Health Literacy in Surgery

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ABSTRACT

Background: Low health literacy is associated with poor health outcomes in many chronic diseases and may have an important role in determining surgical outcomes. This study aims to comprehensively review the current state of science on adult health literacy in surgery and to identify knowledge gaps for future research. **Methods:** Using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, a systematic search was conducted to identify all studies from January 2002 through May 2018 that used validated instruments to assess health literacy among adult patients undergoing surgery. Studies were assessed for quality using the Newcastle-Ottawa scale and evaluated on findings by their focus on identifying health literacy levels, understanding associations with surgical outcomes, and/or developing interventions to address low health literacy. **Key Results:** There were 51 studies on health literacy with data from 22,139 patients included in this review. Low health literacy was present in more than one-third of surgical patients (34%, interquartile range 16%-50%). The most commonly used validated instrument for assessment of health literacy in the surgical population was the Newest Vital Sign. Most studies were focused on identifying the prevalence of low health literacy within a surgery population (84%, $n = 43$). Few studies focused on understanding the association of health literacy to surgical outcomes (12%, $n = 6$) and even fewer studies developed interventions to address health literacy (4%, $n = 2$). **Discussion:** Low health literacy is common among surgical patients. Important opportunities exist to better understand the role of health literacy in determining surgical outcomes and to develop more health literacy-sensitive models of surgical care. **[*HLRP: Health Literacy Research and Practice*. 2020;4(1):e45-e65.]**

Plain Language Summary: Health literacy has not been well-studied in surgery but likely plays an important role. In this article, we reviewed all current research on health literacy in surgery to help us understand where we are at and where we need to go. We found that low health literacy is common and we need more ways to address it in surgery.

Health literacy is a major determinant of health outcomes. Low health literacy is associated with increased risk for emergency care and hospitalizations, poor adherence to medication regimen, and higher mortality rates (Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011). The US Department of Health and Human Services (HHS) and the National Academy of Medicine (NAM) define health literacy as the "degree to which individuals have the capacity to obtain, process, and understand health information and services needed to make health decisions"(Kindig, Panzer, & Nielsen-Bohlman, 2004). Failures by providers and health care systems to account for these capacities may contribute to poor outcomes (De Oliveira, McCarthy, Wolf, & Holl, 2015). Recognizing these deficiencies, HHS enacted the National Action Plan to Improve Health Literacy in 2010 to improve access to accurate and actionable health information and usable health services

(U.S. Department of Health and Human Services, 2000). Initiatives by other major institutions such as the NAM (Institute of Medicine, 2011), National Institutes of Health (2016), and Centers for Disease Control and Prevention (2016) to improve health literacy have followed, but few studies to date have focused on surgical patients (De Oliveira et al., 2015). Therefore, the role of health literacy in determining surgical outcomes is poorly understood but may have significant implications in the care of surgical patients (De Oliveira et al., 2015).

The only review of health literacy studies in surgery was limited to 10 studies and found that low health literacy was present in certain surgical populations such as transplant and orthopedic patients (De Oliveira et al., 2015). Among these selected populations, low health literacy was associated with nonadherence to preoperative and/or discharge instructions as well as poor comprehension of surgical procedures (De Oliveira et al., 2015). The current state of science on health literacy in surgery since 2013 has not been readdressed. Therefore, the objective of this study was to systematically review the available research on health literacy in adult surgical patient populations and to identify the knowledge gaps to inform future research.

METHODS

Systematic Search

Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Liberati et al., 2009), a comprehensive search of the National Library of Medicine's PubMed database, Embase, Scopus database, Proquest, PsychInfo, and the Cumulative Index of Nursing and Allied Health Literature (CINAHL) was performed through May 31, 2018. Through partnerships with Library Services at the University of Alabama Birmingham, keywords and medical subject heading (MESH) terms used in the search included "health literacy," "surgical," "post-operative," and "surgery." The entire search string for each database along with the number of screened abstracts can be found in **Table A**. Two authors (S.J.B. and I.C.D.S M.) who are experienced researchers independently evaluated abstracts of the 673 articles obtained by the initial search. Article titles and abstracts were screened for a validated tool to measure health literacy and relevance to the aim of this systemic review. Discrepancies about inclusion of articles were resolved with a third person (D.I.C.) who was blinded regarding evaluation of the first two authors.

Inclusion and Exclusion Criteria

We included published articles that evaluated health literacy in the perioperative setting. Studies were included if they were peer-reviewed articles, available in their full length, and measured health literacy using a validated instrument. Studies were excluded if they did not use a validated instrument, were conducted on a pediatric population, conducted

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on a caregiver, or included procedures such as percutaneous coronary intervention, cataract surgery, or endoscopic procedures.

Validity Scoring

The Newcastle-Ottawa scale was used to assess the quality and risk of bias in cohort, case-control, and cross-sectional studies (Stang, 2010). Two authors (S.J.B., I.C.D.S.M.) independently read the included articles and scored articles with the Newcastle-Ottawa scale. Discrepancies in scores were resolved by a third author (D.I.C.) who scored the article, and a discussion was then held among the authors. Potential bias of each study was described according to the PRISMA guidelines.

Data Extraction and Analysis

Two authors (S.J.B. and I.C.D.S.M.) independently reviewed all included studies and extracted data using the same data collection form. Discrepancies in data extraction were resolved by discussion among the authors. The variables collected included surgical subspecialty, study design, sample size, time in relation to surgical procedure (preoperative, postoperative, or both), prevalence of patients with low health literacy, validated health literacy instrument used, and potential bias in the study. The primary objective of each study was also evaluated. Median and interquartile ranges (IQR) were calculated for number of patients enrolled per study, prevalence of low health literacy, and Newcastle-Ottawa Scale (NOS) scores.

RESULTS

The comprehensive search initially identified 1,048 abstracts from January 1, 2002 to May 31, 2018. After duplicates were removed and previous studies' bibliographies were manually reviewed, 673 abstracts remained for initial screening. After the abstract/title screen, 73 articles were suitable for full-text review. Once these full-text articles were assessed for inclusion and exclusion criteria, 51 studies were eligible to be included in the review for data collection and reporting. The PRISMA flow diagram can be found in **Figure 1**.

The number of health literacy studies in surgery patient populations has increased over time from January 2002 until May 2018 (**Figure 2**). The 51 health literacy studies included data from 22,139 patients (Alokozai et al., 2017; Beitler et al., 2010; Cajita et al., 2017; Cayci et al., 2018; Chew, Bradley, Flum, Cornia, & Koepsell, 2004; Choi, 2011; Chu & Tseng, 2013; Conlin & Schumann, 2002; Dageforde, Box, Feurer, & Cavanaugh, 2015; Dageforde et al., 2014; Escobedo & Weismuller, 2013; Garcia-Marcinkiewicz, Long, Danielson, & Rose, 2014; Gordon & Wolf, 2009; Grubbs, Gregorich, Perez-Stable, & Hsu, 2009; Halbach et al., 2016; Halleberg Nyman, Nilsson, Dahlberg, & Jaensson, 2018; Hallock, Rios, & Handa, 2017; Huang et al., 2018; Izard et al., 2014; Jones et al., 2016; Kazley, Hund, Simpson, Chavin, & Baliga, 2015; Kazley et al., 2014; Keim-Malpass, Doede, Camacho, Kennedy, & Showalter, 2018; Khan, Fjeraek, Andreasen, Thorup, & Dinesen, 2018; Komenaka et al., 2014; Koster, Schmidt, Philbert, van de Garde, & Bouvy, 2017; Lambert, Mullan, Mansfield, & Lonergan, 2015; Mahoney, Tawfik-Sexton, Strassle, Farrell, & Duke, 2018; Menendez, Mudgal, Jupiter, & Ring, 2015; Menendez, Parrish, & Ring, 2016; Menendez et al., 2017; Mercieca-Bebber et al., 2017; Miller-Matero, Hyde-Nolan, Eshelman, & Abouljoud, 2015; Parekh et al., 2017; Parrish et al., 2016; Patzer et al., 2016; Roh et al., 2018; Rosenbaum et al., 2015; Scarpato et al., 2016; Schmidt et al., 2016; Serper et al., 2015; Tang, Li, Tang, Wang, & Wang, 2017; Taylor et al., 2016; Turkoglu et al., 2019; Wallace et al., 2007; Wallace et al., 2009; Weng et al., 2013; Winton et al., 2016; Wright et al., 2018; Zite & Wallace, 2011) and used an assortment of 18 different types of health literacy instruments (**Table 1**) (Arozullah et al., 2007; Baker, Williams, Parker, Gazmararian, & Nurss, 1999; Pan, Su, & Chen, 2010; Chew, Bradley, & Boyko, 2004; Chew et al., 2008; Chung & Nahm, 2015; Davis et al., 1991; Fagerlin et al., 2007; Galesic & Garcia-Retamero, 2011; Gibbs et al., 2016; Gordon & Wolf, 2009; Ishikawa, Takeuchi, & Yano, 2008; Jordan et al., 2013; Kazley et al., 2014; Morris, MacLean, Chew, & Littenberg, 2006; Nakayama et al., 2015; Osborne, Batterham, Elsworth, Hawkins, & Buchbinder, 2013; Rosenbaum et al., 2015; Sørensen et al., 2012; Wallace et al., 2009; Wangdahl & Martensson, 2015; Weiss et al., 2005).

The median number of patients in health literacy studies was 153 (IQR, 94-364) (Roh et al., 2018; Rosenbaum et al., 2015; Tung et al., 2014; Wallace et al., 2007; Wallace et al., 2009). Of the studies that provided health literacy measurements, the prevalence of low health literacy affected more than one-third of surgical patients (34%; IQR, 16%-50%) (Alokozai et al., 2017; Beitler et al., 2010; Cajita et al., 2017; Cayci et al., 2018; Chew, Bradley, Flum et al. 2004; Choi, 2011; Chu & Tseng, 2013; Conlin & Schumann, 2002; Dageforde et al., 2015; Dageforde et al., 2014; Escobedo & Weismuller, 2013; Garcia-Marcinkiewicz et al., 2014; Gordon & Wolf, 2009; Grubbs et al., 2009; Halbach et al., 2016; Halleberg Nyman et al., 2018; Hallock et al., 2017; Izard et al., 2014; Jones et al., 2016; Keim-Malpass et al., 2018; Komenaka et al., 2014; Koster et al., 2017; Mahoney et al., 2018; Menendez et al., 2016; Menendez et al., 2017; Miller-Matero et al., 2015; Patzer et al., 2016; Roh et al., 2018; Rosenbaum et al., 2015; Scarpato et al., 2016; Serper et

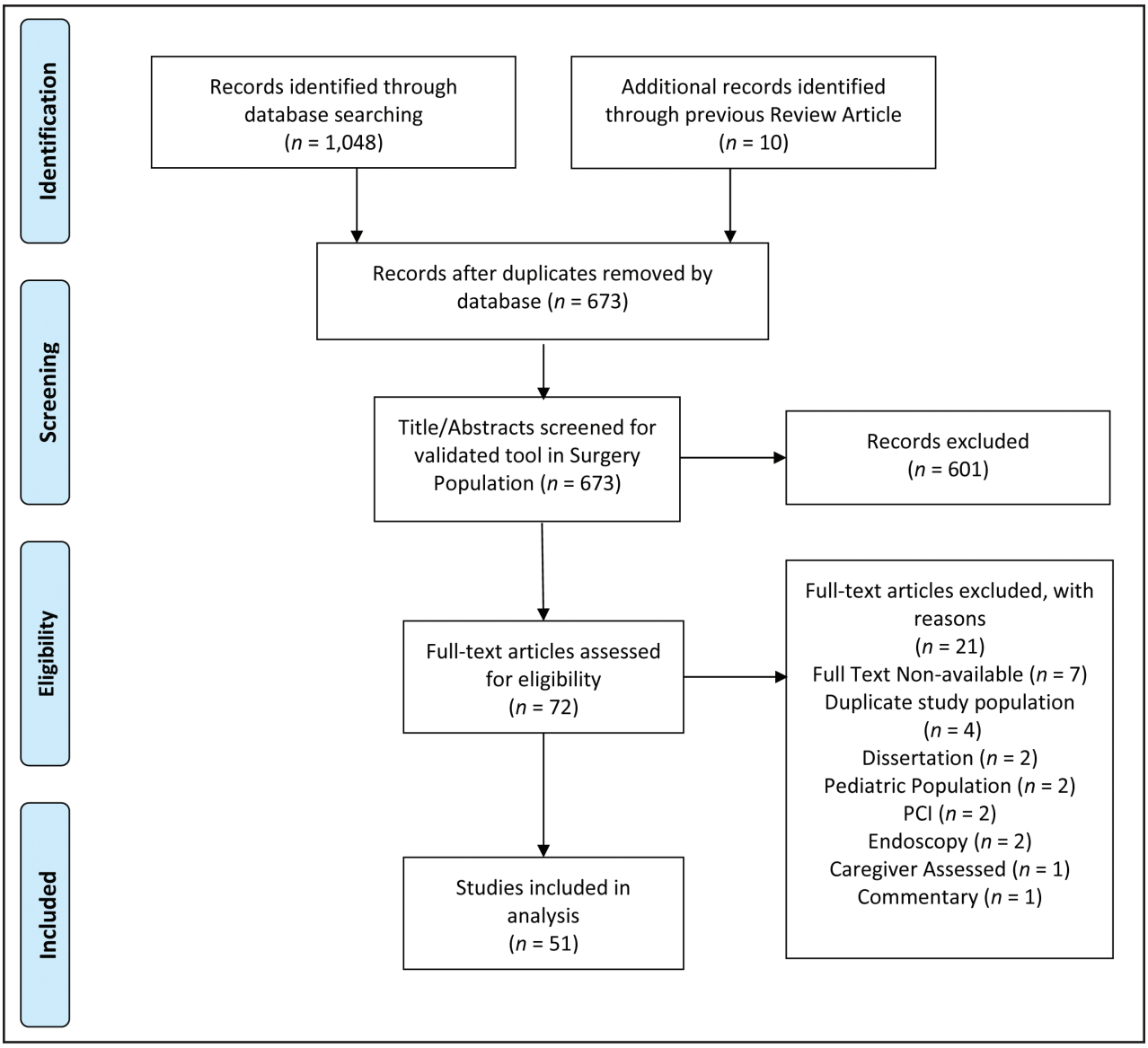

Figure 1. Flowchart describing selection of included studies. PCI = percutaneous coronary intervention.

al., 2015; Tang et al., 2017; Taylor et al., 2016; Turkoglu et al., 2019; Wallace et al., 2007; Weng et al., 2013; Winton et al., 2016; Wright et al., 2018; Zite & Wallace, 2011) The median NOS score was 7 (IQR, 7-8) (Alokozai et al., 2017; Beitler et al., 2010; Cajita et al., 2017; Cayci et al., 2018; Chew, Bradley, Flum et al., 2004; Chu & Tseng, 2013; Conlin & Schumann, 2002; Escobedo & Weismuller, 2013; Garcia-Marcinkiewicz et al., 2014; Gordon & Wolf, 2009; Grubbs et al., 2009; Halbach et al., 2016; Halleberg Nyman et al., 2018; Hallock et al., 2017; Huang et al., 2018; Izard et al., 2014; Jones et al., 2016; Kazley et al., 2015; Kazley et al., 2014; Keim-Malpass et al., 2018; Koster et al., 2017; Lambert et al., 2015; Menendez, Mudgal et al., 2015; Menendez et al., 2016; Menendez et al., 2017; Mercieca-Bebber et al., 2017; Parrish et al., 2016; Roh et al., 2018; Rosenbaum et al., 2015; Scarpato et al., 2016; Schmidt et al., 2016; Serper et al., 2015; Tang et al., 2017; Taylor et al., 2016; Tung et al., 2014; Turkoglu et al., 2019; Wallace et al., 2007; Weng et al., 2013; Winton et al., 2016; Wright et al., 2018), where a score of 7-9 indicates low risk of bias and high quality.(Stang, 2010)

Health Literacy Instruments

Health literacy instruments can be used to assess a person's ability or perception of ability to read and comprehend medical information, to assess a person's ability or perception of ability to perform mathematic operations, or both.

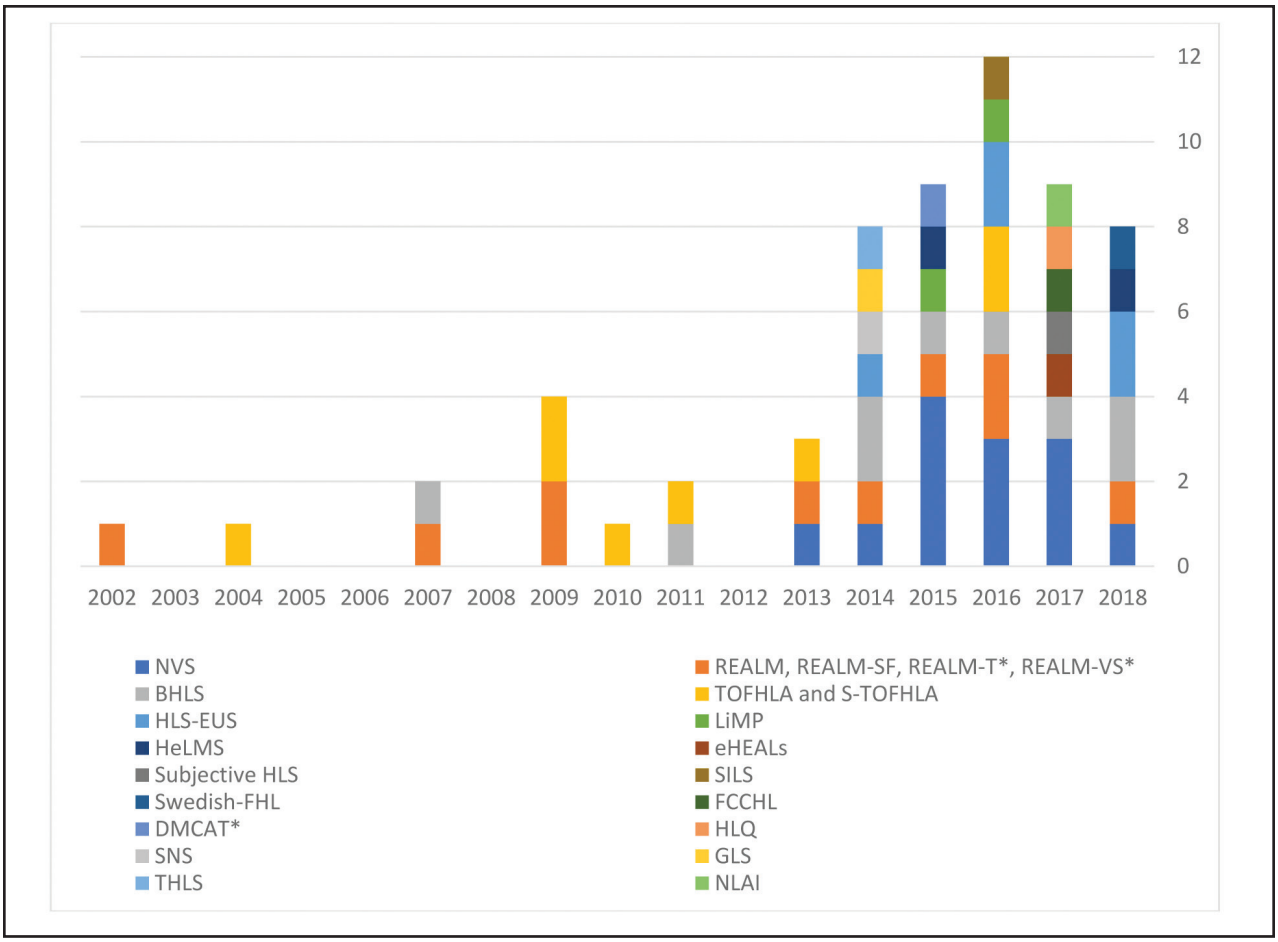

Figure 2. Trends in studies on health literacy and health literacy assessment tools in surgery patient populations (January, 2002 to May, 2018). Asterisk denotes disease-specific health literacy measurement tool. BHLS = Brief Health Literacy Screener; DMCAT = Decision Making Capacity Assessment Tool; eHEALS = Electronic Health Literacy Scale; FCCHL = Functional Communicative Critical Health Literacy; FHL = Functional Health Literacy; GLS = Graphic Literacy Scale; HeLMS = Health Literacy Management Scale; HLQ = Health Literacy Questionnaire; HLS = Health Literacy Screen; HLS-EU = European Health Literacy Scale; LiMP = Literacy In Musculoskeletal Patients; NLAI = Nutrition Literacy Assessment Instrument; NVS = Newest Vital Sign; REALM = Rapid Estimate of Adult Literacy; REALM-SF = Rapid Estimate of Adult Literacy in Medicine–Short Form; REALM-T = Rapid Estimate of Adult Literacy in Medicine–Transplant; REALM-VS = Rapid Estimate of Adult Literacy in Medicine–Vascular Surgery; SILS = Single Item Literacy Screener; SNS = Subjective Numeracy Scale; S-TOFHLA = Short Form Test of Functional Health Literacy in Adults; THLS = Taiwan Health Literacy Scale; TOFHLA = Test of Functional Health Literacy in Adults.

Most of the 18 tools included in these studies assessed literacy or reading comprehension (n = 13) (Baker et al., 1999; Chew et al., 2008; Chung & Nahm, 2015; Ishikawa et al., 2008; Jordan et al., 2013; Kazley et al., 2014; Morris et al., 2006; Nakayama et al., 2015; Rosenbaum et al., 2015; Sorensen et al., 2012; Wangdahl & Martensson, 2015). A small number of health literacy tools measured numeracy (n = 2) (Fagerlin et al., 2007; Weiss et al., 2005), a combination of numeracy and literacy/reading (n = 2) (Baker et al., 1999; Parker, Baker, Williams, & Nurss, 1995), or a patient's ability to comprehend information presented in graphic form (n = 1) (Galesic & Garcia-Retamero, 2011). Numeracy is defined as the ability to perform mathematical tasks such as working with fractions and use of numerical information over prose. Across studies, 59% of these studies measured literacy or reading comprehension (59%, n = 30) (Cajita et al., 2017; Cayci et al., 2018; Chu & Tseng, 2013; Conlin & Schumann, 2002; Dageforde et al., 2015; Dageforde et al., 2014; Garcia-Marcinkiewicz et al., 2014; Halbach et al., 2016; Halleberg Nyman et al., 2018; Hallock et al., 2017; Huang et al., 2018; Keim-Malpass et al., 2018; Khan et al., 2018; Koster et al., 2017; Lambert et al., 2015; Mahoney et al., 2018; Mercieca-Bebber et al., 2017; Miller-Matero et al., 2015; Patzer et al., 2016; Scarpato et al., 2016; Schmidt et al., 2016; Tang et al., 2017; Taylor et al., 2016; Tung et al., 2014; Turkoglu et al., 2019; Wallace et al., 2007; Wallace et al., 2009; Wright et al., 2018; Zite & Wallace, 2011), 21.5% measured both reading comprehension and numeracy (n = 11) (Beitler et al., 2010;

TABLE 1

Health Literacy Instruments

Instrument	Description	Test Time (minutes)	Scoring	Number of Studies
NVS (Weiss et al., 2005)	Nutrition label with 6 questions measuring health literacy	3	Raw score converted to 3 categories of likelihood of low health literacy	13
REALM variations used				
REALM (Davis et al., 1991)	66-item health-related vocabulary test	3-5	Scale 0-66. Raw score converted by grade level: <3rd , 4th -6th grade, 7th-8th grade, and >9th	6
REALM-SF (Arozullah et al., 2007)	7-item health-related vocabulary test	3	Scale 0-7. Raw score converted by grade level: <3rd , 4th -6th grade, 7th-8th grade, and >9th	1
REALM-T[a] (Gordon & Wolf, 2009)	69-item transplant health-related vocabulary test	3-5	Scale 0 to 69. Scored based on number of words correct	2
REAL-VS (Wallace et al., 2009)	75-item vascular health-related vocabulary test	3-5	Scale 0 to 75. Scored based on number of words correct	1
BHLS (Chew, Bradley, & Boyko, 2004)	3 single-item screening questions identifying need for help with reading and comprehension	<7	Sum of scores of 3 questions on a 5 value Likert scale	9
Test of Functional Health Literacy in Adults				
TOFHLA (Parker et al., 1995)	50-item reading comprehension and 17-item numerical ability test using actual health-related materials such as prescription bottle labels and appointment slips	22	Scale of 0 to 100. Score based on test performance, age, and years of education	1
S-TOFHLA (Baker et al., 1999)	36 cloze items in 2 prose passages and 4 numeracy items to evaluate reading comprehension	12	Scale of 0 to 36. Score based on test performance, age, and years of education	7
Health Literacy Scale European Union				
HLS-EU-Q47 (Nakayama et al., 2015)	47 items of self-rating comfort with health literacy	No data available	4-point Likert scale converted to low, problematic, or sufficient health literacy	4
HLS-EU-Q16 (Sørensen et al., 2012)	16 items self-rating comfort with health literacy	25-90	4-point Likert scale converted to low, problematic, or sufficient health literacy	1
LiMP[a] (Rosenbaum et al., 2015)	9-item test specific to health literacy in musculoskeletal conditions	No data available	Raw score cutoff indicating adequate health literacy	2
HeLMS (Jordan et al., 2013)	24 items that test four dimensions: (1) information acquisition ability, (2) communication and interaction ability, (3) willingness to improve health, and (4) economic support	No data available	5-point Likert Scale, maximum 120 points	2
eHEALS (Chung & Nahm, 2015)	8-item scale developed to measure consumers' combined knowledge, comfort, and perceived skills at finding, evaluating, and applying electronic health information to health problems	No data available	5-point Likert and the score ranges from 8 to 40, with a higher score indicating higher literacy	1
Subjective HLS (Chew et al., 2008)	Question identifying need for help with completing medical forms	<1	5-point Likert scale converted to adequate, marginal, and low health literacy	1

TABLE 1 (*continued*)

Health Literacy Instruments

Instrument	Description	Test Time (minutes)	Scoring	Number of Studies
SISL (Morris et al., 2006)	Question identifying need for help with reading and comprehension	<3	5-point Likert scale converted to adequate, marginal, and low health literacy	1
Swedish- FHL (Wangdahl & Martensson, 2015)	5-item questionnaire identifying need for help with reading and comprehension	No data available	5-point Likert scale converted to inadequate, problematic, and sufficient health literacy	1
Dutch version of FCCHL (Ishikawa et al., 2008)	14-item assessment of perception of an individual's health literacy	No data available	4-point Likert scale for functional, communicative, and critical aspects of health literacy	1
HLQ (Osborne et al., 2013)	44 items cover nine conceptually distinct aspects of health literacy: (1) feeling understood and supported by health care providers; (2) having sufficient information to manage health; (3) actively managing health; (4) social support for health; (5) appraisal of health information; (6) ability to actively engage with health care providers; (7) navigating the health care system; (8) ability to find good health information; and (9) understanding health information well enough to know what to do	No data available	Provides scores for each of the 9 domains. Must obtain a license in order to access the tool and scoring	1
DMCAT[a] (Kazley et al., 2014)	7-item test specific to health literacy in kidney disease	No data available	4-point Likert scale for health literacy in kidney disease	1
SNS (Fagerlin et al., 2007)	8-item test that measures perception of math ability. The preference subdomain measures predilections for information in numeric versus prose formats. The ability subdomain measures a person's subjective capacity to perform calculations	No data available	6-point Likert-type scale. Score is calculated as the average rating across the 8 questions	1
GLS (Galesic & Garcia-Retamero, 2011)	13 items measuring whether individuals understand common graphic representations of numeric health information and is divided into 3 subdomains: (1) reading, (2) reading between the data, and (3) reading beyond the data	<10	Score is calculated as the number correct out of 13	1
THLS (Pan, Su, & Chen, 2010)	66-item test using prose to assess comprehension	No data available	Sum score based on 5-point Likert-type scale	1
NLit-BCa[a] (Gibbs et al., 2016)	Nutritional literacy test that measures 6 content areas: (1) nutrition and health, (2) macronutrients, (3) food portions, (4) label reading, (5) food groups, and (6) consumer skills	No data available	Each correct answer received a score of 1 with a maximum total score of 64	1

Note. BHLS = Brief Health Literacy Screen; DMCAT[a] = Decision Making Capacity Assessment Tool; eHEALS = Electronic Health Literacy Scale; FCCHL = Functional Communicative Critical Health Literacy; FHL = Function Health Literacy; GLS = Graphic Literacy Scale; HeLMS = Health Literacy Management Scale; HLQ = Health Literacy Questionnaire; HLS = Health Literacy Screener; HLS-EU = European Health Literacy Scale; LiMP = Literacy in Musculoskeletal Patients; NLit-BCa[a] Nutrition Literacy Assessment Instrument for Breast Cancer Patients; NVS = Newest Vital Sign; REAL-VS[a] = Rapid Estimate of Adult Literacy–Vascular Surgery; REALM = Rapid Estimate of Adult Literacy in Medicine; REALM-SF = Rapid Estimate of Adult Literacy in Medicine–Short Form; REALM-T[a] = Rapid Estimate of Adult Literacy in Medicine–Transplant; S-TOFHLA = Short Form Test of Function Health Literacy in Adults; TOFHLA = Test of Functional Health Literacy in Adults; SILS = Single Item Literacy Screener; SNS = Subjective Numeracy Scale; THLS = Taiwan Health Literacy Scale; TOFHLA = Test of Functional Health Literacy in Adults.
[a]Disease-specific health literacy measurement tool.

Chew, Bradley, Flum, et al. 2004; Choi, 2011; Gordon & Wolf, 2009; Grubbs et al., 2009; Izard et al., 2014; Jones et al., 2016; Kazley et al., 2015; Parekh et al., 2017; Rosenbaum et al., 2015; Weng et al., 2013), and 19.5% measured only numeracy (n = 10) (Alokozai et al., 2017; Escobedo & Weismuller, 2013; Menendez, Mudgal, et al., 2015; Menendez et al., 2016; Menendez et al., 2017; Parrish et al., 2016; Roh et al., 2018; Serper et al., 2015; Winton et al., 2016).

The most common tool that was used to measure health literacy was the Newest Vital Sign (NVS) (n = 13) (Alokozai et al., 2017; Escobedo & Weismuller, 2013; Kazley et al., 2015; Komenaka et al., 2014; Menendez, Mudgal, et al., 2015; Menendez et al., 2016; Menendez et al., 2017; Parekh et al., 2017; Parrish et al., 2016; Roh et al., 2018; Rosenbaum et al., 2015; Serper et al., 2015; Weiss et al., 2005; Winton et al., 2016). The second most common tool used was the Rapid Estimate of Adult Literacy (REALM) (n = 10) (Arozullah et al., 2007; Chu & Tseng, 2013; Davis et al., 1991; Gordon & Wolf, 2009; Izard et al., 2014; Kazley et al., 2015; Mahoney et al., 2018; Miller-Matero et al., 2015; Patzer et al., 2016; Wallace et al., 2009), followed by the Brief Health Literacy Screen (BHLS) (n = 9) (Chew, Bradley & Boyko, 2004; Conlin & Schumann, 2002; Dageforde et al., 2015; Dageforde et al., 2014; Garcia-Marcinkiewicz et al., 2014; Hallock et al., 2017; Keim-Malpass et al., 2018; Scarpato et al., 2016; Wallace et al., 2007; Wright et al., 2018; Zite & Wallace, 2011). The description of all studies using these various tools and others can be found in **Table 2**.

Health Literacy Has Been Assessed in Limited Surgical Populations

Health literacy was assessed to varying degrees in surgical subspecialties (**Figure 3**): 13 were in abdominal transplant (Dageforde et al., 2015; Dageforde et al., 2014; Escobedo & Weismuller, 2013; Gordon & Wolf, 2009; Grubbs et al., 2009; Jones et al., 2016; Kazley et al., 2015; Lambert et al., 2015; Miller-Matero et al., 2015; Patzer et al., 2016; Serper et al., 2015; Taylor et al., 2016; Weng et al., 2013), nine in breast surgery (Halbach et al., 2016; Huang et al., 2018; Keim-Malpass et al., 2018; Komenaka et al., 2014; Mercieca-Bebber et al., 2017; Parekh et al., 2017; Schmidt et al., 2016; Tang et al., 2017; Winton et al., 2016), six in hand surgery (Alokozai et al., 2017; Menendez, Chen, et al., 2015; Menendez et al., 2016; Menendez et al., 2017; Parrish et al., 2016; Roh et al., 2018), five in general surgery (Chew, Bradley, Flum, et al., 2004; Garcia-Marcinkiewicz et al., 2014; Halleberg Nyman et al., 2018; Koster et al., 2017; Wright et al., 2018), three in orthopedics (Choi, 2011; Chu & Tseng, 2013; Rosenbaum et al., 2015), three in urology (Izard et al., 2014; Scarpato et al., 2016; Turkoglu et al., 2019), three in vascular surgery (Tung et al., 2014; Wallace et al., 2007; Wallace et al., 2009), two in bariatric surgery (Cayci et al., 2018; Mahoney et al., 2018), two in gynecological surgery (Hallock et al., 2017; Zite & Wallace, 2011), two in cardiac surgery (Conlin & Schumann, 2002; Khan et al., 2018), and one each in otolaryngology (Beitler et al., 2010), and heart transplant surgery (Cajita et al., 2017). These surgery specialties also show preferences to which instruments were predominantly used to assess health literacy in their patient population. For example, hand surgery has almost exclusively used the NVS (Alokozai et al., 2017; Menendez, Mudgal, et al., 2015; Menendez et al., 2016; Menendez et al., 2017; Parrish et al., 2016; Roh et al., 2018), whereas abdominal transplant (Dageforde et al., 2015; Dageforde et al., 2014; Escobedo & Weismuller, 2013; Gordon & Wolf, 2009; Grubbs et al., 2009; Jones et al., 2016; Kazley et al., 2015; Lambert et al., 2015; Miller-Matero et al., 2015; Patzer et al., 2016; Serper et al., 2015; Taylor et al., 2016; Weng et al., 2013) and breast surgery (Halbach et al., 2016; Huang et al., 2018; Keim-Malpass et al., 2018; Komenaka et al., 2014; Koster et al., 2017; Mercieca-Bebber et al., 2017; Parekh et al., 2017; Schmidt et al., 2016; Tang et al., 2017; Winton et al., 2016) used several instruments to assess health literacy (**Figure 4**).

Health literacy has been assessed in all three phases of operative care (preoperative, perioperative, and postoperative), and no consensus exists as to the optimal timing of assessment with regard to an operation. Twenty-eight studies evaluated health literacy only in the preoperative settings, and 19 studies evaluated it only in the postoperative setting (Beitler et al., 2010; Cajita et al., 2017; Dageforde et al., 2015; Dageforde et al., 2014; Gordon & Wolf, 2009; Halbach et al., 2016; Halleberg Nyman et al., 2018; Izard et al., 2014; Khan et al., 2018; Mercieca-Bebber et al., 2017; Parekh et al., 2017; Patzer et al., 2016; Schmidt et al., 2016; Serper et al., 2015; Tang et al., 2017; Tung et al., 2014; Turkoglu et al., 2019; Weng et al., 2013; Winton et al., 2016). Three studies included assessments of patients in both pre- and postoperative periods (Escobedo & Weismuller, 2013; Kazley et al., 2015; Kazley et al., 2014), and one study did not state in which perioperative setting health literacy was evaluated (Keim-Malpass et al., 2018).

Low Health Literacy is Associated with Patient Characteristics Including Race/Ethnicity

Several studies examined factors associated with health literacy, finding that low health literacy was significantly associated with older age (Koster et al., 2017), male gender (Miller-Matero et al., 2015), lower socio-economic status (Koster et al., 2017), less education (Rosenbaum et al., 2015; Scarpato et al., 2016; Taylor et al., 2016), poor English flu-

TABLE 2

Evaluation of All Studies Included in the Review

Reference	Surgical Specialty	Health Literacy Instrument	Operative Stage	Study Design	Patients in Study (*n*)	Prevalence of Low Health Literacy[a]	Newcastle-Ottawa Scale Score[b]	Potential Bias/ Limitations
Evaluation of studies using the Newest Vital Sign								
Roh et al. (2018)	Hand	NVS	Pre	Prospective, cross-sectional	133	44% (*n* = 58)	8	Low number and single provider
Alokozai et al. (2017)	Hand	NVS	Pre	Prospective, cross-sectional	112	27% (*n* = 30)	8	Limited number of physicians, unknown referral patterns
Menendez et al. (2017)	Hand	NVS	Pre	Cross-sectional	84	26% (*n* = 22)	7	Sample size, coder bias
Parekh et al. (2017)	Breast	NVS, NLit-BCa	Post	Randomized controlled trial	59	-	N/A	Pilot study, selection bias
Menendez et al. (2016)	Hand	NVS	Pre	Prospective cohort	224	31% (*n* = 69)	6	Were unable to quantify complexity of visit
Parrish et al. (2016)	Hand	NVS	Pre	Prospetive, cross-sectional	112	-	7	Single center, measure not discussed
Winton et al. (2016)	Breast	NVS	Post	Retrospective review	403	78% (*n* = 314)	7	Selection bias
Kazley et al. (2015)	Abdominal transplant	NVS, REALM-T, DMCAT	Pre and Post	Cross-sectional	92	-	7	Caregiver present when assessed
Rosenbaum et al. (2015)	Orthopedics	NVS, LiMP	Pre	Cross-sectional	248	48% (*n* = 119, NVS) and 69% (n = 171, LiMP)	7	Participant bias, selection bias
Serper et al. (2015)	Abdominal transplant	NVS	Post	Prospective, multicenter cohort	105	15% (*n* = 15)	8	Self-reported nonadherence, self-selection bias
Menendez, Mudgal et al. (2015)	Hand	NVS	Post	Prospective cross-sectional	200	43% (*n* = 86)	7	Low number, potential for observer bias
Komenaka et al. (2014)	Breast	NVS	Pre	Feasibility study	2,025	86% (*n* = 1634)	N/A	Selection bias
Escobedo & Weismuller (2013)	Abdominal transplant	NVS	Pre and post	Cross-section	44	41% (*n* = 18)	7	Small sample size

TABLE 2 (*continued*)

Evaluation of All Studies Included in the Review

Reference	Surgical Specialty	Health Literacy Instrument	Operative Stage	Study Design	Patients in Study (*n*)	Prevalence of Low Health Literacy[a]	Newcastle-Ottawa Scale Score[b]	Potential Bias/ Limitations
Evaluation of studies using variations of the Rapid Estimate of Adult Literacy								
Mahoney et al. (2018)	Bariatric	REALM-SF	Pre	Prospective, cross-sectional	95	7% (*n* = 7)	7	Low number
Patzer et al. (2016)	Abdominal transplant	REALM	Post	Prospective, cross-sectional	99	25% (*n* = 24)	7	Sample size, interviewer bias
Miller-Matero et al. (2015)	Abdominal transplant	REALM	Pre	Cross-sectional	398	27.5% (*n* = 96)	7	Included patients with cognitive impairment
Kazley et al. (2014)	Abdominal transplant	REALM-T, DMCAT, NVS	Pre and post	Cross-sectional	92	-	7	Caregiver present when assessed
Izard et al. (2014)	Urology	REALM, SNS, GLS	Post	Cross-sectional	50	-	N/A	Small sample size, convenience sample
Chu & Tseng (2013)	Orthopedics	Chinese version of REALM	Pre	Cross-sectional	144	59% (*n* = 86)	4	Translated health literacy tool
Gordon & Wolf (2009)	Abdominal transplant	REALM-T, S-TOFHLA	Post	Cross-sectional	124	9% (*n* = 11, S-TOFHLA) and 81% (n = 100, REALM-T)	5	Only high educated patients
Wallace et al. (2009)	Vascular	REALM-VS	Pre	Validation study, cross-sectional	152	-	N/A	Convenience sample, selection bias
Wallace et al. (2007)	Vascular	REALM, BHLS	Pre	Cross-sectional, validation study	100	39% (*n* = 39)	5	Selection bias, sample size
Conlin & Schumann (2002)	Cardiac	REALM	Pre	Prospective cross-sectional	30	20% (*n* = 6)	7	Small sample size

TABLE 2 (*continued*)

Evaluation of All Studies Included in the Review

Reference	Surgical Specialty	Health Literacy Instrument	Operative Stage	Study Design	Patients in Study (*n*)	Prevalence of Low Health Literacy[a]	Newcastle-Ottawa Scale Score[b]	Potential Bias/ Limitations
Evaluation of studies using the Brief Health Literacy Screener								
Keim-Malpass et al. (2018)	Breast	BHLS	Not stated	Prospective, cross-sectional	512	26% (*n* = 131)	7	No information about if patient was not a candidate for a particular surgery option
Wright et al. (2018)	General	BHLS	Pre	Retrospective, cross-sectional	1,239	49% (*n* = 1,239)	9	Single center, under-representation of minorities
Hallock et al. (2017)	Gynecology	BHLS	Pre	Cross-sectional	150	10% (*n* = 16)	9	Use of a nonvalidated measure for knowledge
Scarpato et al. (2016)	Urology	BHLS	Pre	Retrospective, cross-sectional	368	51% (*n* = 188)	8	Under-representation of minorities
Dageforde et al. (2015)	Abdominal transplant	BHLS	Post	Pilot	104	23% (*n* = 24)	N/A	Convenience sample
Garcia-Marcinkiewicz et al. (2014)	General	BHLS	Pre	Cross-sectional	460	18% (*n* = 83)	8	Selection bias: majori-ty of participants had college level and above education; under-representation of minorities
Dageforde et al. (2014)	Abdominal transplant	BHLS	Post	Retrospective review	360	11% (*n* = 36)	N/A	Retrospective review with differences between the study groups
Zite & Wallace (2011)	Gynecology	BHLS	Pre	Randomized control trial	201	50% (*n* = 101)	N/A	Single institution, selection bias
Wallace et al. (2007)	Vascular	BHLS, REALM	Pre	Cross-sectional, validation study	100	39% (*n* = 39)	5	Selection bias, sample size

TABLE 2 (*continued*)

Evaluation of All Studies Included in the Review

Reference	Surgical Specialty	Health Literacy Instrument	Operative Stage	Study Design	Patients in Study (*n*)	Prevalence of Low Health Literacy[a]	Newcastle-Ottawa Scale Score[b]	Potential Bias/ Limitations
Evaluation of studies using variations of the Test of Functional Health Literacy in Adults								
Jones et al. (2016)	Abdominal transplant	S-TOFHLA, TOFHLA	Pre	Cross-sectional	40 (S-TOFHLA) and 36 (TOFHLA)	5% (*n* = 2, S-TOFHLA) and 14% (*n* = 5, TOFHLA)	4	Sample size, under-representation of minorities
Weng et al. (2013)	Abdominal transplant	S-TOFHLA	Post	Cross-sectional	252	2% (*n* = 6)	7	Self-reported adherence, potential selection bias
Choi et al. (2011)	Orthopedic	S-TOFHLA	Pre	Focus group	15	100% (*n* = 15)	N/A	Sampled patients with low health literacy
Beitler et al. (2010)	Ears, nose, and throat	S-TOFHLA	Post	Cross-sectional	8	37% (*n* = 3)	4	Sample size
Gordon & Wolf (2009)	Abdominal transplant	S-TOFHLA, REALM	Post	Cross-sectional	124	9% (*n* = 11, S-TOFHLA) and 81% (*n* = 100, REALM-T)	5	Only highly educated patients
Grubbs et al. (2009)	Abdominal transplant	S-TOFHLA	Pre	Cohort	62	32% (*n* = 14)	5	Sample size
Chew, Bradley, Flum, et al. (2004)	General	S-TOFHLA	Pre	Cohort	332	12% (*n* = 40)	5	Self-assessment measure of adherence, single center
Evaluation of studies using various health literacy screening tools								
Cayci et al. (2018)	Bariatric	HLS-EU-Q47	Pre	Cross-sectional case control	242 (138 vs. 104)	58% (*n* = 140)	7	Single center and demographic differences between groups
Halleberg Nyman et al. (2018)	Same day, multi-specialty	Swedish-FHL	Post	Multicenter, single blinded, randomized controlled trial	704	39% (*n* = 277)	N/A	Selection bias
Huang et al. (2018)	Breast	HLS-EU-Q	Pre	Prospective, cross-sectional	475	-	N/A	Single center
Khan et al. (2018)	Cardiac surgery	eHEALS	Post	Mixed methods	33	-	9	Sample size
Turkoglu et al. (2018)	Urology	HLS-EU-Q47	Post	Prospective, cross-sectional	126	67% (*n* = 85)	10	Single center

TABLE 2 (*continued*)

Evaluation of All Studies Included in the Review

Reference	Surgical Specialty	Health Literacy Instrument	Operative Stage	Study Design	Patients in Study (*n*)	Prevalence of Low Health Literacy[a]	Newcastle-Ottawa Scale Score[b]	Potential Bias/ Limitations
Cajita et al. (2017)	Heart transplant	Subjective HLS	Post	Cross-sectional, multicenter cohort	1,365	33% (*n* = 451)	10	Secondary analysis
Koster et al. (2017)	General	FCCHL	Pre	Cross-sectional	225	37% (*n* = 84)	7	Adapted health literacy tool
Parekh et al. (2017)	Breast	NLit-BCa, NVS	Post	Randomized controlled trial	59	-	N/A	Small sample size
Tang et al. (2017)	Breast	HeLMS	Post	Prospective, cross-sectional	286	N/A	8	Convenience sample, single center
Mercieeca-Bebber et al. (2017)	Breast	HLQ	Post	Cross-sectional	38	-	7	Selection bias
Halbach et al. (2016)	Breast	German HLS-EU-Q47	Post	Prospective, longitudinal, multicenter cohort	1,060	12% (*n* = 127)	6	Participant bias, potential selection bias
Schmidt et al. (2016)	Breast	HLS-EU-Q16	Post	Prospective, multicenter cohort	1,248	-	7	Selection bias
Taylor et al. (2016)	Abdominal transplant	SILS	Pre	Cross-sectional, multicenter cohort	6,842	14% (*n* = 1,001)	8	Single item screener
Kazley et al. (2015)	Abdominal transplant	DMCAT, NVS, REALM-T	Pre and Post	Cross-sectional	92	-	7	Caregiver present when assessed
Lambert et al. (2015)	Abdominal transplant	HeLMS	Pre	Cross-sectional	153	-	7	Single center
Rosenbaum et al. (2015)	Orthopedic	NVS, LiMP	Pre	Cross-sectional	248	48% (*n* = 119, NVS) and 69% (*n* = 171, LiMP)	7	Participant bias, selection bias
Izard et al. (2014)	Urology	SNS, GLS, REALM	Post	Cross-sectional	50	-	N/A	Small sample size, convenience sample
Tung et al. (2014)	Vascular	THLS	Post	Cross-sectional	105	-	7	Small sample size

Note. BHLS = Brief Health Literacy Screen; DMCAT[c] = Decision Making Capacity Assessment Tool; eHEALS = Electronic Health Literacy Scale; FCCHL = Functional Communicative Critical Health Literacy; FHL = Function Health Literacy; GLS = Graphic Literacy Scale; HeLMS = Health Literacy Management Scale; HLQ = Health Literacy Questionnaire; HLS = Health Literacy Screener; HLS-EU = European Health Literacy Scale; LiMP[c] = Literacy in Musculoskeletal Patients; NLit-BCa[c] Nutrition Literacy Assessment Instrument for Breast Cancer Patients; N/A = not applicable; NSV = Newest Vital Sign; REALM = Rapid Estimate of Adult Literacy in Medicine; REALM-SF = Rapid Estimate of Adult Literacy in Medicine–Short Form; REALM-T[c] = Rapid Estimate of Adult Literacy in Medicine–Transplant; REALM-VS[c] = Rapid Estimate of Adult Literacy–Vascular Surgery; S-TOFHLA = Short Form Test of Function Health Literacy in Adults; TOFHLA = Test of Functional Health Literacy in Adults; SILS = Single Item Literacy Screener; SNS = Subjective Numeracy Scale; THLS = Taiwan Health Literacy Scale; TOFHLA = Test of Functional Health Literacy in Adults.

[a]Low health literacy includes all patients defined as something other than adequate or high health literacy. [b]Newcastle-Ottawa Scale is a scoring system based on the evaluation of case control or cohort studies in the areas of selection, comparability, and outcome/exposure, where 7 to 9 is high, 4 to 6 is moderate, and 1 to 3 is low quality. [c]Denotes a disease-specific health literacy measurement tool.

ency/non-Western background (Schmidt et al., 2016; Taylor et al., 2016), being unmarried (Scarpato et al., 2016), and without car or home ownership (Taylor et al., 2016). Among hand surgery patients, Menendez et al. (2017) demonstrated that limited health literacy significantly affected native Spanish-speaking patients (100%) versus native English-speaking patients (33%). Two other studies (Miller-Matero et al., 2015; Scarpato et al., 2016) found that Black people were more associated with low health literacy than White people, whereas one study (Taylor et al., 2016) conducted in the United Kingdom found that White people rather than Black people were associated with low health literacy. These differences demonstrate the complex interplay between low health literacy and factors such as race/ethnicity and socioeconomic status.

Association of Health Literacy with Surgical Outcomes

The largest study to date that focused on the relationship of health literacy and surgical outcomes found that low health literacy in patients undergoing major abdominal surgery was associated with increased length of stay but not with 30-day emergency department (ED) visits or 90-day hospital readmissions (Wright et al., 2018). In patients undergoing urologic procedures, low health literacy was associated with higher minor postoperative complications at 30 days and higher pathological and biopsy staging (Scarpato et al., 2016). However, Mahoney et al. (2018), found no statistical difference in ED visits, readmissions, or hospital visits among bariatric surgery patients stratified by Rapid Estimate of Adult Literacy in Medicine–Short Form (REALM-SF) health literacy scores. Preoperatively, health literacy has been shown to affect whether patients undergo surgical procedures. In breast surgery, for example, low health literacy has been associated with lower reconstruction rates in patients (Winton et al., 2016). Kazley et al. (2015) has also demonstrated that level of health literacy is a predictor for whether a patient is listed for kidney transplantation.

Studies to date have not found an association between health literacy and patient satisfaction with respect to their hospital stay, outcomes, or interactions with care team (Komenaka et al., 2014; Menendez, Chen, Mudgal, Jupiter, & Ring, 2015; Perez-Brayfield et al., 2016); however, a single study did evaluate health literacy and patient satisfaction with his or her decision to undergo surgery and the informed consent process (Hallock et al., 2017). Hallock et al. (2017) measured patient satisfaction using a scale measuring "satisfaction with decisions" and found that highly satisfied patients scored higher on the informed consent questionnaire that measured knowledge of planned procedure; however, there was no statistically significant difference in health literacy rates between the patients who were highly satisfied versus those who were not. Additional studies (Tang et al., 2017; Turkoglu et al., 2019) have demonstrated a relationship between low health literacy and poor treatment compliance among surgery patients. For surgical populations such as patients receiving transplants, whose outcomes are dependent on compliance with medications, low health literacy has profound implications on graft rejection and loss (Gordon & Wolf, 2009; Patzer et al., 2016; Serper et al., 2015).

Interventions to Address Low Health Literacy in Surgical Patients

Studies (Choi, 2011; Zite & Wallace, 2011) focused on interventions in health literacy for surgical patients are emerging. Choi (2011) studied the use of Internet-based pictograph-formatted discharge instructions for older adults after hip replacement surgery and reported that participants found the website easy to use and understand. Zite and Wallace (2011) used a low health literacy consent form and compared knowledge retention of both the proposed operation and the consent process compared to those who underwent the standard consent process. They found that patients who underwent the consent process using the low health literacy consent form had better understanding without any additional counseling or educational materials.

DISCUSSION

The number of studies on health literacy in surgery has significantly increased from 2002 to 2018 (**Figure 2**). Since the last review in 2013, studies on health literacy in surgery have expanded to surgical subspecialties ranging from general surgery (Garcia-Marcinkiewicz et al., 2014; Koster et al., 2017; Wright et al., 2018) to vascular (Tung et al., 2014) to breast (Halbach et al., 2016; Huang et al., 2018; Keim-Malpass et al., 2018; Komenaka et al., 2014; Mercieca-Bebber et al., 2017; Parekh et al., 2017; Schmidt et al., 2016; Tang et al., 2017; Winton et al., 2016), and urology (Izard et al., 2014; Scarpato et al., 2016; Turkoglu et al., 2019). Several health literacy instruments have also been developed that are unique for surgical subspecialties (Gibbs et al., 2016; Gordon & Wolf, 2009; Kazley et al., 2014; Wallace et al., 2009). Importantly, all of these studies show that more than one-third of surgical patients have low health literacy (Alokozai et al., 2017; Beitler et al., 2010; Cajita et al., 2017; Cayci et al., 2018; Chew, Bradley, Flum et al., 2004; Choi, 2011; Chu & Tseng, 2013; Conlin & Schumann, 2002; Dageforde et al., 2015; Dageforde et al., 2014; Escobedo & Weismuller, 2013; Garcia-Marcinkiewicz et al., 2014; Gordon & Wolf, 2009; Grubbs et al., 2009; Halbach et al., 2016; Halleberg Nyman et al., 2018; Hallock et

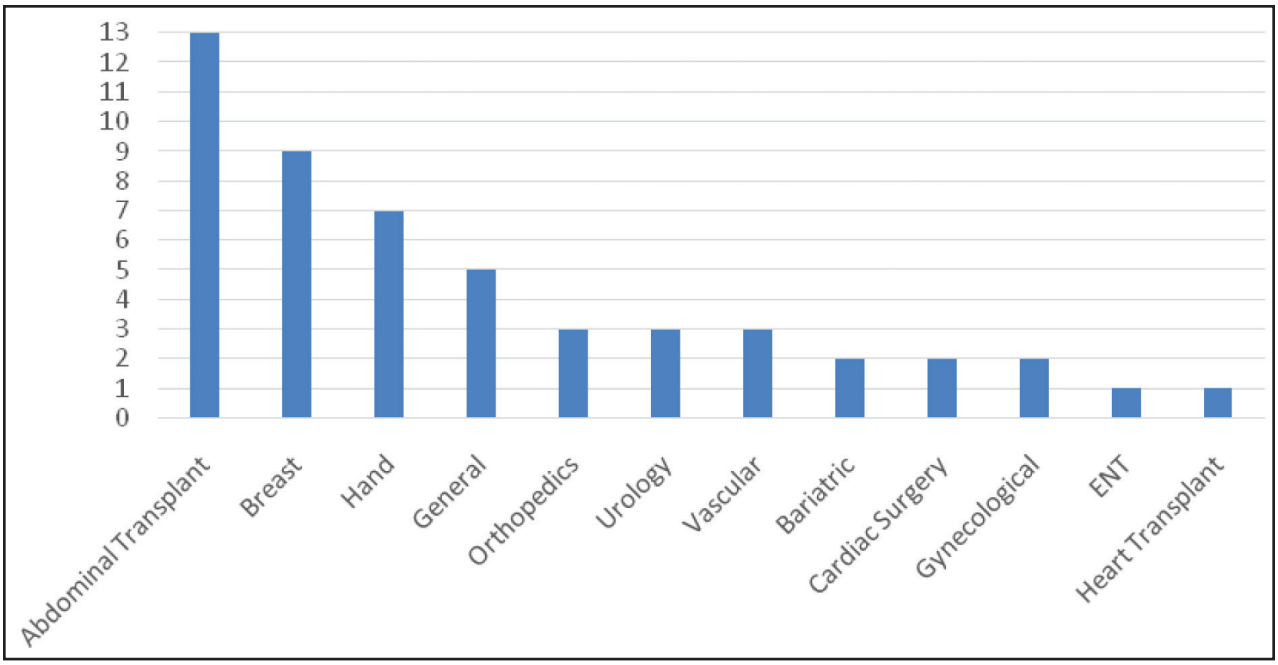

Figure 3. Number of studies in health literacy from 2002 to 2018 by surgery subspecialty. ENT = ears, nose, throat.

al., 2017; Izard et al., 2014; Jones et al., 2016; Keim-Malpass et al., 2018; Komenaka et al., 2014; Koster et al., 2017; Mahoney et al., 2018; Menendez et al., 2016; Menendez et al., 2017; Miller-Matero et al., 2015; Patzer et al., 2016; Roh et al., 2018; Rosenbaum et al., 2015; Scarpato et al., 2016; Serper et al., 2015; Tang et al., 2017; Taylor et al., 2016; Turkoglu et al., 2019; Wallace et al., 2007; Weng et al., 2013; Winton et al., 2016; Wright et al., 2018; Zite & Wallace, 2011). These findings are important because recent studies are now beginning to link low health literacy to poor surgical outcomes, which suggests an opportunity for interventions. The paucity of these latter studies highlights a clear gap and need for more health literacy-sensitive care in surgery.

More than 20 years of studies in nonsurgical fields have shown that low health literacy is associated with poorer health outcomes, including increased hospitalizations and emergency care, decreased use of preventive services such as mammography, poorer global health, and higher mortality among the elderly (Berkman et al., 2011; Dewalt, Berkman, Sheridan, Lohr, & Pignone, 2004). Many of these studies have focused on chronic medical conditions such as heart disease (Ghisi, Chaves, Britto, & Oh, 2018), diabetes mellitus (Schillinger et al., 2002), and cancer (Oldach & Katz, 2014). The relationship between health literacy and surgical outcomes is much less defined but has been identified by the National Institutes of Health and American College of Surgeons as a research priority (Haider et al., 2016). Only recently has one study shown that low health literacy in patients undergoing abdominal surgery is linked to poor outcomes (Wright et al., 2018). However, this retrospective study was limited by a broad three-question literacy assessment, a single-institution cohort characterized by a low proportion of Black participants, generally well-educated patients, and it did not include patients undergoing emergency surgery (Wright et al., 2018). Additional studies have identified relationships between low health literacy and measures that would likely have an impact on surgical outcomes such as treatment compliance (Patzer et al., 2016; Chew, Bradley, Flum et al., 2004), patient satisfaction (Parrish et al., 2016), and physical activity (Tang et al., 2017), but they do not make direct correlations with measures such as readmission, length of stay, morbidity, and mortality. Further studies, both quantitative and qualitative, are needed to more clearly understand the relationship between health literacy and surgical outcomes.

Studies in nonsurgical fields have consistently demonstrated that low health literacy is common among vulnerable populations (Dewalt et al., 2004; Ghisi et al., 2017; Pleasant, 2014). Our review shows similar findings in surgical patients, where non-White surgical patients, for example, were observed to have lower health literacy abilities than White patients (Kazley et al., 2014; Miller-Matero et al.,

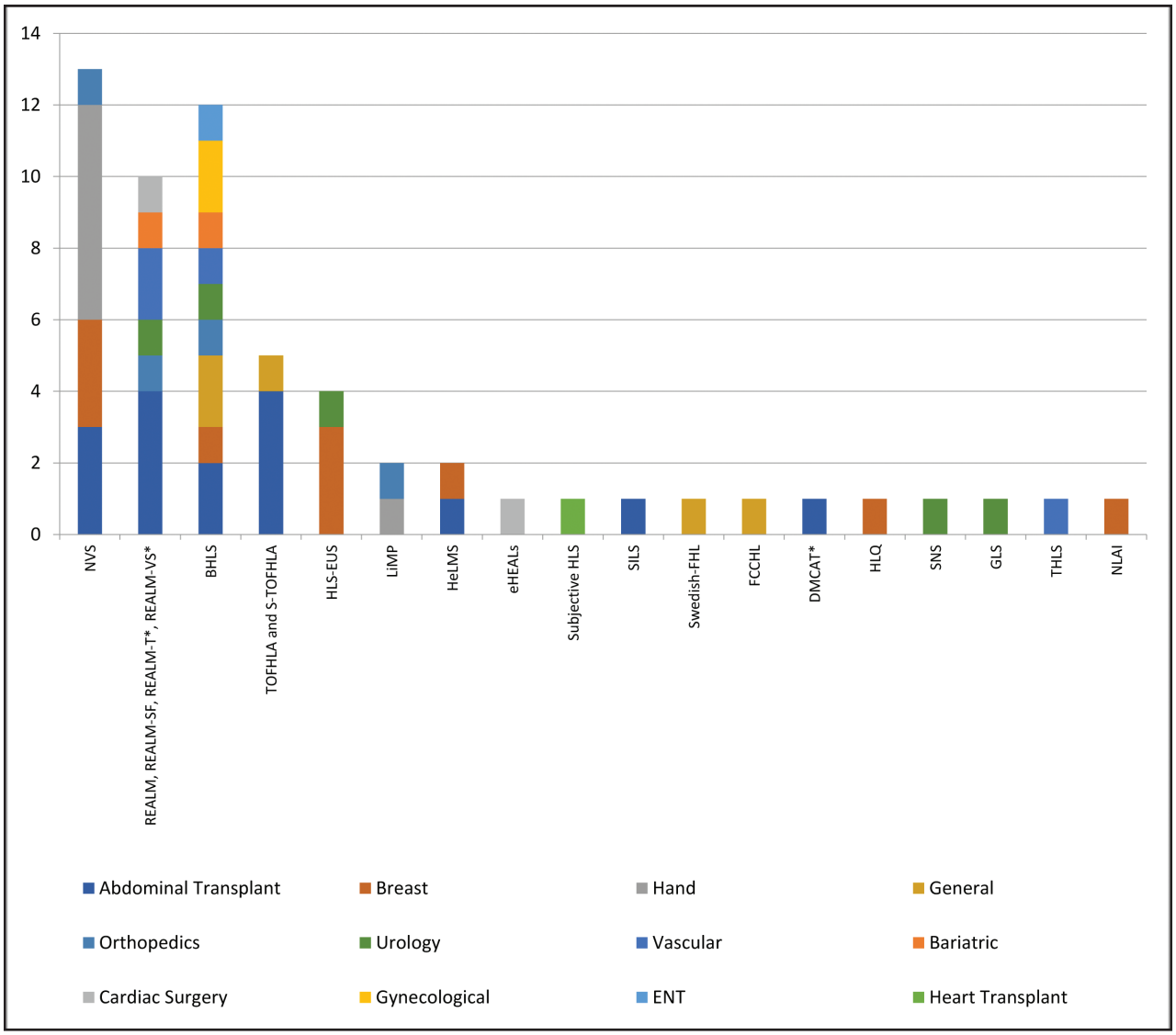

Figure 4. Different health literacy tools used by surgical specialties. Asterisk denotes disease specific health literacy measurement tool. BHLS = Brief Health Literacy Screener; DMCAT = decision making capacity assessment tool; eHEALS = Electronic Health Literacy Scale; FCCHL = functional communicative critical health literacy; FHL = Function Health Literacy; GLS = Graphic Literacy Scale; HeLMS = Health Literacy Management Scale; HLQ = Health Literacy Questionnaire; HLS = Health Literacy Screener; HLS-EUS = European Health Literacy Scale; LiMP = literacy in musculoskeletal patients; NLAI = Nutrition Literacy Assessment Instrument NVS = Newest Vital Sign; REALM = Rapid Estimate of Adult Literacy in Medicine; REALM-SF = Rapid Estimate of Adult Literacy in Medicine–Short Form; REALM-T = Rapid Estimate of Adult Literacy in Medicine–Transplant; REALM-VS = Rapid Estimate of Adult Literacy in Medicine–Vascular Surgery; S-TOFHLA = Short Form–Test of Function Health Literacy in Adults; SILS = Single Item Literacy Screener; SNS = Subjective Numeracy Scale; THLS = Taiwan Health Literacy Scale; TOFHLA = Test of Functional Health Literacy in Adults.

2015; Rosenbaum et al., 2015). Similarly, non-native English-speaking patients were assessed to have lower health literacy levels than native English speakers (Menendez et al., 2017). Other patient characteristics associated with low health literacy included older age (Kazley et al., 2014), male gender (Miller-Matero et al., 2015), poor education (Lambert et al., 2015; Rosenbaum et al., 2015), and cumulative medical comorbidities (Ghisi et al., 2017; Lambert et al., 2015; Schillinger et al., 2002). Effective care for vulnerable populations in surgery needs to account for many moving parts, but health literacy may represent a particularly important factor to target as it lies at the intersection of many patient, language, and socioeconomic factors.

Health literacy is ubiquitous and may also contribute to racial and ethnic disparities in surgical outcomes; therefore, targeting health literacy may be one actionable way to address racial and ethnic surgical disparities. As an example, our institution has demonstrated that adopt-

ing a standardized perioperative recovery protocol (ie, Enhanced Recovery Program) in patients with colorectal cancer eliminated racial and ethnic disparities in postoperative length of stay between Black and White patients (Wahl et al., 2017). Part of this effect may stem from the protocol's emphasis on addressing patient education, understanding, and expectations of the surgical process. Therefore, efforts to address racial and ethnic surgical disparities may also overlap with efforts to address health literacy.

In our review of the surgical literature, we found that only a small sample of interventional studies exist that address adult health literacy. Zite and Wallace (2011) demonstrated that the use of a low health literacy consent form increased patients' knowledge retention compared to the standard consent process. Scott et al. (2018) used a Delphi process to improve discharge instructions through consensus opinion on over 20 topics. This endeavor proved difficult as few topics reached consensus and the original materials were above the 6th-grade reading level. Naik et al. (2017) created a discharge warning tool through user-centered design to aid patients in health care decisions and facilitate discussions with the care teams. Choi (2011) increased understanding of the discharge process after hip-replacement surgery through the use of web-based pictograph-formatted discharge instructions. All studies demonstrated that simple interventions can be applied to improve patient comprehension and engagement, although no improvements in outcomes were specifically reported.

Future work in surgery should focus on the development or implementation of health literacy interventions and establishment of health literate organizations in surgery (Koh, Brach, Harris, & Parchman, 2013). The completion of further prevalence studies will not advance the state of research, as studies to date consistently show low health literacy in the surgical population. Development of health-literate interventions should take best practices in health literacy and adapt them to surgical care at every phase of the perioperative period. Such adaptations could involve development of new surgical care programs or, perhaps more pragmatically, equip existing surgical care programs, such as Enhanced Recovery Programs, with focused health-literate interventions such as enhanced education material and discharge protocols. These interventions should be designed with engagement of patients, providers, and even institutions as we also seek to establish organizations that are health literate. Although funding for health literacy-specific studies are limited (the last National Institutes of Health Funding Opportunity Announcement on health literacy-specific studies was announced in 2013), the cross-disciplinary nature of health literacy and its impact on health disparities suggest an opportunity, and need, for broad support from national funding agencies such as the National Institutes of Health.

LIMITATIONS

Our review has several limitations. Most studies on health literacy were single-center studies with limited sample size of less than 100 patients. Furthermore, all studies involved surveys and recruitment of patients for the studies, which could be influenced by participation bias. The potential bias of each study is described in **Table 2**, but many of these are inherent to the study design. In addition, the validated health literacy tools included in this review are self-reported, which leads to bias inherent to self-reported data such as recall, response, and introspective ability. Furthermore, many questionnaires were written that would certainly influence participation and/or the quality of data collected from people with limited literacy and/or low English proficiency. There were also portions of the literature, particularly in some subspecialties like hand surgery, where the representation of data is dominated by a single group of investigators. For example, in the articles about health literacy in hand surgery, one group of authors contributed more than 50% of the published literature and exclusively used the NVS tool. This lack of diverse representation will also contribute to decreased variation in tool selection and lead to bias. Finally, there were also limitations in performing the systematic review. Although we attempted to find all information regarding the state of adult health literacy in surgery, we may not have captured all available data secondary to our search process and/or publication bias. A validated scoring tool was used in an attempt to mitigate the subjective assessment of the articles by the authors, but this individualized scoring has the potential to be biased as well.

CONCLUSIONS

Research on health literacy in surgery has increased significantly since 2002. Large parts of the surgical population have low health literacy and few interventions in surgery exist that address this problem. These findings highlight important opportunities for the development and implementation of surgical care that is more health literate and for the establishment of health-literate organizations in surgery.

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TABLE A

Health Literacy Search String for Each Database and Number of Abstracts Available at Each Phase

Database	String	Number of Articles	Number of Abstracts Screened (Duplicates Removed)	Number Eligible for Review	Number Included
Pubmed	(((((“Health Literacy”[Mesh]) OR “health literacy”[Title/Abstract]))))) AND ((((((“surgery” [Subheading] OR “Surgical Procedures, Operative”[Mesh])) OR ((surger*[Title/Abstract] OR surgical[Title/Abstract] OR perioperative*[Title/Abstract] OR “post-operative”[Title/Abstract] OR postoperative[Title/Abstract]))))))	358	358	53	43
Embase	(('surgical patient'/exp OR surger*:ti,ab OR surgical:ti,ab OR perioperative:ti,ab) AND ('health literacy'/exp OR 'health literacy':ti,ab)) AND [embase]/lim NOT ([embase]/lim AND [medline]/lim)	253	117	9	2
Scopus	(TITLE-ABS-KEY (“health literacy”) AND TITLE-ABS-KEY (surger* OR surgical OR perioperative OR postoperative OR “post-operative”)) AND NOT INDEX (medline)	317	85	4	3
Proquest/ PsychInfo	(MAINSUBJECT.EXACT(“Health Literacy”) OR ab(“health literacy”)) AND (MAINSUBJECT.EXACT.EXPLODE(“Surgery”) OR ab(surger* OR surgical OR perioperative OR “post-operative” OR postoperative))	50	50	3	1
CINAHL	(surger* OR surgical OR perioperative OR “post-operative” OR postoperative) AND (AB “health literacy”)	60	60	0	0
	Cross Reference from previous review	10	3	3	2
Total	-	1,048	673	72	51

Note. CINAHL = Cumulative Index of Nursing and Allied Health Literature