

Readability of Trauma-Related Patient Education Materials From the American Academy of Orthopaedic Surgeons

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Abstract

Context: According to the American Medical Association (AMA) and the National Institutes of Health (NIH), the recommended readability of patient education materials should be no greater than a sixth-grade reading level. The online patient education information produced by the American Academy of Orthopaedic Surgeons (AAOS) may be too complicated for some patients to understand. This study evaluated whether the AAOS's online trauma-related patient education materials meet recommended readability guidelines for medical information.

Evidence Acquisition: Ninety-nine articles from the "Broken Bones and Injuries" section of the AAOS-produced patient education website, orthoinfo.org, were analyzed for grade level readability using the Flesch-Kincaid formula, a widely-used and validated tool to evaluate the text reading level. Results for each webpage were compared to the AMA/NIH recommended sixth-grade reading level and the average reading level of U.S. adults (eighth-grade).

Results: The mean (SD) grade level readability for all patient education articles was 8.8 (1.1). All but three of the articles had a readability score above the sixth-grade level. The readability of the articles exceeded this level by an average of 2.8 grade levels (95% confidence interval, 2.6 - 3.0; $P < 0.0001$). Furthermore, the average readability of the articles exceeded the average reading skill level of U.S. adults (eighth grade) by nearly an entire grade level (95% confidence interval, 0.6-1.0; $P < 0.0001$).

Conclusions: The majority of the trauma-related articles from the AAOS patient education website have readability levels that may make comprehension difficult for a substantial portion of the patient population.

Keywords: AAOS, Health Literacy, Online Health Information, Patient Education, Readability, Trauma

1. Context

Patients commonly utilize the Internet to access health information (1-7). Every day, an estimated eight million Americans seek health information online (5). In order for patients to use the health information online to inform healthcare decisions, they must first be able to comprehend the material (7). The requisite reading comprehension level a person must have to understand written material is determined by the readability of the text (8). The Flesch-Kincaid grade level (FKGL) formula is a commonly utilized and validated instrument for determining the readability of written materials in terms of U.S. academic grade levels (9-17). Higher FKGL texts require more advanced reading skills.

Approximately 20% of adults in the U.S. cannot comprehend above fourth-grade-level texts (18). Furthermore, nearly half of American adults experience considerable difficulty in synthesizing information from complex or lengthy texts (19), and the average patient reads five grade levels below their reported graduation grade (20). The av-

erage American adult reads at an eighth-grade level (18).

Health literacy is defined as the "capacity to obtain, interpret, and understand basic health information and services and the competence to use such information and services to enhance health" (21). Health literacy has been shown to predict health-related quality of life (22-24). Lower health literacy correlates with overall increase in healthcare costs (25-28), worse general health (29-34), poor understanding of one's disease (35-41), increased complications (30), and increased hospitalizations (42, 43).

The National Institutes of Health (NIH) and the American Medical Association (AMA) recommend patient education materials should be no greater than a sixth-grade reading level (44-48). Other studies have suggested that currently utilized patient education materials may be too complex for most patients to comprehend (9, 10, 12, 13, 15, 17, 18, 49). To our knowledge, no one has specifically assessed the readability of the trauma-related patient information produced by the American Academy of Ortho-

paediatric surgeons (AAOS). As noted on the website, materials “were developed in partnership with the orthopaedic trauma association” (OTA).

Given that the AAOS is an expert source of information, the prevalence of trauma-related orthopedic problems, and the effect of health literacy on patient outcomes, the goal of our study was to evaluate the readability of trauma-related patient education materials produced by the AAOS to assess if it meets recommended medical information readability guidelines.

2. Evidence Acquisition

The analyzed trauma-related articles from the AAOS patient education website were found under the “Broken Bones and Injuries” section (www.orthoinfo.org/menus/injury.cfm). On the website, articles are further categorized into “Shoulder and Elbow,” “Hand and Wrist,” “Hip and Thigh,” “Knee and Lower Leg,” “Foot and Ankle,” “Neck and Back,” and “General.” The average reading levels for these subsections were analyzed. Our study was exempt from IRB review. The website was accessed between November 3 and 15, 2013. All patient education articles were assessed, excluding those written in non-English, with content predominately in graphic/pictorial form, or table/list format. We hypothesized that the readability of these materials would have a mean FKGL of > 6.

Each article’s text was copied in plain text to individual Microsoft Office Word 2010 (Microsoft Corporation, Redmond, WA) documents. As recommended by Flesch and others, all numbers, decimals, bullets, abbreviations, paragraph breaks, colons, semicolons, and dashes within a sentence were removed in order to avoid underestimating the readability level (50, 51). Any text not directly related to patient education was deleted, including copyright notes, date stamps, author information, hyperlinks, citations, and tables.

For each document, FKGLs were obtained using the readability calculator built into the Word software. FKGL calculator feature was enabled by sequentially selecting “Review,” “Spelling and Grammar,” “Options,” and “Show Readability Statistics.” FKGL is calculated by: $0.39 \times (\text{average number of words per sentence}) + 11.8 \times (\text{average number of syllables per word}) - 15.59$. After grammar and spelling was checked for each document, FKGL was

automatically displayed. Each FKGL was calculated and recorded by the same reviewer.

Unpaired t-tests were done in Microsoft Office Excel 2010 (Microsoft Corporation, Redmond, WA) to compare the mean FKGL with the recommended sixth-grade readability level and the average American adult reading level. A P-value of < 0.05 was used to determine significance.

3. Results

One hundred and seven patient education articles were evaluated for inclusion. Four articles could not be analyzed because they contained predominately video and photo content. Four other articles were used two times in different sections of the website. These articles were only analyzed once. Therefore, 99 articles met the inclusion criteria and were evaluated for FKGL.

The average (SD) FKGL for all the patient education materials was 8.8 (1.1). The readability of the articles exceeded the sixth grade level by an average of 2.8 grade levels (95% confidence interval, 2.6-3.0; $P < 0.0001$). Furthermore, the average readability of the articles exceeded the average reading skill level of U.S. adults (eighth grade) by nearly an entire grade level (95% confidence interval, 0.6-1.0; $P < 0.0001$).

Only three articles “Fracture of the Finger,” “Frostbite,” and “Wrist Sprains” were at or below a sixth-grade reading level, thus 97.0% of the articles were above the recommended reading level (Figure 1).

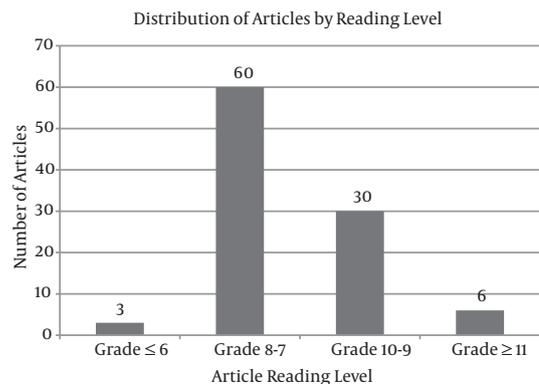


Figure 1. Patient Education Articles on AAOS-Produced Orthoinfo.org, Sorted by Grade Level Readability.

Table 1. Distribution of Articles by Grade Level and Sub-Section Average

Subsection	Average FKGL	Grade 4 - 6	Grade 7 - 8	Grade 9 - 10	Grade 11 - 12	Total Articles
General	9.1 ± 1.3	2	8	6	4	20
Shoulder and Elbow	9.1 ± 1.2	0	14	10	2	26
Hand and Wrist	7.9 ± 0.6	1	9	0	0	10
Hip and Thigh	8.7 ± 1.0	0	4	4	0	8
Knee and Lower Leg	8.5 ± 0.7	0	11	3	0	14
Foot and Ankle	8.4 ± 0.6	0	11	0	0	11
Neck and Back	9.5 ± 1.1	0	3	7	0	10
Total	8.8	3	60	30	6	99

The articles under “General” patient education materials had a mean FKGL of 9.1, “Neck and Back” articles had a mean FKGL of 9.5, “Shoulder and Elbow” articles had a mean FKGL of 9.1, “Hip and Thigh” articles had a mean FKGL of 8.7, “Knee and Lower Leg” articles had a mean FKGL of 8.4, “Foot and Ankle” articles had a mean FKGL of 8.4, and “Hand and Wrist” articles had a mean FKGL of 7.9 (Table 1).

4. Conclusions

The readability level of trauma-related patient education materials on AAOS-produced orthoinfo.org may be too advanced for many patients. The mean reading grade level of the website’s patient education materials was 8.8, which was nearly 3 full grade levels beyond the recommended grade level recommended by the NIH and AMA.

In 2007, Sabharwal et al. analyzed all online patient education articles created by AAOS between 1999 and 2006 and found a mean reading level of 10.4 (13). Although we are unable to directly compare individual articles, our findings suggest that the AAOS may have taken notice and modified the readability of its patient education materials.

When developing patient education materials, the need to provide complete and accurate medical information should be balanced with the reading skills of the intended audience. The readability of patient education materials can be enhanced by using simpler terms, shorter sentences, and illustrations (10, 47, 52, 53). The findings from this study may be of particular interest to the OTA, as the patient education section of the OTA website consists entirely of an external link to orthoinfo.org.

Many medical subspecialty organizations have created patient education materials in an attempt improve the health literacy and outcomes of their patients. This may be due to evidence indicating that low levels of health literacy correlates with lower health-related quality of life, worse general health, and more hospitalizations and complications. Fewer than 20% of adults have the health literacy skills needed to properly manage their health; according to the National Assessment of Adult Literacy (54), improving health literacy may, in turn, improve patient outcomes. More than just patient outcomes, literacy has been shown to have a significant impact on healthcare utilization and costs. Health literacy has been shown to be highly correlated with follow-up rates and compliance with, often complicated, written discharge instructions (25). Thus these organizations, such as the AAOS, may consider lowering the readability level of patient education materials. A recent survey has found that “Fifteen percent of adults with below basic health literacy used the Internet ‘some’ or ‘a lot’ for information on health topics, compared with 31 percent of those with basic health literacy, 49 percent with intermediate health literacy, and 62 percent of those with proficient health literacy” indicating that there is a mismatch between the general population of patients, to which the documents are designed and

the population reading these educational articles (55). Whether decreasing the FKGL of patient education materials actually improves health literacy is a hypothesis which will require examination.

We acknowledge several potential limitations. FKGL evaluates text only (i.e., not diagrams), and does not directly measure comprehensibility. Additionally, we did not assess the reading skills of the website’s visitors, which may differ from the general population. Although we limited our investigation to only the trauma-related patient education materials, orthopaedic surgeons increasingly refer their patients to such professional websites, making this investigation relevant (2, 56-58). Despite these limitations, this study hopefully provides important data regarding the readability of the AAOS’s publically available patient education materials.

For many patients, the AAOS-produced trauma-related patient education materials are too complex to understand. Optimizing patient education materials may enhance patient comprehension, and in turn improve health outcomes.

Footnote

Authors’ Contribution: Adam E. M. Eltorai (literature search, study design, data collection, data analysis, data interpretation, writing, critical revision), Nathan Thomas (data collection, data analysis, data interpretation), Hee-jae Yang (data collection, data analysis, data interpretation), Alan H. Daniels (literature research, study design, data analysis, data interpretation, writing, critical revision). Christopher T. Born (data interpretation, writing, critical revision).

References

1. Beall Iii MS, Golladay GJ, Greenfield MLVH, Hensinger RN, Biermann JS. Use of the Internet by pediatric orthopaedic outpatients. *J Pediatr Orthop*. 2002;22(2):261-4. [PubMed: 11856943]
2. Krempec J, Hall J, Biermann JS. Internet use by patients in orthopaedic surgery. *Iowa Orthop J*. 2003;23:80-2. [PubMed: 14575255]
3. Beall III MS, Beall Jr MS, Beall MJ, Greenfield MLV, Biermann JS. Patient Internet use in a community outpatient orthopaedic practice. *Iowa Orthop J*. 2002;22:103-7. [PubMed: 12180601]
4. Brooks BA. Using the Internet for patient education. *Orthop Nurs*. 2001;20(5):69-77. [PubMed: 12025306]
5. Fox S. Online Health Search 2006. *Pew Internet and American Life Project*. 2006. Available from: http://www.pewinternet.org/~media/Files/Reports/2006/PIP_Online_Health_2006.pdf.
6. Aslam N, Bowyer D, Wainwright A, Theologis T, Benson M. Evaluation of Internet use by paediatric orthopaedic outpatients and the quality of information available. *J Pediatr Orthop B*. 2005;14(2):129-33. [PubMed: 15703525]
7. Berland GK, Elliott MN, Morales LS, Algazy JI, Kravitz RL, Broder MS, et al. Health information on the Internet: accessibility, quality, and readability in English and Spanish. *JAMA*. 2001;285(20):2612-21. [PubMed: 11368735]
8. Department of Health and Human Services. *Pretesting in health communications*. Bethesda: National Institutes of Health; 1982.
9. Albright J, de Guzman C, Acebo P, Paiva D, Faulkner M, Swanson J. Readability of patient education materials: implications for clinical practice. *Appl Nurs Res*. 1996;9(3):139-43. [PubMed: 8771859]
10. Cooley ME, Moriarty H, Berger MS, Selm-Orr D, Coyle B, Short T. Patient literacy and the readability of written cancer educa-

- tional materials. *Oncol Nurs Forum*. 1995;22(9):1345-51. [PubMed: 8539175]
11. Bluman EM, Foley RP, Chiodo CP. Readability of the Patient Education Section of the AOFAS Website. *Foot Ankle Int*. 2009;30(4):287-91. doi: 10.3113/FAL.2009.0287. [PubMed: 19356350]
 12. Badarudeen S, Sabharwal S. Readability of patient education materials from the American Academy of Orthopaedic Surgeons and Pediatric Orthopaedic Society of North America web sites. *J Bone Joint Surg Am*. 2008;90(1):199-204. doi: 10.2106/JBJS.G.00347. [PubMed: 18171975]
 13. Sabharwal S, Badarudeen S, Unes Kunju S. Readability of online patient education materials from the AAOS web site. *Clin Orthop Relat Res*. 2008;466(5):1245-50. doi: 10.1007/s11999-008-0193-8. [PubMed: 18324452]
 14. Yi PH, Ganta A, Hussein KI, Frank RM, Jawa A. Readability of arthroscopy-related patient education materials from the American Academy of Orthopaedic Surgeons and Arthroscopy Association of North America Web sites. *Arthroscopy*. 2013;29(6):1108-12. doi: 10.1016/j.arthro.2013.03.003. [PubMed: 23726111]
 15. Wang SW, Capo JT, Orillaza N. Readability and comprehensibility of patient education material in hand-related web sites. *J Hand Surg Am*. 2009;34(7):1308-15. doi: 10.1016/j.jhsa.2009.04.008. [PubMed: 19596175]
 16. Polishchuk DL, Hashem J, Sabharwal S. Readability of online patient education materials on adult reconstruction Web sites. *J Arthroplasty*. 2012;27(5):716-9. doi: 10.1016/j.arth.2011.08.020. [PubMed: 22000573]
 17. Vives M, Young L, Sabharwal S. Readability of spine-related patient education materials from subspecialty organization and spine practitioner websites. *Spine (Phila Pa 1976)*. 2009;34(25):2826-31. doi: 10.1097/BRS.0b013e3181b4bb0c. [PubMed: 19910867]
 18. Doak CC, Doak LG, Root JH. *Teaching Patients with Low Literacy Skills*. 2nd ed. Philadelphia: PA: JB Lippincott; 1996.
 19. Kirsch IS, Jungeblut A, Jenkins L, Kolstad A. *Adult Literacy in America: A First Look at the Results of the National Adult Literacy Survey*. Washington: National Center for Education Statistics; 1993.
 20. Doak LG, Doak CC. Lowering the silent barriers to compliance for patients with low literacy skills. *Promot Health*. 1987;8(4):6-8. [PubMed: 10282858]
 21. U.S. Department of Health and Human Services. *Healthy People 2010*. 2000.
 22. Wang C, Li H, Li L, Xu D, Kane RL, Meng Q. Health literacy and ethnic disparities in health-related quality of life among rural women: results from a Chinese poor minority area. *Health Qual Life Outcomes*. 2013;11:153. doi: 10.1186/1477-7525-11-153. [PubMed: 24020618]
 23. Wallace LS, Rogers ES, Weiss BD. Relationship between health literacy and health-related quality of life among Tennesseans. *Tenn Med*. 2008;101(5):35-9. [PubMed: 18507259]
 24. Song L, Mishel M, Bensen JT, Chen RC, Knaff GJ, Blackard B, et al. How does health literacy affect quality of life among men with newly diagnosed clinically localized prostate cancer? Findings from the North Carolina-Louisiana Prostate Cancer Project (PCaP). *Cancer*. 2012;118(15):3842-51. doi: 10.1002/cncr.26713. [PubMed: 22180041]
 25. Weiss BD, Palmer R. Relationship between health care costs and very low literacy skills in a medically needy and indigent Medicaid population. *J Am Board Fam Pract*. 2004;17(1):44-7. [PubMed: 15014052]
 26. Howard DH, Gazmararian J, Parker RM. The impact of low health literacy on the medical costs of Medicare managed care enrollees. *Am J Med*. 2005;118(4):371-7. doi: 10.1016/j.amjmed.2005.01.010. [PubMed: 15808134]
 27. Friedland RB. Understanding health literacy: new estimates of the costs of inadequate health literacy. *Washington, DC: National Academy on an Aging Society*. 1998:1-24.
 28. Vernon J. *Low health literacy: an economic drain on the US health-care system*. Washington, DC: National Press Club; 2007.
 29. Baker DW, Parker RM, Williams MV, Clark WS, Nurss J. The relationship of patient reading ability to self-reported health and use of health services. *Am J Public Health*. 1997;87(6):1027-30. [PubMed: 9224190]
 30. Schillinger D, Grumbach K, Piette J, Wang F, Osmond D, Daher C, et al. Association of health literacy with diabetes outcomes. *JAMA*. 2002;288(4):475-82. [PubMed: 12132978]
 31. Kalichman SC, Rompa D. Functional health literacy is associated with health status and health-related knowledge in people living with HIV/AIDS. *J Acquir Immune Defic Syndr*. 2000;25(4):337-44. [PubMed: 11114834]
 32. Weiss BD, Hart G, McGee DL, D'Estelle S. Health status of illiterate adults: relation between literacy and health status among persons with low literacy skills. *J Am Board Fam Pract*. 1992;5(3):257-64. [PubMed: 1580173]
 33. Bennett CL, Ferreira MR, Davis TC, Kaplan J, Weinberger M, Kuzel T, et al. Relation between literacy, race, and stage of presentation among low-income patients with prostate cancer. *J Clin Oncol*. 1998;16(9):3101-4. [PubMed: 9738581]
 34. Sudore RL, Yaffe K, Satterfield S, Harris TB, Mehta KM, Simonick EM, et al. Limited literacy and mortality in the elderly: the health, aging, and body composition study. *J Gen Intern Med*. 2006;21(8):806-12. doi: 10.1111/j.1525-1497.2006.00539.x. [PubMed: 16881938]
 35. Williams MV, Baker DW, Parker RM, Nurss JR. Relationship of functional health literacy to patients' knowledge of their chronic disease: a study of patients with hypertension or diabetes. *Arch Int Med*. 1998;158(1):166-72. [PubMed: 9448555]
 36. Arnold CL, Davis TC, Berkel HJ, Jackson RH, Nandy I, London S. Smoking status, reading level, and knowledge of tobacco effects among low-income pregnant women. *Prev Med*. 2001;32(4):313-20. doi: 10.1006/pmed.2000.0815. [PubMed: 11304092]
 37. Williams MV, Baker DW, Honig EG, Lee TM, Nowlan A. Inadequate literacy is a barrier to asthma knowledge and self-care. *Chest*. 1998;114(4):1008-15. [PubMed: 9792569]
 38. Davis TC, Arnold C, Berkel HJ, Nandy I, Jackson RH, Glass J. Knowledge and attitude on screening mammography among low-literate, low-income women. *Cancer*. 1996;78(9):1912-20. [PubMed: 8909311]
 39. Davis TC, Dolan NC, Ferreira MR, Tomori C, Green KW, Sipler AM, et al. The role of inadequate health literacy skills in colorectal cancer screening. *Cancer Invest*. 2001;19(2):193-200. [PubMed: 11296623]
 40. Gazmararian JA, Williams MV, Peel J, Baker DW. Health literacy and knowledge of chronic disease. *Patient Educ Couns*. 2003;51(3):267-75. [PubMed: 14630383]
 41. Dolan NC, Ferreira MR, Davis TC, Fitzgibbon ML, Rademaker A, Liu D, et al. Colorectal cancer screening knowledge, attitudes, and beliefs among veterans: does literacy make a difference? *J Clin Oncol*. 2004;22(13):2617-22. doi: 10.1200/JCO.2004.10.149. [PubMed: 15226329]
 42. Baker DW, Gazmararian JA, Williams MV, Scott T, Parker RM, Green D, et al. Functional health literacy and the risk of hospital admission among Medicare managed care enrollees. *Am J Public Health*. 2002;92(8):1278-83. [PubMed: 12144984]
 43. Baker DW, Parker RM, Williams MV, Clark WS. Health literacy and the risk of hospital admission. *J Gen Intern Med*. 1998;13(12):791-8. [PubMed: 9844076]
 44. Weiss BD. *Health literacy: a manual for clinicians*. Chicago: American Medical Association, American Medical Foundation; 2003.
 45. National Institutes of Health: How to write easy to read health materials. 2013. Available from: <http://www.nlm.nih.gov/medlineplus/etr.html>.
 46. Weiss BD, Coyne C. Communicating with patients who cannot read. *N Engl J Med*. 1997;337(4):272-4. doi: 10.1056/NEJM199707243370411. [PubMed: 9227936]
 47. Cotugna N, Vickery CE, Carpenter-Haeefele KM. Evaluation of literacy level of patient education pages in health-related journals. *J Community Health*. 2005;30(3):213-9. [PubMed: 15847246]
 48. Doak LG, Doak CC, Meade CD. Strategies to improve cancer education materials. *Oncol Nurs Forum*. 1996;23(8):1305-12. [PubMed: 8883075]
 49. Murero M, D'Ancona G, Karamanoukian H. Use of the Internet by patients before and after cardiac surgery: telephone survey. *J Med Internet Res*. 2001;3(3):E27. doi: 10.2196/jmir.3.3.e27. [PubMed: 11720969]

50. Flesch RF. *How to Write Plain English: A Book for Lawyers, Consumers*. 1st ed. New York: NY: Barnes and Noble; 1981.
51. Friedman DB, Hoffman-Goetz L. A systematic review of readability and comprehension instruments used for print and web-based cancer information. *Health Educ Behav*. 2006;**33**(3):352-73. doi: 10.1177/1090198105277329. [PubMed: 16699125]
52. Centers for Disease Control and Prevention . *Scientific and technical information simply put*. 2nd ed. Atlanta: GA: Office of Communication; 1999.
53. Jackson RH, Davis TC, Bairnsfather LE, George RB, Crouch MA, Gault H. Patient reading ability: an overlooked problem in health care. *South Med J*. 1991;**84**(10):1172-5. [PubMed: 1925713]
54. National Center for Education Statistics. *The Health Literacy of America's Adults: Results From the 2003 National Assessment of Adult Literacy*. Washington, DC: U.S. Department of Education; 2006.
55. U.S. Department of Education, Institute of Education Sciences. National Assessment of Adult Literacy.
56. Rozental TD, Bozentka DJ, Beredjikian PK. Patient education through the Internet: academic and private practice sites. *Clin Orthop Relat Res*. 2004;**421**:50-3. [PubMed: 15123925]
57. Beredjikian PK, Bozentka DJ, Steinberg DR, Bernstein J. Evaluating the source and content of orthopaedic information on the Internet. The case of carpal tunnel syndrome. *J Bone Joint Surg Am*. 2000;**82-A**(11):1540-3. [PubMed: 11097441]
58. Purvis JM, Alexander AH, Einhorn TA, Griffin LY. American Orthopaedic Association symposium: Evaluating the flood of orthopaedic media and marketing information. *J Bone Joint Surg Am*. 2005;**87**(6):1392-8. doi: 10.2106/JBJS.E.00191. [PubMed: 15930553]