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Assessing the Readability of English and Spanish Online Patient Educational Materials for Deep Venous Thrombosis

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ABSTRACT

Introduction: Online patient educational materials (OPEMs) help patients engage in their health care. The American Medical Association (AMA) recommends OPEM be written at or below the 6th grade reading level. This study assessed the readability of deep venous thrombosis OPEM in English and Spanish.

Methods: Google searches were conducted in English and Spanish using "deep venous thrombosis" and "trombosis venosa profunda," respectively. The top 25 patient-facing results were recorded for each, and categorized into source type (hospital, professional society, other). Readability of English OPEM was measured using several scales including the Flesch Reading Ease Readability Formula and Flesch-Kincaid Grade Level. Readability of Spanish OPEM was measured using the Fernández-Huerta Index and INFLESZ Scale. Readability was compared to the AMA recommendation, between languages, and across source types.

Results: Only one (4%) Spanish OPEM was written at an easy level, compared to 7 (28%) English OPEM ($P = 0.04$). More English (28%) OPEM were easy to read compared to Spanish (4%), with a significant difference in reading difficulty breakdown between languages ($P = 0.04$). The average readability scores for English and Spanish OPEM across all scales were significantly greater than the recommended level ($P < 0.01$). Only four total articles (8%) met the AMA recommendation, with no significant difference between English and Spanish OPEM ($P = 0.61$).

Conclusions: Nearly all English and Spanish deep venous thrombosis OPEM analyzed were above the recommended reading level. English resources had overall easier readability compared to Spanish, which may represent a barrier to care. To limit health disparities, information should be presented at accessible reading levels.

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Introduction

Online patient educational materials (OPEM) are a valuable source of health-care information for patients and have the potential to improve patient involvement and adherence to medical care.[1] However, for the information provided to be accessible, OPEM must be written at a level that is comprehensible to the public, a concept termed "readability".[2] To this aim, the American Medical Association (AMA) recommends that OPEM be written at or below a 6th grade reading level.[3]

Deep venous thromboses (DVTs) present as a major health concern, affecting up to 5% of the population, with an annual incidence of 1 million people in the United States.[4,5] DVT may lead to life-threatening pulmonary embolism.[6] DVTs are also associated with progression to postthrombotic syndrome, affecting 25%-40% of patients,[4] and resulting in chronic leg swelling as well as venous ulceration. Adequate OPEM that may assist in patient education and increase awareness of DVT and its complications may ameliorate the long term sequelae of untreated DVT.[7]

English and Spanish are the two most commonly spoken languages in the United States,[8] and it is therefore imperative that OPEM in these two languages be written at an appropriate reading level. The objective of this study was to evaluate the readability of DVT OPEM in English and Spanish, compare the readability to the AMA recommendation, between languages, and across source types.

Methods

Data collection

We conducted a Google web engine search in English and Spanish using the terms "deep venous thrombosis" and "trombosis venosa profunda," respectively. Google was chosen as the search engine because it has been shown to comprise most of the market share for internet searches at 88.1%.[9] The search was conducted in private browsing mode with account, location, and tracking settings disabled. The top 25 patient-facing search results in each language were collected. Sources were excluded if they contained purely commercial information, were not currently working, were password-protected, discussion groups or forums, advertisements, subscription-based, or were targeted toward physicians. The articles which fulfilled inclusion criteria were categorized by source type as hospital, professional society, or other. Resources were categorized as "hospital" if they were written by institutions that provide medical or surgical care to patients. "Professional societies" included organizations focused on the advancement of a particular profession or interest. "Other" included information from websites that did not fit in the previous two categories, including health information websites. The following components of articles were removed to avoid misleading the readability analysis software: tables, images, titles, headings, embedded punctuation (decimals, colons, semicolons, parenthesis, abbreviations including periods, and dashes within sentences), bullet points not in sentence form, navigation, copyright notice, disclaimers, date stamps, author information, hyperlinks, and source information.

Assessment of readability

Readability of English-language OPEM was measured using the Flesch Reading Ease Readability Formula (FRES), Automated Readability Index, Coleman-Liau Index, Flesch-Kincaid Grade Level, Gunning Fog, Linsear Write Formula, and the Simple Measure of Gobbledygook Index. Readability of Spanish OPEM was measured using the Fernández-Huerta Index and INFLESZ Scale. Factors evaluated and formulas used in calculating each score are outlined in Table 1. The FRES, Fernández-Huerta Index, and INFLESZ Scale were scored on a scale from 0 (most difficult) to 100 (easiest to read) by convention.[10] The remaining scores were calculated as grade level reading difficulty. Scores for each article were recorded.

Statistical analysis

Median readability scores were compared to the AMA-recommended reading level using a Student's t-test. Fisher's exact tests were used to compare readability between English and Spanish resources by source types and by readability categorized into easy, standard, or difficult by the FRES and Fernández-Huerta Index for English and Spanish, respectively. Mean readability scores for each source type were calculated and compared between English and Spanish resources using an analysis of variance test. A P value <0.05 was chosen for statistical significance. All statistical analyses were performed using STATA version 17.0 (StataCorp, College Station, Texas).

Results

The top 25 English and Spanish resources from the Google search that met inclusion criteria are displayed in Supplementary Tables 1 and 2. The resulting webpages covered a variety of topics about DVTs, including the definition of DVTs, risk factors, tips for prevention, symptoms, complications, treatment, and long-term sequelae. Median readability scores ranged between 9th and 11th grade for English OPEM and median readability scores were 57 and 62 for Spanish OPEM, which both correspond to a reading level of 8th-9th grade (Table 2). The median reading grade levels for English and Spanish OPEM by all readability scales were significantly higher than the AMA-recommended maximum reading level of 6th grade (all P < 0.01). As shown in Table 3, more resources fell within the Hospital category in both English (48%) and Spanish (60%) compared to either Professional Societies or Other. There was no significant difference between the two languages in the breakdown between categories. However, there was a statistically significant difference in the breakdown between reading difficulty in English and Spanish (P = 0.04), as determined by the FRES in English and Fernández-Huerta Index and INFLESZ in Spanish. In Spanish,

Table 1 — Readability analysis tests.

Test	Qualities assessed	Formula
English		
FRES	Word complexity, sentence length	$206.835 - [1.015 \text{ (total words/total sentences)}] - [84.6 \text{ (total syllables/total words)}]$
Gunning fog	Word complexity, sentence length	$0.4 [\text{(words/sentences)} + 100 \text{ (words with three or more syllables/words)}]$
Flesch-Kincaid Grade Level	Word complexity, sentence length	$[0.39 \text{ (total words/total sentences)}] + [11.8 \text{ (total syllables/total words)}] - 15.59$
Coleman-Liau index	Word length, sentence length	$[5.89 \text{ (characters/words)}] - [29.5 \text{ (sentences/words)}] - 15.8$
SMOG	Word complexity, sentence length	$1.0430 (\sqrt{30} \times \text{ words with three or more syllables/sentences}) + 3.1291$
Automated Readability index	Word length, sentence length	$4.71 \text{ (letters/words)} + 0.50 \text{ (words/sentences)} - 21.43$
Linsear Write fFormula	Word complexity, sentence length	$[\text{(one and two syllable words)} + 3 \text{ (three syllable words)}]/\text{total sentences}$
Spanish		
Fernandez-Huerta index	Word complexity, sentence length	$206.84 - [0.60 \text{ (total words/total sentences)}] - [1.02 \text{ (total syllables/total words)}]$
INFLESZ Scale	Word complexity, sentence length	$206.835 - 62.3 \times \text{(syllables/words} - \text{words/sentences)}$

FRES = Flesch Reading Ease Readability Formula; SMOG = Simple Measure of Gobbledygook.

Table 2 — Distribution of readability scores for English- and Spanish-language sites.

Readability scale	Median (interquartile range)	Comparison to 6th grade or lower reading level[*]
English (n = 25)		
FRES[†]	64.3 (58.1-71.3)	P < 0.01
Gunning fog (grade level)	11.1 (9.7-13.7)	P < 0.01
Flesch-Kincaid Grade Level (grade level)	8.1 (6.8-9.4)	P < 0.01
Coleman-Liau index (grade level)	10.0 (9.0-10.0)	P < 0.01
SMOG (grade level)	8.2 (7.2-9.3)	P < 0.01
Automated Readability index (grade level)	8.6 (6.9-9.4)	P < 0.01
Linsear Write Formula (grade level)	9.0 (7.6-10.8)	P < 0.01
Spanish (n = 25)		
Fernandez-Huerta index[†]	61.6 (59.5-65.1)	P < 0.01
INFLESZ scale[†]	57.0 (54.9-60.7)	P < 0.01

FRES = Flesch Reading Ease Readability Formula; SMOG = Simple Measure of Gobbledygook.
[*] Calculated using a Student's t-test with statistical significance set at P < 0.05.
[†] Scored from 0 (most difficult) to 100 (easiest).

only 4% of OPEM were deemed easy to read, compared to nearly one third of English OPEM receiving the easy label (Fig. 1).

There were no significant differences in the median readability of all readability metrics across sources (hospital, professional society, or other), as shown in Table 4. Only four total articles (3/25, 12% in English; 1/25, 4% in Spanish) met the AMA recommended reading level. This was not significantly different between languages (P = 0.61) (Fig. 2).

Table 3 — Source and readability difficulty in English- and Spanish-language materials.

Source and readability	English-language (n = 25)	Spanish-language (n = 25)	P value[*]
Source			0.75
Hospital	12 (48%)	15 (60%)	
Professional society	6 (24%)	5 (20%)	
Other	7 (28%)	5 (20%)	
Readability[†]			**0.04**
Easy	7 (28%)	1 (4%)	
Standard	9 (36%)	16 (64%)	
Difficult	9 (36%)	8 (32%)	

Bolded values indicate statistical significance.
[*] Calculated using a Fisher's exact test.
[†] English-language materials measured using the Flesch Reading Ease Readability Formula and Spanish-language materials measured using the Fernandez Huerta Index.
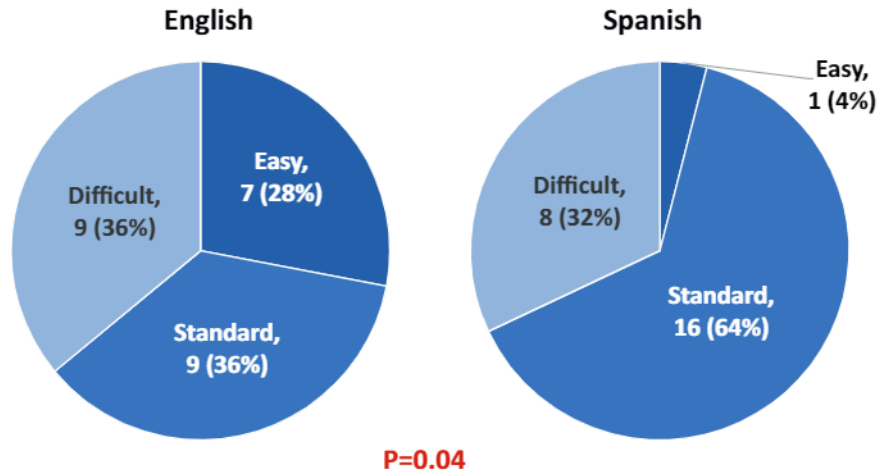
English   Spanish

Fig. 1 — English and Spanish online patient educational materials differ significantly in readability breakdown.

Discussion

This study showed that the median readability for both English and Spanish OPEM was written at a higher reading level than both the AMA-recommendation of 6th grade or lower[3] and the average adult reading level of 8th grade in the United States.[11,12] The National Assessment of Adult Literacy showed that only 12% of American adults possess the literary skills necessary to understand the health-care information presented in brochures or pamphlets.[13] Additionally, more English OPEM were classified as easy to read compared to Spanish resources. This presents a considerable problem as Spanish is the second most spoken language in the United States,[14] and the Spanish-speaking-only community make up 12.8% of the American population. Furthermore, the Hispanic community comprises a disproportionately large segment of the United States population with low English literacy,[13,15]

emphasizing the importance of providing comprehensible health-care information in the Spanish language. Considering that many people who call the United States home speak languages other than English and Spanish as well, efforts should be made to provide accessible OPEM in every language.

DVTs affect more than 1 in 12 people in their lifetime, with prevalence rising exponentially with age.[16,17] The average reading level within the Medicare beneficiary population is 5th grade, even lower than the AMA recommended reading level for OPEM and the average United States adult reading level of 8th grade. Considering that older people are at higher risk for DVT, it becomes increasingly more important that OPEM be written at levels accessible to the aging members of our communities.

Similar readability studies analyzing English resources on topics including peripheral arterial disease,[2] orthopedic surgery,[11] trauma surgery,[12] and more have led to similar conclusions that most patient-facing resources are not written at

Table 4 — Readability by source in English- and Spanish-language materials.				
Readability scale	Hospital	Professional society	Other	P value[*]
English (n = 25)				
FRES[†]	62.5 (10.4)	66.4 (7.2)	67.7 (8.8)	0.47
Gunning fog (grade level)	11.7 (2.4)	10.9 (1.5)	10.7 (1.8)	0.59
Flesch-Kincaid Grade Level (grade level)	8.5 (2.1)	7.8 (1.5)	7.6 (1.6)	0.54
Coleman-Liau index (grade level)	9.8 (1.5)	9.5 (0.8)	9.0 (1.2)	0.50
SMOG (grade level)	8.6 (1.7)	8.0 (1.1)	7.9 (1.4)	0.55
Automated Readability index (grade level)	8.5 (2.3)	7.9 (1.7)	7.7 (1.6)	0.66
Linsear Write Formula (grade level)	9.6 (2.8)	8.7 (1.9)	8.6 (2.0)	0.63
Spanish (n = 25)				
Fernandez-Huerta[†]	61.5 (6.2)	60.3 (2.8)	62.8 (6.4)	0.78
INFLESZ scale[†]	57.0 (6.3)	55.8 (3.0)	58.3 (6.6)	0.79

Reported as mean (standard deviation).
FRES = Flesch Reading Ease Readability Formula; SMOG = Simple Measure of Gobbledygook.
[*] Calculated using an analysis of variance (ANOVA) test.
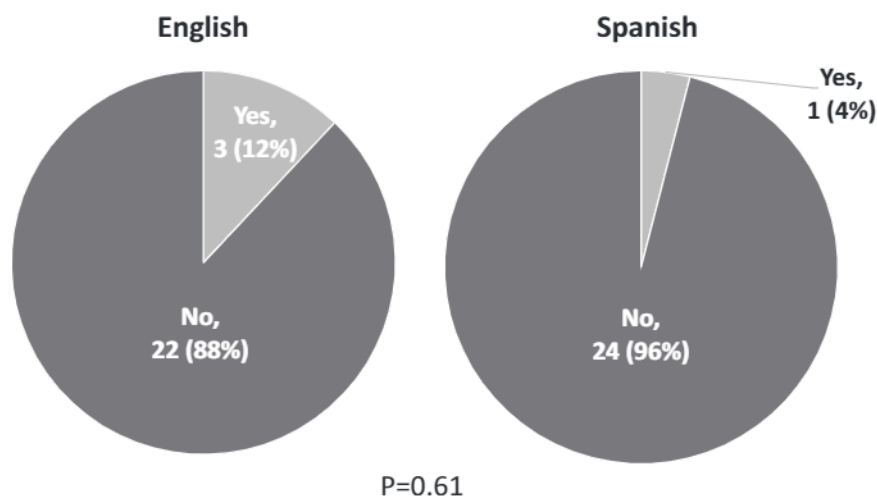[†] Scored from 0 (most difficult) to 100 (easiest).

English

Spanish

Yes, 3 (12%)

No, 22 (88%)

Yes, 1 (4%)

No, 24 (96%)

P=0.61

Fig. 2 — **The majority of English and Spanish online patient educational materials do not meet the recommended reading level.**

a level appropriate for the public. Additional studies have examined the readability of Spanish resources within dermatology,[18] radiology,[19] and vision health,[20] among other categories, finding that they were also written at reading levels too advanced for the average reader. One study analyzing the readability of English and Spanish peripheral arterial disease OPEM found resources in both languages to be above the recommended reading level.[21]

OPEM serve as an essential bridge in knowledge at multiple stages, perhaps early on when the patient first begins experiencing symptoms, reading OPEM may prompt patients to present symptoms to their health-care provider. Once the patient has talked to a health-care professional, OPEM may be used to increase the patient's understanding of their condition. Following a diagnosis, OPEM may serve as a reminder to the patient of signs and symptoms for which they should monitor. Especially in the case of patient with low health literacy, OPEM may be imperative in reinforcing the teaching that clinicians have provided in their clinic, and ultimately adding to and solidifying the knowledge that clinicians have shared. This is particularly relevant in the case of DVTs, as 20%-50% of patients may progress to the postthrombotic syndrome, which is known to reduce quality of life through symptoms of lower extremity edema, pain, and venous ulceration.[22,23] OPEM may help remind patients of potential long term complication leading to increased vigilance, diagnosis and management of the chronic condition.

Now that it has been established that OPEM readability in many topics, including DVT, do not meet the recommended or average public reading level, efforts must be dedicated to creating OPEM that are more widely comprehensible. One mechanism of doing so may include using artificial intelligence such as Chat Generative Pretrained Transformer to rewrite existing OPEM at lower reading levels. Acknowledging that the accuracy of information could potentially be compromised during this process, the work would need to be thoroughly proofread prior to publication.

Limitations of this study include the fact that the readability analysis software used analyzes only the readability of the written words. This means that the content was not examined for accuracy and that no media including images, photos, diagrams, videos, or tables, were included in the readability analysis. Additionally, only the top 25 articles in each languages were studied, but less than 2% of Google users click beyond the 10th search engine result.[24]

Conclusions

Nearly all English and Spanish OPEM on the topic of DVT were written at a reading level higher than that recommended by the AMA. There was a significant difference between the two languages in the percentage of OPEM that were classified as easy, standard, or difficult to read. Efforts should be made to develop OPEM that are comprehensible to the public, especially in common languages such as English and Spanish.

Supplementary Materials

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jss.2024.08.013.

Disclosure

The authors report no proprietary or commercial interest in any product mentioned or concept discussed in this article.

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CRediT authorship contribution statement

Karissa M. Wang: Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization. **Joel L. Ramirez:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Conceptualization. **James C. Iannuzzi:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Jesus G. Ulloa:** Writing – review & editing, Supervision, Methodology, Conceptualization.

REFERENCES

1. Rooney MK, Santiago G, Perni S, et al. Readability of patient education materials from High-impact medical journals: a 20-year analysis. *J Patient Exp.* 2021;8:2374373521998847.
2. Avra TD, Le M, Hernandez S, et al. Readability assessment of online peripheral artery disease education materials. *J Vasc Surg.* 2022;76:1728–1732.
3. Seth P, Kaur H, Kaur M. Clinical profile of diabetic ketoacidosis: a prospective study in a tertiary care hospital. *J Clin Diagn Res.* 2015;9:OC01–OC04.
4. Duffett L. Deep venous thrombosis. *Ann Intern Med.* 2022;175:ITC129–ITC144.
5. Olaf M, Cooney R. Deep venous thrombosis. *Emerg Med Clin North Am.* 2017;35:743–770.
6. Brill A. Multiple facets of venous thrombosis. *Int J Mol Sci.* 2021;22:3853.
7. Moustafa A, Alim HM, Chowdhury MA, Eltahawy EA. Postthrombotic syndrome: long-term sequela of deep venous thrombosis. *Am J Med Sci.* 2018;356:152–158.
8. Bureau UC. Income and poverty in the United States: 2019. U. S. Census Bur. Available at: https://www.census.gov/library/publications/2020/demo/p60-270.html. Accessed July 21, 2021.
9. Anon. Search Engine Market Share United States Of America. StatCounter glob. Stats. Available at: https://gs.statcounter.com/search-engine-market-share/all/united-states-of-america. Accessed December 19, 2023.
10. Scott B. Learn about the Flesch reading Ease formula. ReadabilityFormulas.com. 2023. Available at: https://readabilityformulas.com/learn-about-the-flesch-reading-ease-formula/. Accessed December 29, 2023.
11. Eltorai AEM, Sharma P, Wang J, Daniels AH. Most American Academy of Orthopaedic Surgeons' online patient education material exceeds average patient reading level. *Clin Orthop.* 2015;473:1181–1186.
12. Eltorai AEM, P. Thomas N, Yang H, et al. Readability of trauma-related patient education materials from the American academy of orthopaedic Surgeons. *Trauma Mon.* 2016;21:e20141.
13. Cutilli CC, Bennett IM. Understanding the health literacy of America results of the national assessment of adult literacy. *Orthop Nurs.* 2009;28:27–34.
14. Bureau UC. Language use in the United States: 2019. Census.gov. Available at: https://www.census.gov/library/publications/2022/acs/acs-50.html. Accessed October 7, 2023.
15. OECD. *OECD skills outlook 2013: first results from the survey of adult skills. OECD skills Outlook.* Paris, France: OECD; 2013.
16. Brækkan SK, Hansen JB. VTE epidemiology and challenges for VTE prevention at the population level. *Thromb Update.* 2023;10:100132.
17. White RH. The epidemiology of venous thromboembolism. *Circulation.* 2003;107:I4–I8.
18. Mazmudar RS, Sheth A, Tripathi R, Scott JF. Readability of online Spanish patient education materials in dermatology. *Arch Dermatol Res.* 2021;313:201–204.
19. Novin SA, Huh EH, Bange MG, et al. Readability of Spanish-language patient education materials from RadiologyInfo.org. *J Am Coll Radiol.* 2019;16:1108–1113.
20. Karthik N, Barekatain K, Vu H, et al. A readability comparison of online Spnaish and English patient education materials about vision health. *Ophthalmic Epidemiol.* 2022;29:182–188.
21. Ramirez JL, Wang K, Sung E, et al. Readability of Spanish-language online patient educational materials for peripheral artery disease do not meet recommended standards and represent a literacy barrier to care. *Ann Vasc Surg.* 2023;101:157–163.
22. Kahn SR. The post-thrombotic syndrome. *Hematol Am Soc Hematol Educ Program.* 2016;2016:413–418.
23. Busuttil A, Lim CS, Davies AH. Post thrombotic syndrome. In: Islam MdS, ed. *Thrombosis and Embolism: from Research to Clinical Practice: Volume 1. Advances in Experimental Medicine and Biology.* Cham: Springer International Publishing; 2017:363–375.
24. Anon. *Google Click-through Rates (CTRs) by Ranking Position in 2024;* 2023. First Page Sage; 2023. Available at: https://firstpagesage.com/reports/google-click-through-rates-ctrs-by-ranking-position/. Accessed December 28, 2023.