Hand Surgery Resources Exceed American Health Literacy

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Julia A. Cook¹, Sarah E. Sasor¹, Sunil S. Tholpady^{1,2}, Arash Momeni³,
and Michael W. Chu^{1,2}

Abstract

Background: The National Institutes of Health, American Medical Association, and US National Library of Medicine recommend that educational material for patients be written at a sixth-grade reading level. The purpose of this study is to assess the complexity of hand surgery information on academic plastic and orthopedic surgery websites. **Methods:** An online search was performed for all hand surgery patient education materials provided by institutions with plastic and orthopedic surgery training programs. Readability analyses were conducted using the Flesch-Kincaid Reading Ease, Flesch-Kincaid Grade Level, Simple Measure of Gobbledygook Index, Gunning Fog Score, Automated Readability Index, and Coleman-Liau Index. A 2-tailed z test was used to compare means. **Results:** Seventy-six institutions with both plastic and orthopedic surgery training programs were identified; 42 had educational material available online. The average readability for all hand-related information was at the 11.92 grade reading level. Information regarding de Quervain tenosynovitis had the highest grade level for all plastic surgery procedures (13.45). Hand arthritis had the highest grade level for all orthopedic surgery procedures (12.82). Ganglion cysts had the lowest grade level for both plastic and orthopedic surgery (10.15 and 11.01, respectively; $P = .12$). Carpal tunnel release was the most commonly described procedure overall. There were no differences in text complexity among geographic regions. **Conclusions:** Online patient resources for common hand ailments are too complex for the average patient to understand. Efforts should be made to provide materials at the recommended sixth-grade reading level to improve patient education and improve the physician-patient relationship.

Keywords: readability, hand surgery, education, Flesch-Kincaid, Coleman-Liau, Gunning Fog, Automated Readability Index

Introduction

Preoperative patient education is critical to informed consent, improved outcomes, decreased rates of malpractice litigation, and overall patient satisfaction.^{2,4,18,21} Online medical information is a key component of patient education. In 2015, 84% of adults in America used the Internet regularly,¹⁹ and approximately 48.6% of Internet users initially turn to the Internet to answer health care questions.¹¹ Unfortunately, medical online resources often exceed the health care literacy levels of patients. The American Medical Association (AMA), National Institutes of Health (NIH), and US National Library of Medicine recommend that medical information be written at a sixth-grade reading level.^{16,23} Numerous, validated readability tests can be used to determine the complexity of written materials. As surgical subspecialties continue to be increasingly more complex, we examined the online material available to patients seeking information regarding hand surgery procedures. The purpose of this study is to assess the readability of online patient resources for surgical hand

procedures and compare plastic and orthopedic surgery platforms. We hypothesized that the information available would exceed the recommended literacy levels.

Materials and Methods

The Association of American Medical Colleges's Electronic Residency Application Service website was used to determine academic institutions with both plastic and orthopedic

¹Indiana University, Indianapolis, USA

²Richard L. Roudebush VA Medical Center, Indianapolis, IN, USA

³Stanford University, Palo Alto, CA, USA

Supplemental material is available in the online version of the article.

Corresponding Author:

Julia A. Cook, Division of Plastic & Reconstructive Surgery, Indiana University School of Medicine, Indiana University, 545 Barnhill Drive #232, Indianapolis, IN 46202, USA.
Email: juacook@gmail.com

Table 1. Readability Scale Derivations.

Scale	Equation	Variables
Flesch-Kincaid Reading Ease (FKRE)	$FKRE = 206.835 - 1.015 (ASL) - 84.6 (ASW)$	Average number of words per sentence (ASL) Average number of syllables per word (ASW) Calculates Reading Ease (RE) RE of 90.1-100.0 = 5th-grade material RE of 70.1-80.0 = 7th-grade material RE of 50.1-60.0 = 10th-12th grade material RE of 0.0-30.0 = college graduate material
Flesch-Kincaid Grade Level (FKGL)	$FKGL = 0.39 (ASL) + 11.8 (ASW) - 15.59$	Average number of words per sentence (ASL) Average number of syllables per word (ASW) Calculates grade level of material
SMOG Readability Formula (SMOG)	$SMOG = 3 + \sqrt{PSC}$	Polysyllable count: number of words with ≥ 3 syllables (PSC) Calculates grade level of material
Gunning Fog Index (GFI)	$GFI = 0.4 (ASL + PHW)$	Average number of words per sentence (ASL) Percentage of words with ≥ 3 syllables (PHW) Calculates grade level of material
Automated Readability Index (ARI)	$ARI = 4.71 (ACW) + 0.5 (ASL)$	Average number of characters per word (ACW) Average number of words per sentence (ASL) Calculates grade level of material
Coleman-Liau Index (CLI)	$CLI = 0.0588 (L) - 0.296 (S) - 15.8$	Average number of letters per 100 words (L) Average number of sentences per 100 words (S) Calculates grade level of material

surgery residency programs.⁹ Online patient information for hand surgery procedures offered by both specialties was identified. Diagnoses of interest included the most common hand disease states that are referred for elective surgery, including de Quervain tenosynovitis, hand arthritis (osteoarthritis and rheumatoid arthritis), ganglion cyst, carpal tunnel syndrome, cubital tunnel syndrome, trigger finger, and Dupuytren disease.²⁴

Online resources were compiled and formatted into plain text. External links, captions, figure legends, disclaimers, references, and unrelated text were removed. Multimedia, images, and audio resources were excluded. Readability analysis was performed using the Readability Studio Professional Edition Version 2012.1 software (Oleander Software, Ltd, Vandalia, Ohio). Average word count per procedure, word count per sentence, and syllable count per word were evaluated for each resource.

Six readability tests were used to evaluate available information for each academic hospital: Flesch-Kincaid Reading Ease (FKRE), Flesch-Kincaid Grade Level (FKGL), Simple Measure of Gobbledygook (SMOG) Readability Index, Gunning Fog Index (GFI), Automated Readability Index (ARI), and Coleman-Liau Index (CLI; Table 1).^{6,8,10,13,15,22} Analyses were performed by 2 independent reviewers (J.A.C., M.W.C.), and descriptive text statistics were determined. A 2-tailed *z* test was used to analyze all averages, and statistical significance was set at $P < .05$ (SPSS Statistics Version 23.0; SPSS, Inc, Chicago, Illinois).

Results

Identification of Academic Plastic and Orthopedic Surgery Websites

Seventy-six academic hospitals had plastic surgery and orthopedic surgery training programs; 42 programs (55.3%) provided online educational materials for both training programs (Supplemental Table). Of the 34 programs that did not offer resources for both specialties, 4 programs only offered hand surgery education materials on their plastic surgery website, 6 programs only offered information on their orthopedic surgery website, and 23 programs did not offer hand surgery patient education materials for either training program.

Six (7.9%) plastic and orthopedic surgery programs referenced the same educational material for hand procedures at the institution. To reflect patient results while searching for plastic surgery- or orthopedic surgery-specific materials, data for these institutions were included in both plastic surgery and orthopedic surgery calculations.

Carpal tunnel release was the most commonly referenced procedure for both surgical specialties—found on 90.4% and 83.3% of plastic surgery and orthopedic surgery websites, respectively. Surgical treatment of de Quervain tenosynovitis was the least commonly described procedure for both specialties—found only on 9.5% and 16.7% of websites, respectively.

Average number of words, words per sentence, and syllables per word are found in Table 2.

Table 2. Two-Tailed z Test Analysis of Text Composition for Hand Surgery Materials Provided by Plastic Surgery Versus Orthopedic Surgery Websites.

	Combined	Plastic surgery	Orthopedic surgery	P value
Number of words	321.5 ± 122.2	309.7 ± 143.8	333.3 ± 106.5	.73
Words per sentence	17.4 ± 1.1	17.2 ± 1.2	17.7 ± 1.0	.42
Syllables per word	1.7 ± 0.1	1.6 ± 0.1	1.7 ± 0.1	.76

Note. Significance set at $P \leq .05$.

Table 3. Two-Tailed z Test Analysis of Hand Resources Provided by Plastic and Orthopedic Surgery.

	Plastic surgery	Orthopedic surgery	P value
Flesch-Kincaid Reading Ease	46.1 ± 12.4	44.6 ± 12.3	.29
Flesch-Kincaid Grade Level	11.1 ± 2.6	11.5 ± 2.4	.20
SMOG Readability	12.2 ± 2.1	12.6 ± 2.0	.13
Gunning Fog Index	12.5 ± 2.8	13.0 ± 2.6	.01
Automated Readability Index	10.9 ± 3.1	11.3 ± 2.8	.23
Coleman-Liau Index	11.9 ± 2.2	12.2 ± 2.2	.20

Note. Significance set at $P \leq .05$. SMOG = Simple Measure of Gobbledygook.

Table 4. Results of Readability Scores for Diagnoses of Interest on Plastic Surgery and Orthopedic Surgery Websites.

	FKRE	FKGL	SMOG	GFI	ARI	CLI
Plastic surgery						
de Quervain tenosynovitis	35.1 ± 6.0	12.9 ± 2.3	13.4 ± 1.6	14.6 ± 2.0	12.7 ± 3.2	13.7 ± 1.2
Hand arthritis	42.5 ± 13.9	11.3 ± 3.1	13.0 ± 2.4	13.5 ± 3.1	11.1 ± 3.7	13.0 ± 2.3
Ganglion cyst	56.8 ± 18.3	9.6 ± 3.8	10.6 ± 2.7	11.0 ± 4.0	9.5 ± 5.0	10.1 ± 3.3
Carpal tunnel syndrome	45.5 ± 8.9	11.4 ± 1.8	12.2 ± 1.6	12.5 ± 2.2	11.2 ± 2.2	12.0 ± 1.6
Cubital tunnel syndrome	45.7 ± 10.0	11.6 ± 1.5	12.3 ± 1.7	12.8 ± 2.4	11.3 ± 2.1	11.6 ± 1.7
Trigger finger	45.6 ± 9.8	11.5 ± 2.5	11.5 ± 2.4	11.7 ± 2.7	11.1 ± 2.1	12.0 ± 2.1
Dupuytren disease	49.1 ± 12.4	10.3 ± 2.7	12.5 ± 2.1	12.2 ± 2.8	9.8 ± 3.5	11.3 ± 2.4
Orthopedic surgery						
de Quervain tenosynovitis	44.9 ± 13.1	11.1 ± 2.8	12.4 ± 1.8	12.9 ± 2.3	11.4 ± 3.0	12.9 ± 1.5
Hand arthritis	40.7 ± 13.1	12.0 ± 2.9	13.3 ± 2.2	14.0 ± 3.0	11.8 ± 3.4	13.0 ± 2.1
Ganglion cyst	52.6 ± 12.7	10.3 ± 2.1	11.9 ± 2.0	12.2 ± 2.4	10.0 ± 2.5	10.8 ± 2.6
Carpal tunnel syndrome	44.8 ± 10.9	11.6 ± 2.1	12.3 ± 1.9	12.7 ± 2.4	11.6 ± 2.7	12.2 ± 2.0
Cubital tunnel syndrome	44.9 ± 14.0	11.8 ± 2.2	12.5 ± 2.1	13.4 ± 2.5	11.4 ± 2.3	11.5 ± 2.3
Trigger finger	42.3 ± 9.0	11.9 ± 1.9	12.6 ± 1.4	12.8 ± 2.1	11.4 ± 2.2	12.2 ± 1.5
Dupuytren disease	45.0 ± 12.5	11.0 ± 2.4	13.0 ± 2.3	12.9 ± 3.0	10.7 ± 3.0	12.3 ± 2.4

Note. Reported scores are average grade level ± SD. FKRE = Flesch-Kincaid Reading Ease; FKGL = Flesch-Kincaid Grade Level; SMOG = Simple Measure of Gobbledygook; GFI = Gunning Fog Index; ARI = Automated Readability Index; CLI = Coleman-Liau Index.

Readability of Composite and Matched Plastic and Orthopedic Surgery Websites

The overall grade level for all hand surgery patient resources was 11.9 ± 1.1 . Plastic surgery educational materials had a significantly lower combined grade level of FKGL, SMOG, GFI, ARI, and CLI than orthopedic surgery resources (11.7 ± 2.7 and 12.1 ± 2.5 , respectively; $P < .01$). Individual readability scales did not significantly differ between the specialties except for the GFI ($P = .01$; Table 3). Average FKRE

score for all hand surgery patient resources was 45.3 ± 12.3 . There was no significant difference between the FKRE score of plastic surgery and orthopedic surgery patient education materials (46.1 ± 12.4 and 44.6 ± 12.3 , respectively; $P = .29$).

Readability derivations are listed in Table 4. Information regarding de Quervain tenosynovitis had the highest combined grade level for all plastic surgery procedures (13.45 ± 0.75). Hand arthritis had the highest combined grade level for all orthopedic surgery procedures (12.82 ± 0.94). Ganglion

cyst excision had the lowest combined grade level for both plastic and orthopedic surgery (10.15 ± 0.67 and 11.01 ± 0.97 , respectively; $P = .12$). There were no significant differences in readability scores across US geographic regions.

Discussion

Health literacy is the ability to read and understand health-related information vital to making informed decisions.³ According to the Office of Disease Prevention and Health Promotion, only 12% of adults in America are considered “health literacy proficient” with the ability to comprehend a health care pamphlet or instructions from a prescription label, or interpret a table to calculate costs.¹ More than one-third of the US population cannot accurately follow prescription instructions or understand childhood immunization charts.^{1,7,12,17} Fifty percent of Americans have low or basic levels of reading proficiency, and approximately 20% cannot “locate information in text,” “make low-level inferences using printed materials,” or “integrate information.”¹⁷ Regardless of literacy level, studies have demonstrated that patients prefer materials written in simple, concise language.²⁰ Unfortunately, patients with low literacy levels are reluctant to admit these deficiencies to health care providers and commonly leave physician offices with unanswered questions or sign documents that are not completely understood.²⁰

While there is no consensus to determine the appropriateness of educational materials for patients or measurements of comprehension, numerous validated readability instruments can quantify the complexity of written text. Several readability scales were used in this analysis; each calculates the reading grade level differently using variables including number of words per sentence, syllables per word, characters per word, letters per 100 words, and sentences per 100 words (Table 1).

For optimal patient comprehension, it is recommended health care educational materials be written at the sixth-grade reading level.^{16,23} This study shows that most online hand surgery information requires an 11th-grade reading level, which is 5 grade levels above the AMA and NIH recommendations and 6 grades above the average American fifth-grade literacy level.¹⁷

New regulations link patient satisfaction to hospital reimbursement. Patient satisfaction increases with improved comprehension of health care information. Patients should be educated on disease processes, treatment options, and expectations.^{5,14,25} Modifiable factors include physician-patient communication, realistic expectations, and continuity of care.¹⁵

Plastic surgery resources, as compared with orthopedic surgery resources, had a significantly lower combined readability of all the scales measuring readability grade level

including the GFI, FKRE, FKGL, SMOG Readability Index, ARI, and CLI readability scales did not demonstrate the same significant difference.

The GFI differs from other readability indices because its variables include percentage of words with greater than 3 syllables and average number of words per sentence.¹⁰ While all scales have been validated to assess text complexity, the Gunning Fog calculation may serve as a more sensitive index for health care information. The GFI is the only scale to calculate the text complexity using the multisyllabic word percentage, rather than word count, potentially making it better able to detect texts with higher proportions of complex words. Regardless, the grade level of all materials, regardless of readability scale, was considerably higher than NIH recommendations. Reasons may include the inherent complexity of hand surgery procedures and the difficulty of presenting this information in a simple manner. Medical terms are often multisyllabic, which contributes to increased readability index scores (Table 1).

Current patient educational materials should be edited to conform to NIH guidelines. Simpler terms should replace medical jargon. Academic training program websites should be evaluated and patient resources should be revised as needed. While face-to-face consultation and patient education cannot be substituted, physicians should make efforts to focus office visits toward patient education and can direct patients to appropriate websites for supplement information. Improving patient comprehension can improve patient satisfaction and outcomes. Readability is a useful measurement tool to help achieve this goal.

This study is limited by the use of readability scales to assess written text. These scales are a calculation of text complexity and do not measure true comprehension or a patient's ability to use information in a health care setting. Illustrations, multimedia and videos, were not included in this analysis but may be helpful for patients who prefer other learning modalities. In addition, the repetition of data for institutions that did not have plastic surgery— or orthopedic surgery—specific resources may pose a type II error; however, the data analysis was performed to reflect the search results of a patient researching plastic surgery— or orthopedic surgery—specific resources on academic surgery websites.

Conclusion

Written online educational resources for hand surgery provided by academic institutions exceed the recommended reading level of sixth grade. Current online education materials are a potential obstacle to patient education, decision making, and patient satisfaction. Health care institutions should consider drafting new materials or referencing health encyclopedias with simpler language that would be accessible to patients. This study identifies online patient

education materials for hand surgery as an area in need of quality improvement.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

Not applicable.

Statement of Informed Consent

Not applicable.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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