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HEALTH SERVICES RESEARCH

Is the Readability of Spine-Related Patient Education Material Improving?

An Assessment of Subspecialty Websites

Adam E.M. Eltorai, BA,* Morgan Cheatham, BS,* Syed S. Naqvi, BS,* Siddharth Marthi, BS,* Victor Dang, BS,* Mark A. Palumbo, MD,*,† and Alan H. Daniels, MD*,†

Study Design. Analysis of spine-related patient education materials (PEMs) from subspecialty websites.

Objective. The aim of this study was to assess the readability of spine-related PEMs and compare to readability data from 2008.

Summary of Background Data. Many spine patients use the Internet for health information. Several agencies recommend that the readability of online PEMs should be no greater than a sixth-grade reading level, as health literacy predicts health-related quality of life outcomes. This study evaluated whether the North American Spine Society (NASS), American Association of Neurological Surgeons (AANS), and American Academy of Orthopaedic Surgeons (AAOS) online PEMs meet recommended readability guidelines for medical information.

Methods. All publicly accessible spine-related entries within the patient education section of the NASS, AANS, and AAOS websites were analyzed for grade level readability using the Flesch-Kincaid formula. Readability scores were also compared with a similar 2008 analysis. Comparative statistics were performed.

Results. A total of 125 entries from the subspecialty websites were analyzed. The average (SD) readability of the online articles was grade level 10.7 (2.3). Of the articles, 117 (93.6%) had a readability score above the sixth-grade level. The readability of the articles exceeded the maximum recommended level by an average of 4.7 grade levels (95% CI, 4.292–5.103; $P < 0.001$). Compared with 2008, the three societies published more spine-related patient education articles (61 *vs.* 125, $P = 0.045$) and the average readability level improved from 11.5 to 10.7 ($P = 0.018$). Of three examined societies, only one showed significant improvement over time.

Conclusion. Our findings suggest that the spine-related PEMs on the NASS, AAOS, and AANS websites have readability levels that may make comprehension difficult for a substantial portion of the patient population. Although some progress has been made in the readability of PEMs over the past 7 years, additional improvement is necessary.

Key words: American Association of Neurological Surgeons, American Academy of Orthopaedic Surgeons, comprehension, Flesch-Kincaid, North American Spine Society, online health information, patient education materials, readability, spine.

Level of Evidence: 2

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Spine patient education is undergoing a major transformation with increasing online health information available to care providers and patients. In addition to the dramatic influx of material obtainable via multimedia sources, an increasingly conscientious and inquisitive patient population is seeking more involvement in health care decisions.[1–7]

These developments have led to a greater focus on improving health literacy. *Health literacy* is the "capacity to obtain, interpret, and understand basic health information and services and the competence to use such information and services to enhance health."[8] Studies have shown that health literacy is an independent predictor of health-related quality of life.[9–11] Moreover, lower health literacy portends higher rates of hospitalizations and complications,[12–14] increased health care cost,[15–18] and poorer overall health.[12,19–23]

Central to the success of health literacy is the capacity of consumers to make health care decisions based on the ability to comprehend the available material.[7] A misalignment between intention and understanding can be costly to the patient and society. In turn, it is imperative that the readability of material is based at a level appropriate to convey its intended meaning to allow productive and appropriate

From the *Warren Alpert Medical School, Brown University, Providence, RI; and †Division of Spine Surgery, Department of Orthopaedic Surgery.

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Address correspondence and reprint requests to Adam E.M. Eltorai, BA, Warren Alpert Medical School, Brown University, Box G-9999, Providence, RI 02903; E-mail: adam_eltorai@brown.edu

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decisions.[24] Improved readability is associated with increased comprehension, and thus may portend improved health outcomes.

Unfortunately, several studies indicate that current patient education materials (PEMs) are written at a level above the average comprehension of most patients.[25–36] This is true despite formal recommendations from several organizations including the US Department of Health and Human Services, American Medical Association, and National Institutes of Health for the readability of PEMs not to exceed a sixth-grade reading level (11–12 years of age).[37–41]

In this study, we first sought to examine whether the readability of spine-related PEMs on spine society websites—North American Spine Society (NASS), American Academy of Orthopaedic Surgeons (AAOS), and American Association of Neurological Surgeons (AANS)—exceeds the recommendation of a sixth-grade reading level (11–12 years) as measured by the Flesch-Kincaid Grade Level (FKGL) formula.[25–30,42–44] We hypothesized that the readability of these online materials would have an FKGL above the sixth-grade level (11–12 years). Our second aim was to determine if the readability of the materials had changed since they were first analyzed in 2008.[30]

METHODS

This study analyzed the spine-related patient educational material on the NASS (www.knowyourback.org/Pages/Default.aspx), AANS (www.aans.org/Patient%20Information/Conditions%20and%20Treatments.aspx), and AAOS (orthoinfo.aaos.org/menus/spine.cfm) websites. The study was exempt from institutional review board review. The websites are publicly accessible and were accessed in 2014.

All publicly available patient education articles were assessed for this study, excluding those with content predominately in graphic/pictorial form, table format, or written in a language other than English. Only the patient education articles directly related to pathology, diagnosis, and treatment of spine conditions were analyzed.

Text from each webpage was copied in plain text format into individual Microsoft Office Word 2010 (Microsoft Corporation, Redmond, WA) documents. Copyright notes, date stamps, author information, hyperlinks, citations, tables, and any other text not directly related to patient education were deleted. To avoid underestimating the readability level, all of the numbers, decimals, bullets, abbreviations, paragraph breaks, colons, semicolons, and dashes within a sentence were removed, as recommended by Flesch and others.[45,46]

The FKGLs were obtained for each document utilizing the readability calculator in the Word software. The FKGL is calculated with the following equation: $0.39 \times$ (average number of words per sentence) $+ 11.8 \times$ (average number of syllables per word) $- 15.59$. The built-in FKGL calculator was enabled by sequentially selecting "Review," "Spelling & Grammar," "Options," and "Show Readability Statistics." The FKGL for each document was automatically displayed after grammar and spelling were checked. Each FKGL was recorded and analyzed.

Unpaired *t* tests were calculated with Microsoft Office Excel 2010 (Microsoft Corporation) to compare the mean FKGLs with the recommended readability level of sixth-grade and to Vives *et al*'s[30] 2008 readability scores. A statistical cutoff of $P < 0.05$ was used for the determination of significance.

RESULTS

A total of 125 entries from the three subspecialty websites were analyzed. The average (SD) readability of the articles was grade level 10.7 (2.3). One hundred seventeen of the articles (93.6%) had a readability score above the sixth-grade level, the maximum level recommended by several health care agencies. The readability of the articles exceeded this level by an average of 4.7 grade levels (95% CI, 4.29–5.10; $P < 0.001$) (Tables 1–3).

For the 48 AAOS spine-related articles, the mean FKGL was 9.2 (1.7). Forty-three of the articles (89.5%) were above the sixth-grade level and 30 (62.5%) were above the eighth-grade level. The readability of the articles exceeded the sixth-grade level by an average of 3.2 grade levels (95% CI, 2.70–3.70; $P < 0.001$) (Table 1).

For the 28 AANS articles, the mean FKGL was 11.8 (1.3). All (100%) of the articles were above the eighth-grade level. The readability of the articles exceeded the sixth-grade level by an average of 5.8 grade levels (95% CI, 5.29–6.26; $P < 0.001$) (Table 2).

For the 49 NASS articles, the mean FKGL was 11.5 (2.5). Forty-six of the articles (93.9%) of the articles were above the sixth-grade level and 42 (85.7%) were above the eighth-grade level. The readability of the articles exceeded the sixth-grade level by an average of 5.5 grade levels (95% CI, 4.85–6.25; $P < 0.001$) (Table 3).

Compared to 2008, the three societies published more spine patient education articles (61 *vs.* 125, $P = 0.045$). Although the overall average readability level of society-produced, spine-related articles dropped from 11.5 to 10.7 ($P = 0.018$) (Figure 1), the AAOS was the only society whose articles' FKGLs dropped significantly ($P = 0.001$) (Figure 2 and Table 4).

DISCUSSION

Heath education materials have become a fundamentally important topic of study due to easier access to online health information and greater interest by patients. In line with several other previous reports[25–36] this study found that the readability of online health education materials may exceed the comprehension level of a substantial component of the spine patient population.

In our study we found that the PEM on trusted society websites averaged a readability score of 10.7, an average well above the sixth-grade level recommended by several health care agencies. These findings support a growing

TABLE 1. Mean Flesch-Kincaid Grade Level for Articles on the American Academy of Orthopaedic Surgeons Website

Article Topic	FKGL	Grade Levels Above Recommended (FKGL-6)
Back pain in children	8.2	2.2
Cervical fracture (broken neck)	9.6	3.6
Fracture of the thoracic and lumbar spine	10.6	4.6
Herniated disk	8.9	2.9
Herniated disk in the lower back	8.8	2.8
Low back pain	7.5	1.5
Neck pain	10.6	4.6
Neck sprain	9.4	3.4
Osteoporosis and spinal fractures	10.5	4.5
Spondylolysis and spondylolisthesis	10	4
Adult spondylolisthesis in the low back	9.1	3.1
Back pain in children	8.2	2.2
Cauda equina syndrome	10.6	4.6
Cervical radiculopathy (pinched nerve)	8	2
Cervical spondylosis (arthritis of the neck)	8.5	2.5
Cervical spondylotic myelopathy (spinal cord compression)	8.7	2.7
Chordoma	9.2	3.2
Congenital muscular torticollis (twisted neck)	9.8	3.8
Congenital scoliosis	8.9	2.9
Idiopathic scoliosis in children and adolescents	9.9	3.9
Kyphosis (roundback) of the spine	10.1	4.1
Lumbar spinal stenosis	8.7	2.7
Sciatica	9	3
Scoliosis: frequently asked questions	10.5	4.5
Spinal deformity in children with myelomeningocele	10.6	4.6
Spondylolysis and spondylolisthesis	10	4
Anterior lumbar interbody fusion	9.5	3.5
Artificial disk replacement in the lumbar spine	11.1	5.1
Bone grafts in spine surgery	6.7	0.7
Cervical radiculopathy: surgical treatment options	9.6	3.6
Cervical spondylotic nyelopathy: surgical treatment options	9.6	3.6
Electrodiagnostic testing	9.8	3.8
Lateral lumbar interbody fusion	10.1	4.1
Low back pain exercise guide	4.6	–
Minimally invasive spine surgery	11.2	5.2
Posterior lumbar interbody fusion and transforaminal lumbar interbody fusion	9	3
Posterolateral lumbar fusion	9.8	3.8
Preparing for low back surgery	9.5	3.5
Spinal fusion	8.7	2.7
Spinal fusion glossary	7.5	1.5
Spinal injections	10.3	4.3
Spine conditioning program	5.7	–
Backpack safety	7.1	1.1
Preventing back pain at work and at home	5.1	–
Preventing back pain: tips for new moms	5.9	–

TABLE 1 (*Continued*)		
Article Topic	**FKGL**	**Grade Levels Above Recommended (FKGL-6)**
A patient's experience with incomplete spinal cord injury	14.2	8.2
Patient story: scoliosis treatment with growing rods	11.1	5.1
Patient story:scoliosis treatment with spinal fusion surgery	11.6	5.6
Mean	9.2	3.2
FKGL indicates Flesch-Kincaid Grade Level.		

concern that current health information may not effectively educate patients simply due to the fact that many patients cannot comprehend the material. Thus, many patients will not have the requisite health literacy skills to manage their health issues.[47]

Poor health literacy is a contributing factor to reduced health outcomes, increased hospitalizations, and higher health care costs.[9–23] Recognition of the unrealistically high reading level of online PEMs is an important first step. However, secondary measures including improved readability screening and testing may improve the utility of online health resources. Providers of health education material may also benefit from training opportunities geared toward content revision, as utilizing simpler terms, shorter

TABLE 2. Flesch-Kincaid Grade Level for Articles on the American Association of Neurological Surgeons Website		
Article Topic	**FKGL**	**Grade Levels Above Recommended (FKGL-6)**
Anatomy of the spine and peripheral nervous system	9	3
Artificial cervical disc	13.8	7.8
Artificial lumbar disc	12.9	6.9
Cauda equina syndrome	11.5	5.5
Central cord syndrome	14.8	8.8
Cervical spine	11.1	5.1
Chronic pain	12.3	6.3
Glossary of spine-related terms	10.9	4.9
Herniated disc	10.9	4.9
Low back pain	12.7	6.7
Low back strain and sprain	9.4	3.4
Lumbar spinal stenosis	12.5	6.5
Minimally invasive spine surgery (MIS)	11.9	5.9
Neck pain	11.4	5.4
Neurological diagnostic tests	10.3	4.3
Osteoarthritis	11	5
Scoliosis	13.2	7.2
Spasticity	11.5	5.5
Spina bifida	11.5	5.5
Spinal cord injury	11.2	5.2
Spinal cord stimulation	11.9	5.9
Spinal infections	13.4	7.4
Spinal pain	11.7	5.7
Spinal tumors	13.5	7.5
Sports-related neck injury	11.2	5.2
Tarlov cyst	10.6	4.6
Tethered spinal cord syndrome	11.9	5.9
Vertebral compression fractures	11.7	5.7
Mean	11.8	5.8
FKGL indicates Flesch-Kincaid Grade Level.		

TABLE 3. Mean Flesch-Kincaid Grade Level for Articles on the North American Spine Society Website

Article Topic	FKGL	Grade Levels Above Recommended (FKGL-6)
Acute low back pain	13.4	7.4
Chronic low back pain	11.5	5.5
Cervical stenosis, myelopathy, and radiculopathy	12.1	6.1
Herniated lumbar disk	11.7	5.7
Herniated cervical disk	11.8	5.8
Lumbar spinal stenosis	12	6
Osteoporosis	11.3	5.3
Spondylolysis and spondylolisthesis	12.4	6.4
Spinal cord injuries	15.2	9.2
Sports injuries	12.3	6.3
Whiplash and whiplash-associated disorder	10	4
Spinal infections	11.3	5.3
Spinal tumors	11.4	5.4
Scoliosis, adolescent idiopathic	13.4	7.4
Back pain and emotional distress	14	8
Relationship between stress and pain	10.9	4.9
Psychological interventions for back pain	11.8	5.8
Questions you need to ask	11.5	5.5
Discography	10.3	4.3
Electrodiagnostic testing	11.5	5.5
MRI	14.7	8.7
Radiographic assessment for back pain	14.3	8.3
Radiological assessment of spinal disorders	15.2	9.2
Specialized nerve tests	12.4	6.4
Injection treatments epidural steroid injections	14.4	8.4
Lumbar zygapophysial (facet) joint injections	11.8	5.8
Anterior cervical fusion	14.7	8.7
Artificial disc replacement	12.2	6.2
Bone graft alternatives	11.8	5.8
Bone morphogenetic protein	14.3	8.3
Cervical disk replacement	14.2	8.2
Cervical laminoplasty	12.7	6.7
Lumbar open microscopic discectomy	11.7	5.7
Percutaneous vertebral augmentation	13.4	7.4
Posterior cervical foraminotomy	11.7	5.7
Spinal fusion	12.6	6.6
Acupuncture	12.6	6.6
Herbal supplements	11.9	5.9
Hydrotherapy	13.2	7.2
Preventing osteoporosis	8.5	2.5
Back pain during pregnancy	7.3	1.3
Backpack safety	10.1	4.1
Strengthening	6.1	0.1
Stretching and flexibility	3.6	–
Aerobic exercise	9.4	3.4
Cervical exercise	9	3
Strength training for the elderly	8.7	2.7
10 Tips for a healthy back	6	0
Patient safety	7.6	1.6
Mean	11.5	5.5

FKGL indicates Flesch-Kincaid Grade Level; MRI, magnetic resonance imaging.

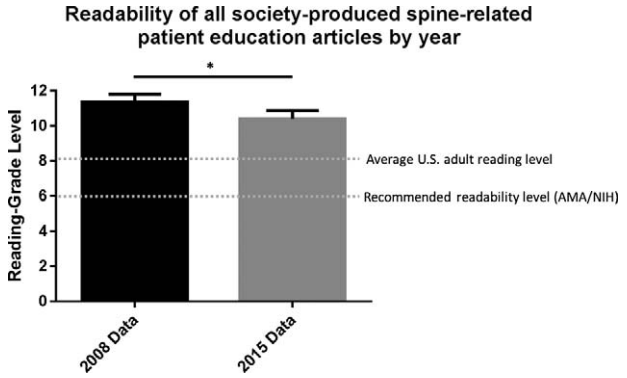

Figure 1. The distribution of all society-produced articles by year (2008 *vs.* 2015). $^{*}P < 0.05$.

sentences, and illustrations have been shown to improve readability.[25,41]

Vives *et al*[30] analyzed the same spine-related PEMs in 2008 and found the average FKGL was 11.5. Previous readability studies examining PEMs have been limited to reporting readability scores at one time point. This study assessed if the readability data of PEMs has changed over time. Our findings suggest society-produced PEMs have improved readability by 0.8 grade levels over the last 7 years. The AAOS was the only individual society with significant improvement in its spine-related PEMs. Further improvement efforts are needed by all three societies. The limited improvement over time may indicate a continued lack of awareness in the spine community regarding the concept of readability.

Suboptimal PEM readability is not limited to spine-related materials—various other medical and surgical specialties are similarly affected.[26–29,33,35,36,41–44,46,48,49] Moreover, a recent study suggests that health literacy minimally improved from 2006 to 2014 across all orthopedic subspecialties, not just spine.[34]

This study has several limitations. We used the FKGL scoring system for evaluation of readability. Although this metric is validated,[25–30,42–44] it only considers written text and not illustrations. In the case of spine education, illustrations may carry substantial value in conveying the intended message. In addition, there may be a limit to how simple a patient educational text can be while still conveying complex medical information. To mitigate the limitations of the FKGL scoring system, future readability studies may consider using different scoring systems such as the Fog Scale, SMOG Index, Coleman-Liau Index, Automated Readability Index, Linsear Write Formula, or the Flesch Reading Ease Formula. In addition, the development of systems for evaluating the comprehensibility of tables and figures is needed. Although future studies across other online sources will hopefully complement the findings from this study, we note the immediate importance of our results as surgeons commonly refer patients to professional websites for information gathering.[3,50,51]

Health care is entering a new period where a greater premium is placed on online patient educational materials. Unfortunately, this exciting advance may not directly improve health literacy if patients cannot comprehend the

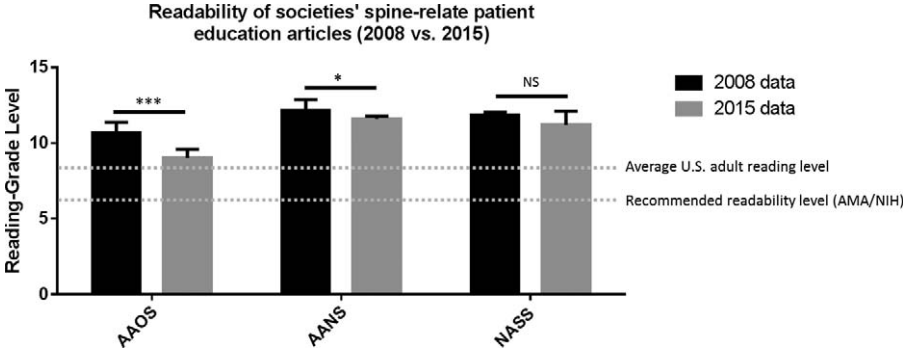

Figure 2. The distribution of individual societies' patient education articles by Flesch-Kincaid Grade Level. $^{*}P < 0.05$.

TABLE 4. Comparison of 2008 *Versus* 2015 Mean Flesch-Kincaid Grade Level by Society

Society	2008 Mean FKGL (Number of Articles)	2015 Mean FKGL (Number of Articles)	*P*
AAOS	10.7 (25)	9.2 (48)	$^{*}P = 0.001$ (95% CI: −0.636 to −2.324)
AANS	12.1 (21)	11.8 (28)	$P = 0.388$ (95% CI: −0.475 to 1.201)
NASS	11.9 (15)	11.5 (49)	$P = 0.617$ (95% CI: −0.965 to 1.614)
Mean	11.5 (61)	10.7 (125)	$^{*}P = 0.018$ (95% CI: −0.133 to −1.423)

$^{*}P < 0.05$.

AANS indicates American Association of Neurological Surgeons; AAOS, American Academy of Orthopaedic Surgeons; FKGL, Flesch-Kincaid Grade Level; NASS, North American Spine Society.

online education materials. Based on the findings from this study of spine educational material offered on major professional society websites, the readability of material on average is at a level above the comprehension levels of many readers. Refining the readability of education material, and thus hopefully improving patient comprehension, may positively affect health outcomes.

Key Points

- Our findings suggest that the spine-related PEMs on the NASS, AAOS, and AANS websites have readability levels that may make comprehension difficult impossible for a substantial portion of the patient population.
- The average (SD) readability of the online articles was grade level 10.7 (2.3).
- Although some progress has been made in the readability of PEMs over the past 7 years, additional improvement is necessary.

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