Oregon Health & Science University
School of Medicine

Scholarly Projects Final Report

Title *(Must match poster title; include key words in the title to improve electronic search capabilities.)*

> Can health literacy scores predict healthcare outcomes in high cost-high need low-income patients?

Student Investigator's Name

> Michael Knapp

Date of Submission *(mm/dd/yyyy)*

> 03/04/2022

Graduation Year

> 2022

Project Course *(Indicate whether the project was conducted in the Scholarly Projects Curriculum; Physician Scientist Experience; Combined Degree Program [MD/MPH, MD/PhD]; or other course.)*

> In the Scholarly Projects Curriculum

Co-Investigators *(Names, departments; institution if not OHSU)*

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> Internal Medicine

Scholarly Project Final Report

Concentration Lead's Name

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Project/Research Question

Among high-need, high-cost (HNHC) patients with high rates of poverty, did those patients with low health literacy (HL) scores predict worse utilization outcomes?

Type of Project *(Best description of your project; e.g., research study, quality improvement project, engineering project, etc.)*

Research study

Key words *(4-10 words describing key aspects of your project)*

Retrospective cohort study and secondary analysis of SUMMIT A-ICU study

Meeting Presentations
If your project was presented at a meeting besides the OHSU Capstone, please provide the meeting(s) name, location, date, and presentation format below (poster vs. podium presentation or other).

n/a

Publications *(Abstract, article, other)*
If your project was published, please provide reference(s) below in JAMA style.

n/a

Submission to Archive
Final reports will be archived in a central library to benefit other students and colleagues. Describe any restrictions below (e.g., hold until publication of article on a specific date).

No restrictions

Next Steps
What are possible next steps that would build upon the results of this project? Could any data or tools resulting from the project have the potential to be used to answer new research questions by future medical students?

> BHLS scores from a different patient population could be correlated with utilization outcomes to compare and contrast how they differ from our HNHC population.

Please follow the link below and complete the archival process for your Project in addition to submitting your final report.

https://ohsu.ca1.qualtrics.com/jfe/form/SV_3ls2z8V0goKiHZP

Student's Signature/Date *(Electronic signatures on this form are acceptable.)*
This report describes work that I conducted in the Scholarly Projects Curriculum or alternative academic program at the OHSU School of Medicine. By typing my signature below, I attest to its authenticity and originality and agree to submit it to the Archive.

Michael Knapp

X
Student's full name

Mentor's Approval *(Signature/date)*

X
Mentor Name

Scholarly Project Final Report

Report: *Information in the report should be consistent with the poster, but could include additional material. Insert text in the following sections targeting 1500-3000 words overall; include key figures and tables. Use Calibri 11-point font, single spaced and 1-inch margin; follow JAMA style conventions as detailed in the full instructions.*

Introduction *(≥250 words)*

Health literacy (HL) is defined as "the degree to which individuals have the capacity to obtain, process, and understand basic health-related decisions."[1] It has been reported that approximately 90 million American adults may lack the literacy skills to navigate our health care system effectively.[2][3] Furthermore, it is important to acknowledge that poor health literacy (HL) is associated with poor health outcomes including poor health knowledge, poor medication adherence, poor control of chronic illness, and higher hospitalization rates.[4][5][6][7][8][9]

Among those who struggle to navigate our healthcare system, there is a small group of urban low-income patients with significant medical complexity accounting for a disproportionate percentage of health care expenditures.[4,5] These patients are categorized as high cost-high need (HCHN) and are often alienated by our healthcare system, which promotes higher utilization of emergency room visits, hospital admissions, and a lack of primary care. The result is an unnecessary strain on a local health care system that fails to efficiently address the chronic medical issues found in these complex patients. To better address the complex needs of HNHC patients within our health care system, it is important to understand the HL levels of these patients. By exploring how HL impacts healthcare utilization, physicians will be better equipped to address appropriate goals of care. Furthermore, a better understanding of the HL levels in HNHC patients may create an opportunity to obtain more efficient care, improving outcomes, and hopefully reduce the disparities seen in this patient population.

The value of HL screening lies in its ability to predict the needs of patients. A previous study found that even a single question of "How often do you have someone help you read hospital material?" was

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[1] Institute of Medicine. Health Literacy: a Prescription to End Confusion. Washington DC: National Academic Press; 2004

[2] Kirsch IJA, Jenkins L, Kolstad A. Adult Literacy in America: a First Look at the Findings of the National Adult Literacy Survey. Washington DC: National Center for Education Statistics, U. S. Dept of Education; 1993

[3] Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, American Medical Association. Health literacy: report of the Council on Scientific Affairs. JAMA. 1999;281(6)552–7

[4] Davis TC, Arnold C, Berkel HJ, et al. Knowledge and attitude on screening mammography among low-literate, low-income women. Cancer. 1996;78(9)1912–20

[5] Williams MV, Baker DW, Parker RM, et al. Relationship of functional health literacy to patients' knowledge of their chronic disease. A study of patients with hypertension and diabetes. Arch Intern Med. 1998;158(2)166–72

[6] Williams MV, Baker DW, Honig EG, et al. Inadequate literacy is a barrier to asthma knowledge and self-care. Chest. 1998;114(4)1008–15

[7] Williams MV, Baker DW, Honig EG, et al. Inadequate literacy is a barrier to asthma knowledge and self-care. Chest. 1998;114(4)1008–15

[8] Baker DW, Gazmararian JA, Williams MV, et al. Functional health literacy and the risk of hospital admission among Medicare managed care enrollees. Am J Public Health. 2002;92(8)1278–83

[9] Schillinger D, Grumbach K, Piette J, et al. Association of health literacy with diabetes outcomes. JAMA. 2002;288(4)475–82

predictive of inadequate health literacy. [10] By measuring how HL levels impact HNHC patients, providers can better address the specific needs of their patients.

   Our research aims to explore how HL impacts healthcare utilization among HCHN patients to better address their complex needs. We performed a secondary analysis of an ongoing RCT where the Brief Health Literacy Survey (BHLS) was administered to HCHN patients with high rates of poverty and correlated with healthcare utilization outcomes. Our objective is to evaluate whether low BHLS scores predicted worse utilization outcomes in HCHN patients.

Methods *(≥250 words)*

We conducted a retrospective cohort study that was a secondary analysis of the SUMMIT A-ICU study to assess the association between health literacy and the rates of healthcare utilization amongst high cost-high need low-income patients. Our study took place at a single FQHC (The Old Town Clinic) in Portland, Oregon. Our participants consisted of (N =189) patients enrolled in the SUMMIT A-ICU study, an intensive primary care intervention for high utilizers. Patients were randomly grouped into either immediate or waitlist arms for the summit team intervention. Patient randomization was also correlated with outcomes and BHLS scores to control for any potential the impact of study intervention. Eligibility criteria consisted of PCP referral, and was based on medical, social, and behavioral complexity:

- Patients met medical burden criteria of > 1 condition including: CHF, uncontrolled DM, adv. CKD, ESLD, severe soft tissue infections, OM, or FTT
- Utilization criteria ≥ 1 hospitalization or ED visit in prior 6 months & SUD, or behavioral health criteria disorder
- Exclusion criteria consisted of: inability to consent, non-English speaking patients, are on hospice or deemed < 6 months to live, or a diagnosis of terminal cancer.

We measured health literacy by administering the Brief Health Literacy Survey collected at baseline for each patient. This is a validated test consisting of three survey questions. For the purposes of our analysis, we stratified the BHLS into four categories of low, intermediate, intermediate high, and high.

Administrative data was used to determine three primary utilization outcomes, which included the number of:

1. Emergency dept visits
2. Inpatient hospital admissions
3. Primary care visits

Descriptive statistics were generated for sociodemographic characteristics. Given a sample size of 189 participants, at an alpha = 0.05 and beta = 0.8, we are powered to detect a difference of 0.8 hospitalizations between people with high health literacy compared to those with low health literacy. The relationship between covariates and BHLS scores were analyzed using Kruskal Wallis & Wilcoxon Whitney tests. ANOVA tests were used to analyze covariates and BHLS scores in relation to utilization

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[10] Wallace LS, Cassada DC, Rogers ES, et al. Can screening items identify surgery patients at risk of limited health literacy. J Surg Res. 2007;140(2)208–13.

outcomes.

Results *(≥500 words)*

Socioeconomic demographics and patient characteristics of our 189 subjects included measurements of age, gender, grouping, ethnicity, education, income, housing status, and BHLS score.

The median age for our subjects was 54.8 with a standard deviation of 9.5. Almost 75% of our patient population was between the ages of 46-64 years of age. Regarding gender, 64% of our subjects were male. The study participants were mostly white (67.7%), followed by 12.7% Hispanic/multi-ethnic, 10.6% African America, and 4.2% Native American/Alaskan. In our study, 71.4% of study subjects graduated high school or received a GED with only 7.4% completing a formal education of eighth grade or less. Just over 54% of our subjects reported a monthly income between 700-1000 dollars per month. Notably, 20.1% reported a monthly income of zero dollars. Only 13.2% of our study participants had an income greater than 1,001 dollars per month.

Participant housing status was collected revealing that 50.8% lacked housing in at some point in the past year. Of the 189 subjects, 24.3% had low BHLS scores (3-8 points), 30.7% has intermediate scores (9-11 points), 28.6% had intermediate high scores (12-14 points), and 16.4% had high (15 points) health literacy scores.

Table 1: Participant characteristics

	N =	Percent
Age (mean = 54.8, std dev = 9.5)		
18 yrs to 45 yrs	28	14.8
46 yrs to 64 yrs	136	72
65 and older	25	13.2
Gender		
female	68	36
male	121	64
Group		
immediate/existing	110	58.2
waitlist	79	41.8
Ethnicity		
black/african american	20	10.6
hispanic/multi-ethnic	24	12.7
native american/alaskan	8	4.2
white	128	67.7
missing	9	4.8
Education		
8th grade or less	14	7.4
some high school but did not graduate	38	20.1
high school graduate or GED	59	31.2
any college	76	40.2
missing	2	1.1

Income

$0/month	38	20.1
$1 - $700 per month	18	9.5
$701 - $1,000 per month	103	54.5
> $1,001/month	25	13.2
missing	5	2.6

Housing

lacked housing in past year	96	50.8
did not lack housing in past year	89	47.1
missing	4	2.1

BHLS score

Low (3-8)	46	24.3
Intermediate (9-11)	58	30.7
Intermediat-High (12-14)	54	28.6
High (15)	31	16.4

Table two seen below describes our patient demographics stratified by BHLS scores. For the entire cohort, 46 participants (24.3%) had a low BHLS score (3-8 points), 58 participants (30.7%) had an intermediate score (9-11 points), 54 participants (28.6%) had an intermediate-high score (12-14), and 31 participants (16.4%) had a high score of 15. The mean BHLS score was 10.75 (intermediate range) with a standard deviation of 3.5. Ethnicity was associated with BHLS scores (p = 0.027). Within our sample, 75% of African Americans and 51% of whites scored low to intermediate BHLS scores. No relationship was observed for all other sociodemographic characteristics.

Table 2: Patient demographics stratified by BHLS score

BHLS Score, No. (%)

Characteristic	Low (3-8) (N= 46 [24.3 %])	Intermediate (9-11) (N= 58 [30.7 %])	Intermediate-High (12-14) (N= 54 [28.6 %])	High (15) (N= 31 [16.4%])	Total (N = 189)	P value
Age						0.423
18-45	11 (39.2%)	4 (14.2%)	6 (21.4%)	7 (25%)	28 (14.8%)	
46-64	33 (24.2%)	45 (33%)	37 (27.2%)	21 (15.4%)	136 (72%)	
> 65	2 (8%)	9 (36%)	11 (44%)	3 (12%)	25 (13.2%)	
Gender						0.428
Female	14 (20.6%)	28 (41.2%)	17 (25%)	9 (13.2%)	68 (36%)	
Male	32 (26.4%)	30 (24.8%)	37 (30.6%)	22 (18.2%)	121 (64%)	

Group						0.661
Immediate/ existing	27 (24.5%)	32 (29.1%)	31 (28.2%)	20 (18.2%)	110 (58.2%)	
Waitlisted	19 (24.1%)	26 (32.9%)	23 (29.1%)	11 (13.9%)	79 (41.8%)	
Ethnicity						0.027*
Black/african america	9 (45%)	6 (30%)	5 (25%)	0 (0%)	20 (10.5%)	
Hispanic/multi-ethnic	4 (16.6%)	8 (33.3%)	7 (29.1%)	5 (20.8%)	24 (12.7%)	
Native america/native alaskan	3 (37.5%)	3 (37.5%)	2 (25%)	0 (0%)	8 (4.2%)	
White	26 (20.3%)	40 (31.3%)	36 (28.1%)	26 (20.3%)	128 (67.7%)	
Missing	4 (44.4%)	1 (11.1%)	4 (44.4%)	0 (0%)	9 (4.8%)	
Education						0.214
8th grade or less	5 (35.7%)	3 (21.4%)	4 (28.6%)	2 (14.3%)	14 (7.4%)	
Some HS but did not graduate	13 (34.2%)	11 (28.9%)	10 (26.3%)	4 (10.5%)	38 (20.1%)	
HS graduate or GED	14 (23.7%)	19 (32.2%)	15 (25.4%)	11 (18.6%)	59 (31.2%)	
Any college	12 (15.7%)	25 (32.8%)	25 (32.8%)	14 (18.4%)	76 (40.2%)	
Missing	2 (100%))	0 (0%)	0 (0%)	0 (0%)	2 (1.0%)	
Income						0.385
$0	9 (23.7%)	8 (21.2%)	11 (28.9%)	10 (26.3%)	38 (20.1%)	
$1 - $700 per month	7 (38.9%)	4 (22.2%)	5 (27.8%)	2 (11.1%)	18 (9.5%)	
$701 - $1,000 per month	21 (20.4%)	38 (36.9%)	28 (27.2%)	16 (15.5%)	103 (54.5%)	
> $1,001/month	7 (28%)	6 (24%)	9 (36%)	3 (12%)	25 (13.2%)	
missing	2 (40%)	2 (40%)	1 (20%)	0 (0%)	5 (2.6%)	
Housing						
Lacked housing in past year	20 (20.8%)	32 (33.3%)	28 (29.2%)	16 (16.7%)	96 (50.8%)	0.652

Did not lack housing in past year	23 (25.8%)	26 (29.2%)	26 (29.2%)	14 (15.7%)	89 (47.1%)
Missing	3 (75%)	0 (0%)	0 (0%)	1 (25%)	4 (2.1%)

Table three demonstrates our covariates in relation to utilization outcomes. Importantly, there was an association between the lack of housing in the past year and inpatient admission rates (p = 0.029). No association was found between the lack of housing in the past year and other utilization outcomes including emergency department visits rates and primary care visit rates. Furthermore, no statistical associations were found between BHLS score by category and any of our three utilization outcomes. We did not observe a relationship between healthcare utilization and other sociodemographic characteristic.

Table 3: Covariates in relation to utilization outcome

Characteristic	Inpatient admission rate (mean)	P-value	Emergency Dept. visit rate (mean)	P-value	Primary care visit rate (mean)	P-value
BHLS score (category)		0.29		0.897		0.295
Age		0.102		0.46		0.46
18-45	3.01		6.02		7.04	
46-64	2.33		3.86		9.53	
> 65	3.48		3.55		9.53	
Gender		0.304		0.083		0.519
female	2.09		3.06		10.07	
male	2.86		4.75		8.64	
Group		0.663		0.669		0.13
immediate/ existing	2.45		4.35		10.44	
waitlisted	2.77		3.85		7.37	
Ethnicity		0.622		0.577		0.949
black/african america	2.92		3.21		11.32	
hispanic/multi-ethnic	3.88		4.53		9.42	
native america/native alaskan	3.06		7.37		8.85	
white	2.34		4.21		8.71	
missing	1.44		1.33		10.44	

|			
Education	0.686	0.251	0.511
8th grade or less	1.76	1.71	8.51
some high school but did not graduate	2.75	5.93	7.58
high school graduate or GED	2.16	4.54	8.07
any college	3.03	3.44	11.06
missing			
Income	0.561	0.306	0.434
$0	2.3	6.25	5.72
$1 - $700 per month	1.59	2.33	7.57
$701 - $1,000 per month	2.6	3.78	10.11
> $1,001/month	3.91	4.36	11.45
missing	1.4	1	10
Lacked housing (past yr)	0.029*	0.082	0.901
yes	3.36	5.15	9.15
no	1.8	3.14	9.41

Seen below is table four, an ANOVA comparing BHLS score to healthcare utilization rates. No correlation was found between utilization outcomes and BHLS score by category. Given these findings, we accepted our null hypothesis that low BHLS scores do not predict an increase in the risk of utilization in high cost-high need low-income patients.

Table 4: ANOVA comparing BHLS score to healthcare utilization rates

Healthcare utilization rate	F	P value (0.05)
Inpatient admissions	1.26	0.29
Emergency Dept visits	0.19	0.89
Primary care visits	1.24	0.29

Figure one seen below illustrates BHLS scores stratified by healthcare utilization outcome. This figure demonstrates no correlation between BHLS scores and outcomes supporting the rejection of our alternative hypothesis that low BHLS scores predict an increase in the risk of utilization of high cost-high need low-income patients.

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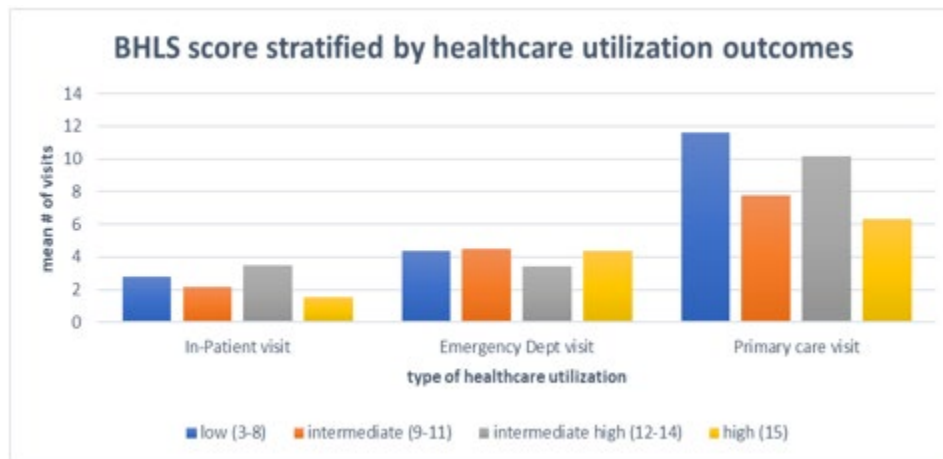
BHLS score stratified by healthcare utilization outcomes

In this retrospective cohort study with a small sample of high cost-high need low-income patients, we found no association between health literacy and our three healthcare utilization outcomes (emergency department visits, hospital admissions, and primary care visits). Ethnicity was the only sociodemographic characteristic found to have a statistically significant (p = 0.027) relationship with the BHLS score. Furthermore, a statistically significant relationship was found between the mean number of inpatient admissions and a positive response to houselessness within the last year (p= 0.029). No interaction between healthcare utilization and any other sociodemographic characteristics was found. To our knowledge, this is the only study describing the relationship between health literacy and healthcare utilization in a high cost-high need low-income patient population.

Although our hypothesis predicted a low BHLS score being associated with higher utilization outcomes, our results did not support this. One possible explanation is that our patient population consisted of a relatively large portion of high utilizers. The mean and median emergency department visit rates in a six-month period were 4.14 and 2, respectively. Another potential contribution that could have influenced the lack of variation seen BHLS scores was the relatively low education attainment of our patient population with 27.5% having not graduated high school. Furthermore, the economic homogeneity of our patient population should also be noted when considering the healthcare utilization rates. Approximately 20.1% of our participants reported a monthly income of zero dollars per month, with only 13.2% reporting an income over 1,001 dollars per month.

This study has several limitations. Firstly, this is a small sample size of only 189 participants. The study population was 67.7% white, 64% male, and 72% were between the ages of 46-62 years of age. The study population had a mean BHLS score of 10.75 with 24.3% of participants scoring a BHLS of low (3-8 points). Secondly, all participants were chosen from a single FQHC reflecting the characteristics of an urban low-income environment.

Given that our study is a secondary analysis of participants enrolled in the SUMMIT A-ICU study (an intensive primary care study) there was concern that perhaps the study intervention could have influenced healthcare utilization. According to the preliminary SUMMIT A-ICU findings demonstrated in *An Ambulatory Intensive Primary Care Team for Medically and Socially Complex Patients in a Healthcare for the Homeless Setting—A Randomized Controlled Trial*, patients receiving the SUMMIT team

intervention did not have significantly higher rates of hospitalization compares to the usual care group, which lessened our concerns for a potential interaction.

Lastly, our study encountered an unresolved issue regarding a linear regression analysis. Attempts to build a linear regression models displayed significant heteroskedasticity due to our positively skewed healthcare utilization outcomes which did not meeting the assumptions of normality. Further attempts to normalize the data with log transformations remained unsuccessful. Even after removing outliers, attempts at building a linear regression analysis remained elusive.

Despite our findings demonstrating no association between BHLS scores and healthcare utilization in our HCHN patient population, health literacy (HL) remains an important factor in patient care. Studies have shown that low HL is associated with higher mortality, higher rates of hospitalization, and poor self-management skills for patients with chronic disease[11]. Additionally, early unplanned hospital reutilization after discharge is a common and costly occurrence in U.S. hospitals linked to low HL. Recent studies have determined the importance of self-management following a hospital discharge, and the association between low HL with a higher incidence of unplanned readmissions[12] and increased rates of acute care and emergency department visits.[13] Therefore, interventions to assess HL has the potential to identify early, unplanned, or preventable hospital utilization.

Additionally, HL screening can improve the relationship between physicians and patients. It has been found that patients with low HL are more likely to report unsatisfactory patient–doctor communication at the time of discharge, suggesting that some physicians may be insensitive or unaware when their patients are having difficulties comprehending discharge instructions.[14]

Finding ways to better address the complex needs of HCHN patients within our healthcare system remains important from both patient care and financial perspectives. By exploring utilization outcomes, our study highlighted important clues that could serve to better manage the care of HCHN patients. Notably, our findings indicating an association between housing status and healthcare utilization presents an area in need of further investigation into the care of HCHN patients.

Conclusions *(2-3 summary sentences)*

The aim of this project was to determine if low BHLS scores could predict worse utilization outcomes in HCHN patients. Our findings demonstrate no statistically significant relationship between healthcare utilization outcomes & BHLS scores in our patient population. Ethnicity was the only sociodemographic characteristic found to have a statistically significant *(p < 0.05)* relationship with BHLS score. Furthermore, a statistically significant relationship was found between the mean number of inpatient admissions and a positive response to houselessness (within the last year).

References *(JAMA style format)*

1. Institute of Medicine. Health Literacy: a Prescription to End Confusion. Washington DC: National Academic Press; 2004.
2. Kirsch IJA, Jenkins L, Kolstad A. Adult Literacy in America: a First Look at the Findings of the National Adult Literacy Survey. Washington DC: National Center for Education Statistics, U. S. Dept of Education; 1993
3. Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, American

Medical Association. Health literacy: report of the Council on Scientific Affairs. JAMA. 1999;281(6)552–7.

4. Davis TC, Arnold C, Berkel HJ, et al. Knowledge and attitude on screening mammography among low-literate, low-income women. Cancer. 1996;78(9)1912–20.

5. Williams MV, Baker DW, Parker RM, et al. Relationship of functional health literacy to patients' knowledge of their chronic disease. A study of patients with hypertension and diabetes. Arch Intern Med. 1998;158(2)166–72.

6. Williams MV, Baker DW, Honig EG, et al. Inadequate literacy is a barrier to asthma knowledge and self-care. Chest. 1998;114(4)1008–15

7. Williams MV, Baker DW, Honig EG, et al. Inadequate literacy is a barrier to asthma knowledge and self-care. Chest. 1998;114(4)1008–15

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9. Schillinger D, Grumbach K, Piette J, et al. Association of health literacy with diabetes outcomes. JAMA. 2002;288(4)475–82

10. Parikh NS, Parker RM, Nurss J, et al. Shame and health literacy: the unspoken connection. Patient Educ Couns. 1996;27(1)33–9

11. Wallace LS, Cassada DC, Rogers ES, et al. Can screening items identify surgery patients at risk of limited health literacy. J Surg Res. 2007;140(2)208–13

12. Berkman ND, Sheridan SL, Donahue KE, Halpern DJ, Crotty K. Low health literacy and health outcomes: an updated systematic review. Ann Intern Med. 2011;155(2):97-107.

13. Kutner MA. The Health Literacy of America's Adults: Results From the 2003 National Assessment of Adult Literacy. Washington, DC: National Center for Education Statistics; US Department of Education; 2006.

14. US Census Bureau. Population. http://www.census.gov/topics/population.html.