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## Featured Article

## Patient-reported health literacy scores are associated with readmissions following surgery



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## ABSTRACT

**Background:** Health literacy (HL) impacts medical care. We hypothesized that patients with low HL would have higher readmission rates following surgery.

**Methods:** We conducted a prospective, multi-institutional study from 8/2015–6/2017 within the Veterans Affairs (VA) System including veterans who underwent general, vascular, or thoracic surgery. HL was assessed by Brief Health Literacy Screener and stratified into adequate vs. low. Patients were followed for 30 days post-discharge. Multivariable analyses examined correlations and logistic regression models adjusted for covariates.

**Results:** 736 patients were enrolled in the study; 98% (n = 722) completed the HL survey. At discharge, 33.2% of patients had low HL. The overall 30-day readmission rate was 16.3%, with a significant difference by HL (Adequate HL: 13.3% vs. Low HL: 22.5%, p < 0.01). After adjusting for clinical and demographic covariates, patients with low HL were 59% more likely to be readmitted (OR = 1.59, 95% CI = 1.02–2.50).

**Conclusion:** Low HL is common among VA surgery patients and is associated with readmission. Future studies should be focused on interventions to target this vulnerable patient population.

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## Introduction

Health literacy (HL) can be defined broadly as the ability to obtain, process, and understand information about one's health.<sup>1,2</sup> According to the National Assessment of Adult Literacy (NAAL) by the U.S. Department of Education, Institute of Educational Sciences in 2003, 33% of the U.S. population can be classified as having low health literacy.<sup>1,2</sup> Low health literacy affects people of all ages, ethnic backgrounds, socioeconomic status, education, and insurance coverage, albeit differentially. Lower health literacy is associated with less education, age greater than 65, lower socioeconomic

status and being uninsured or having Medicaid or Medicare insurance.<sup>1–4</sup> In medical patient populations, such as those with congestive heart failure or diabetes, health literacy has been studied and linked with medical outcomes.<sup>4</sup> In the Veteran patient population, health literacy levels have been assessed both within the surgical<sup>5</sup> and medical patient populations<sup>6</sup> but have not yet been linked to post-surgical outcomes, such as readmissions.

Low health literacy impacts the health care system, providers, and the patients themselves. It is also associated with higher health care costs, estimated to be between \$106 billion and \$238 billion annually.<sup>1–3,7,8</sup> It can place an individual at increased risk of adverse drug reactions and medication errors.<sup>1</sup> Patients can be labeled deliberately non-adherent or as willfully and knowingly not following instructions, when in reality they have poor understanding of medication instructions or schedules.<sup>4</sup> Patients with low health literacy may also have limited or inadequate self-care

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skills in managing their chronic conditions<sup>1</sup> as well as, by extension, their postoperative wounds and other changes (acute conditions). They also have decreased utilization of screening and preventative tests (such as colonoscopy screening for colon cancer), potentially due to a lack of understanding or the inability to read the information given to them.<sup>2,4</sup>

Post-operative readmissions have gained attention at both the national level<sup>9,10</sup> and within the surgical literature<sup>10,11</sup> as a marker of quality of care. This increased focus is justified as readmissions are taxing on patients and costly to healthcare systems.<sup>12,13</sup> Recent studies focus on predicting which patients are at risk of returning to the hospital<sup>14,15</sup> and what factors may reflect surgical quality.<sup>16</sup> Both administrative data and patient-reported information can be used to estimate readmission risk, but a large amount of variation remains unexplained.<sup>11</sup>

Furthermore, little is known about what patients experience after they leave the hospital.<sup>9</sup> One-third of post-operative complications occur post-discharge,<sup>17</sup> and a patient's level of health literacy may dictate if and how they seek medical attention.<sup>18</sup> Self-care following surgery can be complicated and overwhelming for some patients.<sup>19</sup> Unique challenges for patients following surgery include post-operative wound or drain care, becoming accustomed to a new amputation or ostomy, and discerning between expected post-operative pain and a new or worsening symptom that may warrant urgent evaluation. Post-surgical care may be thwarted by the emotional toll of learning of a new critical diagnosis, such as cancer, while trying to manage a complex post-operative care plan with the implications or need for further treatment.<sup>19</sup>

Given the overall rates of low health literacy in the general population and recent studies exploring their associations to post-surgical outcomes, we sought to understand the association between health literacy and surgical readmissions in our Veteran surgical patient population. Our hypothesis is that patients who have lower health literacy scores would experience higher readmission rates following surgery.

## Methods

This is a prospective, observational, multi-institution cohort study that includes patients being discharged following an elective or emergent inpatient general, vascular, or thoracic surgery at one of four VA Medical Centers (Birmingham, Palo Alto, Milwaukee, and Boston) between August 2015 and June 2017. Patients with a length of stay less than 2 days or more than 30 days were not eligible for enrollment in order to adequately capture a "typical" inpatient surgery population. Patients whose primary language was not English were excluded from the study.

### Recruitment, enrollment and procedures

Patients were identified during their hospital stay at each of the four enrollment sites. Weekly phone calls among the research personnel were conducted during the enrollment period to ensure consistent methods of recruitment across all sites. Recruiters identified patients on either the day before or the day of planned discharge with the help of the surgical nurse coordinator at each site. As part of the discharge process, a member of the healthcare team would introduce the study to the patient and their caregiver, if present, and ask if the patient would like to hear more. If the patient was interested, then the trained recruiter would come to the patient's room before discharge to give them further details about the study, answer their questions, and perform the informed consent process.

Patients were interviewed on the day of discharge and followed for 30 days or to readmission at a VA hospital, whichever occurred

first. Follow-up interviews repeated all questions from the discharge interview and included additional information on post-discharge healthcare utilization such as clinic visits, emergency department (ED) visits, and non-VA hospital readmissions. If a patient was readmitted to a VA hospital within 30 days after discharge, they were interviewed in-person at the time of the readmission while still in the hospital and as close to the day of readmission as possible. Patients who were not readmitted to a VA hospital within 30 days post-discharge were interviewed via follow-up phone call. Survey questions used for this study include only those captured at discharge, additional data was collected for other study objectives outside this research question.

Data were entered into an electronic form developed within REDCap with paper forms used as a back-up. Patients not contacted within 45 days post-discharge were deemed as lost to follow-up to reduce bias introduced by a longer time since discharge.

### Additional data sources

In addition to patient interview data, medical chart abstractions were performed to identify post-discharge complications, ED visits, and inpatient admissions outside of the VA to the extent that they were recorded in the medical record to augment the survey data. Patient demographics and comorbidities obtained from the VA Corporate Data Warehouse Inpatient, Outpatient, and Surgery domains ensured comparable collection of administrative data. The work Relative Value Unit for each operation was determined using the Centers for Medicare & Medicaid designation by the procedure's primary Current Procedural Terminology (CPT) code. Prior to initiation, this study was reviewed and approved by the VA Central Institutional Review Board and by Research & Development Committees at each enrollment site.

### Study variables

Health literacy (HL) was assessed by the validated 3-question Brief Health Literacy Screener (BHLS) [Fig. 1] which sums three 5-point ordinal items (score range 0–12); higher scores indicate more problems understanding health-related information.<sup>20</sup> BHLS has been dichotomized as adequate (scores of 0–3; "adequate HL") versus inadequate health literacy (scores of 4–12; "low HL").<sup>16</sup> The three individual BHLS items were also analyzed. Each BHLS item was dichotomized as follows: difficulty understanding written information was dichotomized as "Never" vs. "Sometimes/occasionally/often/always"; confident filling out medical forms alone was dichotomized as "Always" vs. the response of "somewhat" or less; and how often does someone help you read hospital materials was dichotomized as "Never" vs. "Sometimes/occasionally/often/always".<sup>21</sup>

The primary outcome was any unplanned readmission during the 30 days after discharge. Any planned readmission (for sequential procedures for example) as defined by the CMS algorithm<sup>22</sup> and assessed by chart abstraction was excluded from analysis. We also examined whether HL predicted ED use during this time frame.

Overall health was measured using the validated Veterans Health Survey (VR12) Physical and Mental Component Scores (PCS; MCS).<sup>23</sup> We summarized comorbidity burden using the Charlson Comorbidity Index (CCI), a widely used measure of chronic disease burden that sums weighted indicators of 17 conditions associated post-discharge mortality, adapted for use with administrative data.<sup>24,25</sup> Additional variables that were examined included age, race, marital status, surgery type (general, vascular, thoracic), emergency procedure (yes/no), American Society of Anesthesiologists (ASA) physical status classification (categorized as 1–2, 3, or 4–5), operative time in hours, and work relative value unit (RVU).

<i>How often do you <b>have someone help</b> you read hospital materials?</i>		<i>How often do you have <b>problems learning about a medical condition</b> because of difficulty understanding written information?</i>		<i>How confident are you <b>filling out medical forms</b> by yourself?</i>	
Always	+4	Always	+4	Always	+0
Often	+3	Often	+3	Often	+1
Sometimes	+2	Sometimes	+2	Sometimes	+2
Occasionally	+1	Occasionally	+1	Occasionally	+3
Never	+0	Never	+0	Never	+4

Fig. 1. Brief Health Literacy Screener by Dr. Lisa Chew and scoring for each question.

As this is an observational study, RVU was used as a surrogate measure for case complexity of the operation. New amputation, new ostomy, hospital length of stay (LOS) in days, number of medications filled since discharge, and time to readmission in days were also examined.

#### Statistical analysis

The enrollment time was determined based on an a priori power calculation for a related study on mental health and readmission, and we are exploring the relationship between health literacy and readmission as a secondary study question. We estimated a necessary sample size of 800 to detect a difference by patient depression at discharge and readmission.<sup>26</sup>

Frequencies and distributions for all variables were examined with univariate statistics and histograms prior to bivariate analyses. Health literacy scores were first analyzed as a continuous variable and then as a dichotomous variable for ease of clinical interpretation. Bivariate and multivariable logistic regression were used to examine associations between HL and each outcome (unplanned readmission or any ED use). Multivariable logistic regression models were conducted adjusting for study site, age, race, gender, Charlson Comorbidity Index, Physical Component Score, Mental Component Score, surgery type, operative time, work relative value unit. Prior studies outside of surgery have examined individual items in the BLHS.<sup>21,27,28</sup> In order to investigate if the same trends were seen in surgical patients, we repeated the multivariable logistic regression models for each of the three BHLS questions.

Study data were collected and managed using REDCap electronic data capture tools hosted at Veterans Health Administration.<sup>1</sup> REDCap (Research Electronic Data Capture) is a secure, web-based application designed to support data capture for research studies, providing 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources.<sup>29</sup> SAS version 9.4 was used for modeling and statistical analysis.

#### Results

Overall, 722 (98.1%) of the 736 patients enrolled completed the BHLS: 326 (45.2%) underwent general surgery, 252 (34.9%) vascular, and 144 (19.9%) thoracic surgeries. Median age was 67 (IQR:

61–71), 84.1% were Caucasian (n = 607) and 96.0% male (n = 692). Most (535, 77.2%) patients had been assigned ASA physical status class 3; median Charlson comorbidity score was 4 (Interquartile range (IQR): 2–6). The median overall length of stay (LOS) for the index hospitalization was 5 days (IQR: 3–8) [Table 1]. In comparing the four study sites, there were no differences in HL scores (p = 0.25) or readmission rates (p = 0.56).

During the 30 days following discharge, 118 (16.3%) had unplanned readmissions and 148 patients (20.5%) presented to the emergency department. Of the unplanned readmissions, 17.4% (n = 21) of the patients were readmitted to hospitals outside the VA system. Forty-five percent of patients (n = 67) who presented to the ED within the VA were readmitted. There was no difference in readmission rates by surgical specialty (vascular 16.5%, thoracic 15.3%, general 16.3%<sup>0.2</sup>, p = 0.95).

When examining health literacy in our population, we found that 39.2% (n = 283) scored 0, i.e. they did not need help reading hospital materials, did not have difficulty understanding written information about their medical condition, and were always confident filling out medical forms by themselves. Another 482 (66.8%) patients had scores between 0 and 3 indicating adequate HL and the remaining 33.2% (n = 240) scored  $\geq 4$ , suggesting low health literacy. The distribution of BHLS scores can be seen in Fig. 2.

Mean HL scores were higher among patients who had unplanned readmissions during the 30 days following discharge than among those who did not experience a readmission (mean [SD]: 3.25 [3.18] readmitted vs. 2.38 [2.84] non-readmitted, p = 0.003). Mean HL scores were similar among those with and without ED visits in this time frame (mean [SD]: 2.78 [2.91] ED vs. 2.45 [2.92] non-ED, p = 0.23). The median overall LOS for the index hospitalization was 5 days (IQR = 3.0–8.0), and we found no association between health literacy score and LOS ( $\rho = -0.02$ , p = 0.54).

Patients with adequate HL were younger, more likely to be single, and had better overall physical and mental health compared to those with low HL. Patients with low HL were more likely to be married and had higher rates of post-operative complications (any complication (39.8% low HL vs. 29.9% adequate HL, p = 0.01);) which included congestive heart failure exacerbation (2.9% low HL vs. 0.8% adequate HL; p = 0.03), acute urinary retention (11.7% low HL vs. 6.9% adequate HL; p = 0.03), and return to the operating room (5.9% low HL vs. 2.7% adequate HL; p = 0.04). All complication rates by health literacy group are listed in Table 2.

The pre-discharge complication rate for our entire cohort was 25.8% and the post-discharge complication rate was 17.1%. While

**Table 1**  
Demographic information of entire cohort and stratified by Health Literacy Group.

	Total	Adequate Health Literacy Score of 3 or less	Low Health Literacy Score of 4 or more	p-value
Overall, n (%)	722	482 (66.8)	240 (33.2)	
Race, n (%)				0.07
White	607 (84.3)	414 (86.3)	193 (80.4)	
Black	92 (12.8)	56 (11.7)	36 (15.0)	
Other/Unknown	21 (2.9)	10 (2.1)	11 (4.6)	
Age, years, mean (SD)	65 (10.1)	64.1 (10.5)	67 (9.1)	<0.01
Gender, n (%)				0.02
Female	29 (4.0)	25 (5.2)	4 (1.7)	
Male	692 (96.0)	457 (94.8)	235 (98.3)	
Marital Status, n (%)				<0.01
Married	329 (45.6)	194 (40.2)	135 (56.5)	
Separated/Divorced	270 (37.4)	202 (42.0)	68 (28.4)	
Widowed	43 (6.0)	25 (5.2)	18 (7.5)	
Single/Never Married	78 (10.8)	61 (12.6)	17 (7.1)	
Charlson Comorbidity Index, mean (SD)	4.2 (3.2)	4.0 (3.0)	4.7 (3.4)	<0.01
VR-12 Assessment, mean (SD)				
Physical Component Score (PCS)	31.2 (12.1)	32.0 (11.9)	29.5 (12.2)	0.01
Mental Component Score (MCS)	48.4 (12.4)	49.7 (11.5)	45.9 (13.7)	<0.01
Discharge Destination, n (%)				
Home	466 (64.7)	323 (67.3)	143 (59.6)	0.02
Home with Assistance	147 (20.4)	100 (20.8)	47 (19.6)	
Inpatient Rehabilitation Center	74 (10.3)	39 (8.1)	35 (14.6)	
Skilled Nursing Facility	33 (4.6)	18 (3.8)	15 (6.3)	
Surgery Type, n (%)				0.01
General	326 (45.2)	232 (48.1)	94 (39.2)	
Vascular	252 (34.9)	169 (35.1)	83 (34.6)	
Thoracic	144 (19.9)	81 (16.8)	63 (26.3)	
Emergency Procedure, n (%)	20 (3.5)	10 (2.2)	10 (4.4)	0.10
ASA Classification, n (%)				0.35
1–2	58 (8.4)	41 (8.8)	17 (7.4)	
3	535 (77.2)	362 (78)	173 (75.6)	
4–5	100 (14.4)	61 (13.2)	39 (17)	
Operative Time (hours), median (IQR)	3.2 (2.1–4.7)	3.3 (2.2–4.9)	3.0 (1.7–4.3)	<0.01
Work Relative Value Unit (RVU), mean (SD)	19.5 (11.9)	20.4 (12.1)	17.7 (11.1)	<0.01
New Amputation, n (%)	48 (6.6)	23 (4.8)	25 (10.5)	<0.01
New Ostomy creation, n (%)	50 (6.9)	34 (7.1)	16 (6.7)	0.92
Hospital Length of Stay (days), median (IQR)	5.0 (3.0–8.0)	5.0 (4.0–8.0)	5.0 (3.0–7.0)	0.19

SD = Standard Deviation, ASA = American Society of Anesthesiologists, IQR = Interquartile Range.

the occurrence of a pre-discharge complication did not vary by health literacy at discharge (low HL: 27.9% vs. adequate HL: 24.9%,  $p = 0.37$ ), post-discharge complications were more frequent among patients with low HL (22.1% vs. 14.7%,  $p = 0.01$ ). We examined the timing of the readmission and found no difference in median time to readmission (in days from discharge) for patients with adequate health literacy at 16.5 days (IQR 11–24) compared to 16.0 days (IQR 10–25) for patients with low HL ( $p = 0.94$ ).

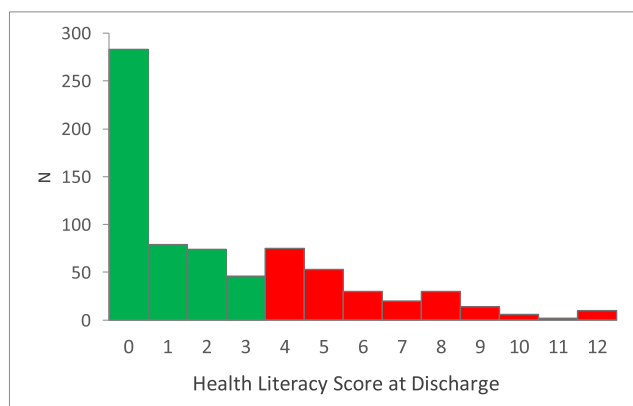


Fig. 2. Distribution of Brief Health Literacy Screener scores.

When considering readmission rates, patients with adequate health literacy had a significantly lower readmission rate at 13.3% as compared to 22.5% for patients with low health literacy ( $p = 0.002$ ) [Fig. 3]. Although not statistically significant, there was an increase in ED utilization for patients with low HL (24.2%) compared to those with adequate HL (18.7%,  $p = 0.08$ ). On bivariate analysis, discharge destination was significantly associated with both HL scores ( $p = 0.03$ ) and 30 day post-discharge readmission ( $p = 0.02$ ). However, discharge destination was not found to be a significant predictor after adjusting for the other factors in the multivariable model ( $p = 0.13$ ) and was removed from the final adjusted model.

In the unadjusted model for readmission, patients having low health literacy were 1.90 times more likely to be readmitted (OR: 1.90, 95% CI: 1.27–2.83). After adjusting for PCS, MCS, Charlson comorbidity index at the time of discharge, age, gender, race, operative time, RVU, and surgical specialty, patients with low health literacy were 59% more likely to experience a readmission (OR = 1.59, 95% CI = 1.02–2.50).

We next examined the distribution of answers to the individual questions within BHLS. The majority of patients stated that they never need help reading hospital material ( $n = 390$ , 54%), never have difficulty learning about a medical condition ( $n = 505$ , 70%), and were always confident filling out medical forms ( $n = 462$ , 64%). In contrast, 13.9% ( $n = 100$ ) people stated that they always need help reading hospital material, 3.1% ( $n = 23$ ) stated that they always have problems learning about medical conditions, and 9.7% ( $n = 70$ )

**Table 2**  
30-Day outcomes by health literacy group.

	Adequate Health Literacy Score of 3 or less	Low Health Literacy Score of 4 or more	p-value	Adjusted Odds Ratio <sup>a</sup> OR (95% CI)
Overall, n (%)	482 (66.8)	240 (33.2)		
Any complication, n (%)	144 (29.9)	95 (39.8)	0.01	1.40 (0.97–2.02)
Pre-hospital discharge, n (%)	120 (24.9)	67 (28.0)	0.38	1.12 (0.75–1.68)
Post-hospital discharge, n (%)	71 (14.7)	53 (22.1)	0.01	1.57 (1.00–2.46)
Any ED visit, n (%)	90 (18.7)	58 (24.2)	0.08	1.27 (0.83–1.94)
Any Unplanned Readmission, n (%)	64 (13.3)	53 (22.1)	<0.01	1.59 (1.02–2.50)

ED = Emergency Department.

<sup>a</sup> Odds ratios are adjusted for study site, age, race, gender, Charlson Comorbidity Index, Physical Component Score, Mental Component Score, surgery type, operative time, work relative value unit.

stated that they never feel confident filling out medical forms. The frequencies of responses to the individual questions and the distribution based on HL score can be found in supplemental material [Table 3].

When exploring the performance of the questions within an adjusted analysis, patients who reported ever having difficulty understanding written information (OR: 1.48, 95% CI: 0.95–2.31), and patients who ever required help to read hospital materials (OR: 1.18, 95% CI: 0.77–1.83) were no more likely to be readmitted. However, patients who reported that they were not always confident filling out medical forms were 79% more likely to be readmitted (OR: 1.79, 95% CI: 1.15–2.78).

## Discussion

In our study, patients with low health literacy had a significantly higher readmission rate at 22.5% as compared to 13.3% of patients with adequate health literacy ( $p = 0.002$ ) on our cohort with an overall 30 day post discharge readmission rate 16.3%. Of those readmitted, 17.4% were readmitted to a hospital outside the VA system which is consistent with prior literature at 15%.<sup>30</sup> Furthermore, when adjusting for clinical and demographic characteristics, patients with low health literacy have 60% increased odds of postoperative readmission compared to patients with adequate health literacy. When we examined the timing of complications (pre or post discharge) related to HL and readmissions, we found that pre-discharge complications were similar between those with adequate vs. low HL. This makes sense because these complications were recognized in the hospital while being cared for by the healthcare team. However once patients were outside of the hospital, we found that post-discharge complication rates were higher among patients with low HL (22.1% vs 14.7%,  $p = 0.01$ ).

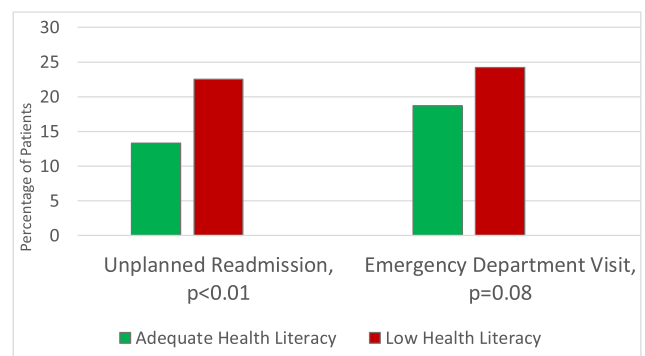
Thirty-three percent of the veteran surgical patient population would be classified as having inadequate health literacy. This rate is consistent with the general population (outside the VA system)<sup>1–3</sup> and higher than previously reported rates within the VA surgery patient populations.<sup>5,20,21</sup> Our findings are consistent with prior reports that health literacy is a significant predictor of 30-day readmissions within the non-VA medical patient population.<sup>31</sup> This association of low health literacy with readmission risk has important health education and post-acute care management implications for VA.

Three recent studies have brought the association between health literacy and post-surgical outcomes into the spotlight. The first and largest (over 1200 patients) by Wright et al. also used the BHLS tool to measure health literacy and found that following major abdominal surgery, patients with low health literacy (26.6% were classified as low or intermediate HL) had a longer length of stay for the index hospitalization. While our study and that of Wright et al. used the same BHLS tool, we categorized groups of

patients in different ways; Wright et al. classified patients as high HL, intermediate-high HL, intermediate and low HL while we simply grouped the patients who scored in the high and intermediate-high groups as adequate HL and those that scored in the intermediate and low HL as low HL. Similarly our rate of low HL was 33% and the rate of patients who scored in the low and intermediate low range for their study was 26.6%. In contrast to our study, they found no correlation between health literacy and 30-day ED visits or 90-day readmissions.<sup>32</sup> One reason for this may be that their population of patients was different from our veteran population (less racial diversity and half the population was female), did not include patients undergoing vascular or thoracic operations, and assessed readmission rates over 90 days instead of thirty.

The second paper that utilizes the same BHLS screening tool is by Scarpato et al., who chose to define high and low HL based on the median for the study population thus resulting in a 51% rate of low HL for their study. This group examined a total of 575 patients undergoing radical cystectomy. They found an association with low HL and minor complications but did not find an association between HL and healthcare utilization within 90 days of discharge (ED visit or readmission). Similar to our study, patients had comparable days to readmission regardless of HL score.<sup>33</sup>

In another study, Halleberg Nyman et al. explored the association between health literacy and healthcare utilization, quality of recovery, and health-related quality of life in Swedish patients undergoing same-day surgery.<sup>34</sup> Similar to the other two studies discussed, they found no association between health literacy and subsequent surgery-related healthcare contact, defined as contact with primary care, emergency department, Sweden's 24 h helpline, outpatient hospital visit, or contact through follow-up phone calls as part of a larger trial, these outcomes were tracked for the 14 days following surgery. Halleberg Nyman et al. did find that patients with low health literacy had a poorer quality of life and recovery



**Fig. 3.** Readmission and ED visit by Health Literacy category.

**Table 3**  
Distribution of responses to individual questions of the BHLS in total and by HL score.

Question	Response	Total		Adequate Health Literacy Score of 3 or less		Low Health Literacy Score of 4 or more	
		(n = 722)	%	(n = 482)	%	(n = 240)	%
How often do you have someone help you read hospital materials?	Never	390	54.0	357	74.1	33	13.8
	Occasionally	119	16.5	83	17.2	36	15.0
	Sometimes	69	9.5	30	6.2	39	16.2
	Often	44	6.1	12	2.5	32	13.3
	Always	100	13.9	0	0.0	100	41.7
How often do you have problems learning about a medical condition because of difficulty understanding written information?	Never	505	70.0	426	88.4	79	32.9
	Occasionally	96	13.3	41	8.5	55	22.9
	Sometimes	70	9.7	13	2.7	57	23.8
	Often	28	3.9	2	0.4	26	10.8
	Always	23	3.1	0	0.0	23	9.6
How confident are you filling out medical forms by yourself?	Always	462	64.0	405	84.0	57	23.8
	Often	80	11.1	43	8.9	37	15.4
	Sometimes	73	10.1	32	6.6	41	17.0
	Occasionally	37	5.1	2	0.4	35	14.6
	Never	70	9.7	0	0.0	70	29.1

using the Swedish Quality of Recovery scale (SwQoR) collected through follow-up phone calls. The study had a similar number of patients as ours and a similar proportion of health literate patients (60.6%) as measured with a different tool validated in their specific study population, the Swedish Functional Health Literacy scale. It is difficult to draw conclusions from two different health literacy measures, however the difference in association (or lack thereof) between health literacy and readmissions among these studies may again be due to the different patient populations examined and procedures performed, since each surgical procedure inherently contains unique risk.

In medical populations, patients with low health literacy experience longer length of stay (LOS), increased severity of chronic disease states on presentation, and higher use of emergency services.<sup>1,2,4</sup> We did not find a significant association with health literacy and ED utilization. However, one should be cautious in drawing conclusions about this as our study may be underpowered to detect association with health literacy and ED utilization as this was not primary outcome. In these patient populations it has been shown that the BHLS can be pared down to one question and still provide adequate information about a person's health literacy.<sup>27</sup> The single question, "How confident are you in filling out medical forms by yourself?" has been validated in several non-surgical populations and is also known as the single-item screener (SIS) for health literacy.<sup>21,27</sup> In our study we did find a significant association between this single item and surgical readmissions. This is consistent with the medical literature and suggesting that a single-item assessment of health literacy may be a feasible tool to quickly and easily measure HL in a surgery population.

The present study is not without limitation, there are multiple validated tools available to measure health literacy, and thus the results reported may not be definitive for drawing conclusions across studies where different tools have been used. Also, most people agree on adequate health literacy and inadequate health literacy, but there is some discussion and ambiguity when it comes to defining cut-off points and distinguishing between categories such as inadequate, marginal, and adequate health literacy. Accordingly, we have provided the results of both our categorical and continuous variable analyses of health literacy. Since this survey was conducted through an in-person interview we must acknowledge the potential social desirability bias in addition to the limitations of survey methodology.

As an observational study the possibility exists (and it likely) that there were unmeasured, unknown confounders. For example, education level and socioeconomic variables were not collected in this study and not routinely collected in the VA health record system which may be confounders. We also did not observe the quality of the discharge instructions given during this study period and therefore cannot make any inferences about their association with HL or readmissions. Furthermore, this is a VA patient population and as such these populations are typically older, predominately white, predominately male, and with different access to care in a single payer system; therefore, these results may not be generalizable to other patient populations.

In conclusion, low health literacy is prevalent in the VA inpatient surgery population, representing one-third of these patients. This study observed an association between low health literacy and increased rate of post-discharge 30-day readmissions. Further efforts and studies should be directed towards identifying patients with low health literacy prior to surgery and ensuring that the healthcare systems are health literate organizations to eliminate any disparity in care and further examine the association between HL and quality of care measures at both the patient and system level.

#### Declaration of competing interest

We have no conflicts of interests to disclose.

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