment (MICA). These rates include acute care hospital discharges of Missouri residents from federal, nonfederal, and nonstate short-term general and specialty hospitals whose facilities are open to the general public.[36] The MICA Web site uses information provided by the Missouri Patient Abstract System, which is compiled from hospital discharge records that are filed with Missouri Department of Health and Senior Services (MDHSS) as required by state law. The rates were age-adjusted using the US 2000 Census standard population, and were reported per 10,000 population. In addition to obtaining the age-adjusted rates, we also obtained the frequency of each type of preventable hospitalization by county.

Charge data for preventable hospitalizations in 2008 were estimated using the MICA Hospital Discharges, Charges, and Days of Care Database. "*Charges*" are defined by MICA as the unadjusted total amount of billed charges for the hospital stay, but not necessarily reflective of the amount reimbursed or cost of services provided during the stay. This database provides principal diagnosis categories associated with each ACSC from which we created a cross-tabulation table to estimate the charges and the length of stay for preventable hospitalizations for each county. We then converted these raw estimates into rates of preventable hospitalization, per 10,000 population. (See Figure 2. Ambulatory Care Sensitive Conditions and Associated ICD-9 Codes.)

Analyses were conducted using PAWS (formerly SPSS) version 19. Because of the highly positive, skewed nature and unequal variances of the preventable hospitalization rates and charges, all analyses were repeated using a natural log transformation of the data to create an approximation of normal distribution and homogeneity of variance. A correlation analysis using Kendall's Tau and Spearman's Rho was conducted to evaluate simple correlation between predictor variables, potential confounding variables, and the outcome variables of interest. We then conducted hierarchical linear regression models to explore the association between community health literacy and preventable hospitalizations, while incorporating some or all of the following covariates: insurance status, poverty, educational attainment, race, gender, and age.

Finally, we divided the counties into three ranked categories according to average

Figure 2. Ambulatory Care Sensitive Conditions and Associated ICD-9 Codes

Ambulatory Care Sensitive Conditions (ACSC)	ICD-9 Code
Angina	Principal diagnosis of 4111, 4118, 413x and not with any procedure below 87000.
Asthma	Principal diagnosis of 493x.
Bacterial Pneumonia	Principal diagnosis of 481x, 4822, 4823, 4829, 483x, 485x, 486x and any secondary diagnosis that is not 2826 and age is 60 days and above.
Cellulitis	Principal diagnosis of 681x, 682x, 683x, or 686x and not with any procedure below 87000, except when the only procedure performed is one of 86000 through 86099.
Chronic Obstructive Pulmonary	Principal diagnosis of 491x, 492x, 494x, 496x or a principal diagnosis of 4660 with a secondary diagnosis of 491x, 492x, 494x, 496x.
Congenital Syphilis	Principal Diagnosis is V3x (newborn) and any secondary diagnosis of 090x.
Congestive Heart Failure	Principal diagnosis of 428x, 40201, 40211, 40291, 5184 and not with any procedure code of 3601, 3602, 3605, 3610-36199, 375x, 3770-37799.
Convulsions	Principal diagnosis of 7803 and excludes newborns.
Dehydration—Volume Depletion	Principal diagnosis of 2765.
Dental Conditions	Principal diagnosis of 521x, 522x, 523x, 525x, 528x.
Diabetes	Principal diagnosis of 2500-2503, 2508-2509.
Ear, Nose, Throat—Severe Infections	Principal diagnosis of 382x, 462x, 463x, 465x, 4721 and not a procedure of 2001.
Epilepsy	Principal diagnosis of 345x.
Failure to Thrive	Principal diagnosis of 7834 and age is not 1 or above.
Gastroenteritis	Principal diagnosis of 5589.
Hypertension	Principal diagnosis of 401x (but not 4010 or 4019), 40200, 40210, 40290 and not with any procedure code of 3601, 3602, 3605, 3610-36199, 375x, 3770-37799.
Hypoglycemia	Principal diagnosis of 2512.
Immunization Preventable	Principal diagnosis of 033x, 390x, 391x, 037x, 045x or a principal diagnosis of 3200 for ages greater than 0 but less than 6.
Kidney/Urinary Infection	Principal diagnosis of 590x, 5990, 5999.
Nutritional Deficiencies (Includes Iron Deficiency Anemia)	Principal diagnosis of 260x, 261x, 262x, 2680, 2681 or a principal diagnosis of 2801, 2808, 2809 for ages greater than 0 but less than 6.
Pelvic Inflammatory Disease	Principal diagnosis of 614x and sex is female and not with any procedure from 68300 through 68999.
Tuberculosis—Pulmonary	Principal diagnosis of 011x 012x, 013x, 014x, 015x, 016x, 017x, 018x.

county health literacy score ranking (lowest, moderate, and highest) and conducted a Multiple Comparisons: Independent-Samples Kruskall-Wallis Test to analyze differences in the preventable hospitalizations according to health literacy ranks. In all analyses, a two-sided p-value of 0.05 was chosen as the criterion for statistical significance.

Results

The majority of the study population self-identified as White (69.9 percent), with those identifying as Black or Other/Unknown comprising the remaining 26.4 percent and 3.7 percent of the study population, respectively. The mean rate of preventable hospitalizations (calculated per 10,000 population) is greatest within the White subset of the study population (508.4), and within the Black subset of the population the mean is 145.4. Females make up 57.9 percent of the study population and have a slightly higher mean rate of preventable hospitalizations than males (176.5 vs. 141.1, respectively). Of the age groups surveyed, the 45-64 year old age group had the highest average rate of preventable hospitalizations (292.5), more than twice that of the next highest ranked age group (<15 years old, rate of 134.7). Note that the greater-than-65 year old age group was not included in these calculations due to the small group size. It is not surprising that the majority of counties with the highest rate of preventable hospitalizations by race, gender, and age are located in the Bootheel of Missouri—an area known for having a higher rate of poverty and chronic disease burden compared to other areas of Missouri. (See Figure 3. Description of Health Literacy and Preventable Hospitalizations in Missouri Counties.)

Average health literacy scores by county all fell within the Intermediate level based on NAAL scoring, ranging from 231.0 (Pemiscot County) to 259.0 (St. Charles County). St. Louis City and Pemiscot County had the highest percentage of their population with *Basic* or *Below Basic* health literacy at 44.6 percent and 44.7 percent, respectively. Boone County and St. Charles County had the lowest percentage of their population found to have *Basic* or *Below Basic* health literacy, at 23.3 percent and 23.6 percent, respectively. The average number of preventable hospitalizations per 10,000 population for the Missouri population and Medicaid population subset were 158.4 and 49.9, respectively, with Pemiscot County exhibiting the highest rate of preventable hospitalizations for the entire surveyed population (703.9) and for the Medicaid population (321.4). Mean charges for all preventable hospitalizations per county and those associated with Medicaid payors were $12,669,424 and $2,660,923, respectively.

Regression analysis indicated a significant inverse correlation between health literacy and the rate of preventable hospitalizations, as well as the charges of preventable hospitalizations. This significant correlation remained when analyzing health literacy's relationship to Medicaid-specific preventable hospitalization indicators, after controlling for the effect of poverty and insurance status. The strongest correlation was observed between the health literacy score and the rate of preventable hospitalizations among Medicaid recipients. (See Figure 4. Correlation Matrix.) Based on a simple linear regression model, health literacy score explained more than 20 percent of the variation in county preventable hospitalization rates. (See Figure 5. Regression Model Summary.)

Figure 3. Population Demographics and Description of Health Literacy and Preventable Hospitalization (PH) in Missouri Counties

Indicator	Total Number (%) of Population	Mean (SD)	County with Lowest (Average) [Total]	County with Highest (Average) [Total]
County Health Literacy Score		244.9 (5.3)	Pemiscot (231.0), St. Louis City (231.6)	Boone (259.9), St. Charles (259.0)
Percent below Basic Health Literacy		34.2 (4.0)	Boone (23.3%), St. Charles (23.6%)	Pemiscot (44.7%), St. Louis City (44.6%)
Rate of Preventable Hospitalizations (All)		158.4 (78.6)	Douglas (58.3)	Pemiscot (703.9)
Rate of Preventable Hospitalizations (Medicaid)		49.9 (39.4)	Polk (12.2)	Pemiscot (321.4)
Total Preventable Hospitalization Charges per County (All)		$12,669,424 ($28,106,867)	Worth [$42,065]	St. Louis County [$208,494,496]
Total Preventable Hospitalization Charges per county (Medicaid)		$2,660,923 ($6,690,874)	Worth [50,690]	St. Louis County [$42,859,735]
Percent Uninsured		16.88 (2.97)	Pemiscot (9.8%)	Scotland (24.2%)
Percent Poverty		16.51 (4.79)	St. Charles (5.0%)	Pemiscot (31.7%)
Preventable Hospitalizations by Race	**Total Number (%) of Population**	**Mean (SD) Rate of PH**	**County with Lowest Average Rate of PH**	**County with Highest Average Rate of PH**
White	605,796 (69.9)	508.4 (933.9)	Worth (24)	St. Louis County (7161)
Black	228,100 (26.4)	145.4 (759.9)	0*	St. Louis County (5544)
Other/Unknown	32,144 (3.7)	18.0 (58.8)	0*	Jackson (495)
Preventable Hospitalizations by Gender				
Male	141.1 (67.6)	141.1 (67.6)	Douglas (50.2)	Pemiscot (640.2)
Female	176.5 (92.8)	176.5 (92.8)	Douglas (65.9)	Pemiscot (762.1)
Preventable Hospitalizations by Age**				
<15	134.7 (89.5)	134.7 (89.5)	Douglas (24.8)	Dunklin (656.3)
15–24	79.6 (45.5)	79.6 (45.5)	Worth (0.0)	Pemiscot (267.3)
25–44	116.1 (71.3)	116.1 (71.3)	Shelby (40.6)	Pemiscot (661.8)
45–64	292.5 (138.8)	292.5 (138.8)	Douglas (97.6)	Pemiscot (1342.4)
≥65	87,850 (10.2)	N/A	N/A	N/A

* For some variables, the lowest scores of "0" applied to multiple Missouri counties.
** N/A - Data could not be analyzed for ≥65 age group due to the small sample size.
All rates are calculated per 10,000 population.

Figure 4. Correlation Matrix

Indicators	Prev. Hosp. Rates	Prev. Hosp. Charges	Medicaid Prev. Hosp. Rates	Medicaid Prev. Hosp. Charges
		Kendall's Tau/Spearman's Rho		
Mean HL Score	–0.275*/–0.403*	0.278*/0.396*	–0.404*/–0.565*	0.185*/0.269*
Percent below Mean HL	–0.275*/0.401*	–0.290*/–0.412*	N/A	N/A
Percent Uninsured	–0.112*/0.160	–0.427*/–0.579*	N/A	N/A
Percent Poverty	0.226*/0.323	–0.103*/–0.157	N/A	N/A

* Correlation is significant at the 0.01 level (2-tailed)

Figure 5. Regression Model Summary

Indicator	R^2	Adjusted R^2	P-value	Standardized Beta (P-value)
Mean Health Literacy Score	0.210	0.204	<0.001	–0.459 (<0.001)
Mean Health Literacy and Insurance Status	0.283	0.277	<0.001	–0.361 (<0.005) –0.259 (<0.005)
Mean Health Literacy, Insurance Status and Poverty	0.311	0.293	<0.001	–0.391 (<0.005) –0.250 (<0.005) 0.255 (<0.005)

A Bonferroni post hoc test was applied to further evaluate the relationship between health literacy and preventable hospitalizations. It appears that rates of preventable hospitalizations were no different between counties with the lowest levels of health literacy and counties with moderate levels of health literacy (p=0.368) and moderate levels of health literacy and highest levels of health literacy (p=0.119). When county health literacy rates were highest, however, preventable hospitalization rates were significantly lower than those counties in which health literacy rates were lowest (p=0.001). The effect size of this relationship was estimated using Spearman's rho (r=-0.403, p<0.001 (two tailed)) and Kendall's tau (r = -0.275, p<0.001 (two tailed)).

Discussion

Although preventable hospitalizations have traditionally been thought of as indicators of access to quality care, estimations of the effects of health literacy on preventable hospitalizations at a population level is a relatively nontraditional approach to understanding the degree to which health literacy impacts the effectiveness of preventive care, primary care, and public health efforts. Further, many studies that evaluate hospitalization for ACSCs do not consider

factors outside of the direct control of the clinical setting, such as attributes that may affect a patient's ability or willingness to adhere to recommendations for prevention, or early treatment or management of these conditions, for example, health literacy. Our analysis indicates that mean health literacy scores are inversely associated with rates of preventable hospitalizations in Missouri counties at a significant level, and to an even greater extent among the Medicaid population. In addition, the results indicate that for Missouri counties with the lowest levels of mean health literacy scores, rates of preventable hospitalizations are significantly higher compared to preventable hospitalization rates in counties that have the highest levels of mean health literacy scores.

Study Limitations

The study has several limitations worth noting. First, only secondary data was analyzed. Accordingly, we are unable to account for error associated with the collection and management of the primary data utilized. Additionally, because the units of analysis were at the county level, the sample was relatively small.

The limited methods available for measuring health literacy are another limitation. The health literacy score data is based on results from the NAAL and it therefore reflects just one accepted method of scoring health literacy. There are in fact several alternative scoring mechanisms, but the NAAL was chosen due to the large size of the study and because it comprehensively assesses functional health literacy, such as through the measurement of the ability to read a medicine label. Additionally, the health literacy variables are not results of actual surveys conducted in each county, but are predictions based on statistical analysis. Further, the health literacy data is predicted based on tests administered and completed in 2004, but the mean health literacy score per county is derived from demographic data and extrapolated onto Missouri counties by the RAND Missouri Health Literacy mapping tool project. The most recent demographic data used in these extrapolations is from 2007. The health literacy data also did not include specific estimations for the Medicaid population. However, note that the two counties exhibiting the lowest average county health literacy scores, namely Pemiscot County and St. Louis City, are among those areas with some of the largest percentages of the county population enrolled in Medicaid.[37]

As preventable hospitalization data was obtained from general ICD-9 charge data reported on the State Inpatient Database, the charges incurred due to preventable hospitalizations are a crude estimate that may overstate the actual charges. As such, it is possible that some of the charges described as relating to preventable hospitalizations are in actuality attributable to hospitalizations that do not fall under our definition of preventable hospitalizations.

A final limitation of this study is the rather simplistic statistical methods and regression employed for data analysis. However, as this study is only intended to estimate the general direction and magnitude of health literacy's impact on preventable hospitalizations, the chosen analytical methods are suitable for the purposes of these research questions. Because the results of this study are nonspecific in nature, they cannot be reliably used to predict the effect that a change in health literacy scores may have on preventable

hospitalization rates. Lastly, the results and conclusions drawn from this study may only be applied to Missouri, and may not be representative of the association between health literacy scores and preventable hospitalizations in other states or in a national population-level study.

Suggestions for Future Research

Public health literacy has been described as an ethical imperative for public health agencies, organizations, and professionals.[38] As such, addressing health literacy is not the sole responsibility of those individuals actually providing health care services, but rather it involves a multitude of stakeholders, including health care policymakers, purchasers and payers, regulatory entities, and health care patients and consumers. One conceptual model of health literacy posits that health literacy is dependent on not only individual ability, but also on the health care system or environment.[39] Research has shown the value of using an ecological method for health promotion that considers both intra-personal and environmental factors.[40] Accordingly, an ecological approach provides a more comprehensive, robust contextualization of the challenge of low health literacy. This process is necessary to identify individuals and populations with poor health literacy and to develop effective, long-term solutions to address the problem of low health literacy, solutions that cannot be achieved without the involvement and collaboration of multiple stakeholders. Inherent in this approach is an understanding that health literacy is not solely a result of individual attributes, but is collectively impacted by social, economic, environmental, and policy factors.[41]

It is hoped that this study will encourage policymakers in Missouri to better allocate resources that can promote public health literacy. Although Missouri is among the states that receive some of the lowest levels of federal and state public health funding, research has shown that local public health agencies receiving a higher proportion of federal and state funding also are actually more likely to generate higher local revenues as opposed to allowing significant outside funds to offset lower local spending.[42] Additionally, we suggest that future research should seek to identify and develop strategies to effectively measure health literacy, to increase and sustain desirable changes to health literacy rates in low-literacy communities, and to compare the costs associated with state-funded intervention efforts that demonstrate a measurable increase in health literacy with the amount of taxpayer-funded preventable hospitalizations of Missouri Medicaid patients. A health literacy framework that emphasizes how individuals can change their own behavior to improve their health status is likely insufficient to address these problems. There is currently a paucity of research and evidence regarding successful initiatives to significantly improve and sustain public health literacy and the quantitative and qualitative effects of such interventions on health outcomes, both at the individual and community levels.

Ultimately, we encourage the promotion of more efficient Medicaid spending by highlighting the relationship between low health literacy and preventable hospitalizations in Missouri. With state and local policymakers considering alternative methods to improve health outcomes, such as expanding insurance coverage and providing more cost-effective ways to improve safety-net

performance, understanding health literacy's impact on outcomes and performance could result in considerable cost savings to the state Medicaid budget, both through more efficient use of resources and better overall health outcomes.

Conclusion

Every day, individuals receive health-related information that leaves them with more questions than answers. Obtaining appropriate health care necessitates having the proper skills to read and fill out medical and health insurance forms and prescriptions, communicate with health care providers, and follow instructions and medical advice, including discharge-planning instructions. As such, for individuals to make appropriate decisions about their health, they need to be health literate. Unfortunately, many Missourians have difficulty obtaining, processing, and understanding basic everyday health information. Improving health literacy may be the critical component necessary for achieving overall health and wellness goals in Missouri. With a better understanding of health literacy's practical and associated financial impact on preventable hospitalizations, public health officials and policy makers can emphasize, promote, and enhance investment in health literacy initiatives, which may in turn promote significant long-term savings in Medicaid and other health care expenditures.

Many current health policy debates include issues surrounding Medicare and Medicaid, health insurance costs and coverage, patient's bills of rights, health information privacy, and electronic medical records. As state and local policymakers consider alternatives to expanding insurance coverage to ensure access to effective care, this study highlights the importance of health literacy as a factor that affects and influences the overall health of a community. This study is a call to action for those who influence, develop, or implement policies that will lead the way to resolution of the issue of low health literacy in Missouri.

REFERENCES

1. Olson, LK, "Medicaid, the States and Healthcare Reform," *New Political Science* 34(1): 37-54 (March 2012).
2. Gilmer, T and RG Kronick, "Differences in the Volume of Services and in Prices Drive Big Variations in Medicaid Spending by States and Regions," *Health Affairs* 30(7):1316–1324 (2011).
3. Blouin, A, J Hill, K Funk, and E Lucier, "Missouri's Budget Crisis: The Impact on Access to Health Care Cuts, Consequences and Policy Options to Restore Health." p. 1, 4 (February 2005). Available at: *http://www.mobudget.org/files/restorehealth.pdf,* accessed on May 19, 2012.
4. Barker, MR, "Missouri Medicaid Basics: Spring 2011." Missouri Foundation for Health, p. 1, 7 (2011). Available at: *http://www.mffh.org/mm/files/MedicaidBasics2011.pdf,* accessed May 19, 2012.
5. Centers for Medicare & Medicaid Services, "Missouri Medicaid Statistics." Available at: *http://www.medicaid.gov/Medicaid-CHIP-Program-Information/By-State/missouri.html,* accessed on May 22, 2012.
6. *Supra,* n.4.
7. Patient Protection and Affordable Care Act, Pub. L. No. 111-148, § 2001, § 10203, 124 Stat. 271, 927 (March 23, 2010).
8. *Supra,* n.4.

9. Levi, J, LM Segal, and C Juliano, "Prevention for a Healthier America: Investments in Disease Prevention Yield Significant Savings, Stronger Communities," p. 4 (2009). Available at: *http://healthyamericans.org/reports/prevention08/Prevention08.pdf,* accessed May 21, 2012.
10. Levi, J, R St. Laurent, LM Segal, and S Vinter, "Shortchanging America's Health: A State-by-State Look at how Public Health Dollars are Spent and Key State Health Facts," p. 5, 9 (2010). Available at: *http://healthyamericans.org/assets/files/TFAH2010 Shortchanging05.pdf,* accessed December 7, 2011; Levi, J, LM Segal, R St. Laurent, and A Lang, "Investing in America's Health: A State by State Look at Public Health Funding and Key Health Facts." p. 6, 9 (2012). Available at: *http://healthyamericans.org/assets/files/Investing.pdf,* accessed May 19, 2012.
11. Baker, DW, RM Parker, MV Williams, WS Clark, and J Nurss, "The Relationship of Patient Reading Ability to Self-Reported Health and Use of Health Services," *American Journal of Public Health* 87(6):1027–1030 (1997).
12. Kutner, M, E Greenberg, Y Jin, and C Paulsen, *The Health Literacy of America's Adults: Results From the 2003 National Assessment of Adult Literacy (NCES 2006–483)*, Washington, DC: National Center for Education Statistics, p. 2, 10, 18 (2006).
13. Nielsen-Bohlman, L, AM Panzer, DA Kindig, *Health Literacy: A Prescription to End Confusion*, Washington DC: National Academies Press (2004); Selden, CR, Zorn, M, Ratzan, SC, and Parker, RM, Editors, *National Library of Medicine Current Bibliographies in Medicine: Health Literacy,* Vol. NLM, Pub. No. CBM 2000-1. Bethesda, MD: National Institutes of Health, US Department of Health and Human Services (2000).
14. *Supra,* n.12.
15. Freedman, DA, Bess, KD, Tucker, HA, Boyd, DL, Tuchman, AM, and Wallston, KA, "Public Health Literacy Defined," *American Journal of Preventive Medicine* 36(5):446–451 (2009).
16. US Department of Health and Human Services, Office of Disease Prevention and Health Promotion, *National Action Plan to Improve Health Literacy,* Washington, DC: p. 4–6 (2010).
17. Billings, J, L Zeitel, J Lukomnik, TS Carey, AE Blank, and L Newman, "Impact of Socioeconomic Status on Hospital Use in New York City," *Health Affairs* 12(1):162–173 (1993); Billings, J and RM Weinick, *Monitoring the Health Care Safety Net, Book 1: A Data Book for Metropolitan Areas,* Rockville, MD: Agency for Healthcare Research and Quality. Publication No. 03-0025, p. 289 (2003).
18. Agency for Healthcare Research and Quality, Guide to Prevention Quality Indicators: Hospital Admission for Ambulatory Care Sensitive Conditions (Version 3.1), p. 2 (2007).
19. Jiang, HJ, CA Russo, and ML Barrett "Nationwide Frequency and Costs of Potentially Preventable Hospitalizations, 2006," Agency for Healthcare Research and Quality, Statistical Brief #72:1–9, (2009).
20. Baker, *supra,* n.11. Weiss, BD, JS Blanchard, DL McGee, G Hart, B Warren, M Burgoon, and KJ Smith, "Illiteracy among Medicaid Recipients and Its Relationship to Health Care Costs," *Journal of Health Care for the Poor and Underserved* 5(2):99–111 (1994); Nielsen-Bohlman, *supra,* n.13
21. Weiss, *supra,* n.20.
22. *Supra,* n.13.
23. DeWalt, DA, ND Berkman, S Sherican, KN Lohr, and MP Pignone, "Literacy and Health Outcomes: A Systematic Review of the Literature," *Journal of General Internal Medicine* 19(12):1228–1239 (2004).
24. Berkman ND, SL Sheridan, KE Donahue, DJ Halpern, A Viera, K Crotty, A Holland, M Brasure, KN Lohr, E Harden, E Tant, I Wallace, and M. Viswanathan, "Health Literacy Interventions and Outcomes: An Updated Systematic Review," *Evidence Report/Technology Assessment No. 199*. Rockville, MD: Agency for Healthcare Research and Quality, p. 226 (2011); Pignone, MP, DA DeWalt, SL Sheridan, ND Berkman, and KN Lohr, "Interventions to Improve Health Outcomes for Patients with Low Health Literacy: A Systematic Review," *Journal of General Internal Medicine* 20(2):185–192 (2004).
25. Vernon, JA, A Trujillo, S Rosenbaum, BA DeBuono *Low Health Literacy: Implications for National Health Policy,* p. 8, (2007).
26. Berkman, *supra,* n.24.

27. Foster, RS, "Estimated Financial Effects of the Patient Protection and Affordable Care Act. Centers for Medicare & Medicaid Services," p. 3 (2010). Available at: *http://www.hhs.gov/asl/testify/2011/03/t20110330e.html,* accessed May 23, 2012.
28. *Supra,* n.12.
29. Baker, DW, "The Meaning and the Measure of Health Literacy," *Journal of General Internal Medicine* 21:878–883 (2006); Weiss, *supra,* n. 20; Nielsen-Bohlman, *supra,* n.13; Weiss, BD and R Palmer, "Relationship Between Health Care Costs and Very Low Literacy Skills in a Medically Needy and Indigent Medicaid Population," *Journal of the American Board of Family Medicine* 17:144–147 (2004); Kutner, *supra,* n.12; Vernon, JA, A Trujillo, and WK Hughen, "Health Policy Brief: The High Economic Cost of Low Health Literacy in Missouri," (2009). Available at: *http://www.mffh.org/mm/files/vernon.pdf,* accessed on December 7, 2011
30. Sewell, J, "New Tools for an Old Problem: Overcoming Health Literacy Barriers in Medicaid: Health Literacy Tool Kit," The Council of State Governments (2003) available at: *http://www.csg.org/knowledgecenter/docs/ToolKit03HealthLiteracy.pdf*, accessed December 7, 2011.
31. Lurie, N, LT Martin, R Ruder, JJ Escarce, B Ghosh-Dastidar, D Sherman, CE Bird, and A Freemont, "Estimating and Mapping Health Literacy in the State of Missouri," *RAND Health*, p. 5, 6 (2009) available at: *http://www.rand.org/content/dam/rand/pubs/working_papers/2010/RAND_WR735.pdf*, accessed December 7, 2011; Vernon, *supra,* n. 29.
32. Vernon, *supra,* n. 29.
33. Armbrecht ES, *Ambulatory Care Sensitive Conditions: Analysis of Preventable Hospitalizations in Missouri, 2002-2009*, [49], Missouri Hospital Association (2010).
34. Nielsen-Bohlman, *supra,* n.13.
35. Lurie, *supra,* n.31.
36. Missouri Department of Health and Senior Services, *Missouri Information for Community Assessment* database (2010). Available at: *http://www.dhss.mo.gov/MICA,* accessed August 8, 2010.
37. Barker, MR, *Missouri Medicaid Basics: 2010*, Missouri Foundation for Health, p. 11 (2010). Available at: *http://www.mffh.org/mm/files/MedicaidBasics2010.pdf,* accessed December 7, 2011.
38. Gazmararian, JA, JW Curran, RM Parker, JM Bernhardt, and BA DeBuono, "Public Health Literacy in American: An Ethical Imperative," *American Journal of Preventative Medicine* 28(3):317–322 (2005).
39. Baker, *supra*, n. 29.
40. McLeroy, KR, D Bibeau, A Steckler, and K Glanz, "An Ecological Perspective on Health Promotion Programs," *Health Education Quarterly* 15(4):351–377 (1988).
41. Freedman, DA, KD Bess, HA Tucker, DL Boyd, AM Tuchman, and KA Wallston, "Public Health Literacy Defined," *American Journal of Preventive Medicine* 36(5): 446–451 (2009).
42. Bernet, PM, "Local Public Health Agency Funding: Money Begets Money," *Journal of Public Health Management Practice* 13(2):188–193 (2007).