Readability assessment of Spanish online patient education materials in gynecologic oncology

Dionna Thomas [a], Rubina Ratnaparkhi [b,*]

[a] University of Kansas School of Medicine, Kansas City, KS, USA
[b] Division of Gynecologic Oncology, University of Kansas Medical Center, Kansas City, KS, USA

ARTICLE INFO

ABSTRACT

Objective: Over half of Spanish-speaking patients use the internet to understand their diagnosis. We evaluated readability of Spanish online patient education materials (OPEMs) about gynecologic cancer to assess compliance with National Institute of Health (NIH) recommendations to be at or below eighth grade reading level.
Methods: We conducted an online search using six Spanish gynecologic cancer terms on three major search engines with cookies and location disabled. The first five results by cancer type were included. Readability was analyzed by Spanish Simple Measure of Gobbledygook (SMOG) and Gilliam-Peña-Mountain (GPM) indices. One-way ANOVA with Tukey's Honestly Significant Difference (HSD) post-hoc analysis was performed.
Results: 322 unique OPEMs were retrieved using Spanish queries. This included 132 (41 %) from non-profit organizations, 114 (35.4 %) from governmental organizations, and 63 (19.5 %) from academic medical centers; the remainder were from professional medical society or pharmaceutical company sources. Overall, gynecologic oncology OPEMs were written at a mean 9.8 ± 1.2 grade reading level. Only 14 % of OPEMs were written at or below an eighth grade reading level. There were significant differences in readability by publishing source ($p < 0.001$). Though there were no significant differences in readability by cancer type ($p = 0.07$), the mean reading level for all cancer types was between ninth and eleventh grade level.
Conclusions: 86% of readily searchable Spanish gynecologic oncology OPEMs are written above recommended reading levels. Gynecologic oncologists should curate and support Spanish-speaking patients in finding high-quality online educational content.

1. Introduction

Health literacy is closely linked to patient outcomes.(Dewalt et al., 2004) In oncologic care, low health literacy has been associated with decreased cancer screening, laterstage at diagnosis, and increased mortality rates.(Samuel et al., 2019) Research shows that a significant portion of adults in the U.S. have low health literacy. For Spanish-speaking patients, the risk of low health literacy is even higher.(Brice et al., 2008) Many Spanish-speaking patients report that language barriers in conversations with healthcare providers due to primary language discordance prevent them from receiving adequate information about their cancers.(Kaplan et al., 2016) As a result, more than half of Hispanic patients report using the internet to better understand their medical diagnosis and support their medical decision-making.(Adepoju et al., 2024).

Readability, an objective measure of how easily a text can be read and understood, is a critical metric in the evaluation of patient education materials.(Badarudeen and Sabharwal, 2010) According to the Program for the International Assessment of Adult Competencies (PIAAC), 52 % of American adults aged sixteen or older read below a proficient level, defined as at or around an approximately sixth grade reading level. Recognizing this, the American Medical Association (AMA) and the National Institute of Health (NIH) recommend that patient education materials be written at a sixth to eighth grade reading level to ensure that they are understandable for most Americans.(Weis, 2003; National Institutes of Health, 2015) When patient education materials are too complex, they hold less utility and can negatively impact patients by perpetuating confusion, misinformation, fear, and avoidance of care. (Samuel et al., 2019) This makes readability of patient education materials a determinant not only of comprehension but also of patient empowerment and ability to achieve optimal health outcomes.

Previous studies have shown that English online patient education

materials (OPEMs) in gynecologic oncology exceed the recommended reading level.(Samuel et al., 2019; Fahimuddin et al., 2019 May; Ingledew et al., 2014) However, there is minimal available information on the readability of comparable educational materials in Spanish. The objective of this study was to determine the readability of readily accessible Spanish OPEMs on gynecologic oncology topics and evaluate their compliance with AMA/NIH guidelines.

2. Methods

2.1. Search strategy

Over a one-week period in March 2024, a cross-sectional online search was conducted to identify Spanish OPEMs related to gynecologic oncology. The search was performed in incognito mode with location services and cookies disabled. Six distinct Spanish terms (cáncer de útero, cáncer de endometrio, cáncer de ovarios, cáncer de cuello de uterino, cáncer de vulva, sarcoma uterino) were entered into three different search engines (Google, Yahoo, Bing), resulting in a total of fifteen searches.(Martin et al., 2019) It is important to note that this study did not require Institutional Review Board (IRB) approval, as it exclusively utilized publicly available data devoid of any identifiable patient health information.

2.2. Inclusion and Exclusion criteria

OPEMs included in the final analysis were selected from organizations that appeared within the top five results in each search engine. To ensure relevance, organizations were required to appear in the top five results for at least two different search terms. Reputable organizations were defined as those affiliated with recognized medical institutions, government or public health organizations, non-profit cancer education organizations, or those providing evidence-based content. Additionally, we reviewed OPEMs from academic medical centers that also appeared within the top ten search results from regions with large Spanish-speaking populations, including New York, Miami, and Southern California.

Analyzed OPEMs met the following additional inclusion criteria: written in Spanish, directed to patients for educational purposes, addressing a topic in gynecologic oncology, freely available with no charge to access content, and published by a source not affiliated with news media. OPEMs were excluded if they were primarily multimedia, duplicated from another source, editable by the public, or affiliated with sponsorship. Eleven sources ultimately were reviewed including the American Cancer Society (ACS), American Society of Clinical Oncology (ASCO), Centers for Disease Control and Prevention (CDC), Mayo Clinic, Merck Pharmaceuticals, MedlinePlus (National Library of Medicine), Memorial Sloan Kettering (MSK), Miami Cancer Institute (MCI), National Cancer Institute (NCI), Planned Parenthood, and the University of California, San Diego (UCSD). Each website was reviewed to compile OPEMs into a database.

2.3. Readability assessment and formulas

OPEMs from the search database were reviewed to ensure that content was consistently measured without extraneous information with care taken to avoid introducing formatting changes that unduly improved or worsened readability. This included removal of navigation links, bullet points, copyright notices, figures with captions, multimedia, and references. Quantitative readability assessments were conducted using Readability Studio (version 2019.1, Oleander Software Ltd., Vandalia, OH). Readability calculations were set as the lowest grade level at which the average reader at grade-level could easily comprehend the document. Scores less than or equal to eight indicate below high school levels of literacy consistent with AMA/NIH guidelines whereas scores greater than twelve indicate the need for education

beyond high school to comprehend materials.

OPEMs were analyzed using two validated Spanish-language readability formulas: the Spanish Modified Simple Measure of Gobbledygook (SMOG) and the Gilliam-Peña-Mountain (GPM) scale. These metrics evaluate factors such as sentence length, polysyllabic word count, number of sentences, and syllables per 100 words (Table 1).

2.4. Data analysis

Readability scores were determined for each OPEM. Mean and standard deviations for readability scores were then assessed by OPEMs sorted by cancer type (uterine, ovarian / fallopian tube / primary peritoneal, cervical, and vulvar). Mean and standard deviations of readability scores were then calculated by source type. Our eleven OPEM sources were classified as follows: governmental organizations (CDC, NCI, Medline Plus), academic medical centers (Mayo Clinic, MSK, MCI, UCSD), non-profit organizations (ACS, Planned Parenthood), medical societies (ASCO), and pharmaceutical companies (Merck).

Statistical differences in readability between cancer and source types were analyzed using a one-way analysis of variance (ANOVA) test followed by Tukey's post-hoc test to confirm the results. Spearman's correlation analysis was performed to assess the relationship between SMOG and GPM scores. A significance level of $p < 0.05$ was set for all comparisons.

3. Results

A total of 322 OPEMs from eleven sources were identified from our search strategy and included in analysis. This included 116 (36 %) from ACS, 54 (17 %) from CDC, 32 (10 %) from MCI, 31 (10 %) from NCI, 29 (9 %) from Medline Plus, 16 (5 %) from Mayo Clinic, 16 (5 %) from Planned Parenthood, 10 (3 %) from MSK, 8 (2 %) by Merck, 5 (2 %) from UCSD, and 5 (2 %) by ASCO (Fig. 1). OPEMs were distributed across cancer type with 77 (29 %) for cervical cancer, 74 (28 %) for endometrial cancer, 61 (23 %) for ovarian / tubal / peritoneal cancer, 49 (18 %) for vaginal/vulvar cancer, and 6 (2 %) for gestational trophoblastic neoplasia (Fig. 1).

The mean readability level was 9.8 ± 1.2 by SMOG scores and 8.7 ± 2.0 by GPM scores with an overall mean readability level across both formulas of 9.3 ± 1.8 (Table 2). OPEMs were written between a range of 6th to 17th grade levels, meaning that the highest scoring documents required graduate-school level reading capabilities. The SMOG formula showed that 44 (14 %) of OPEMs were written at or below the recommended reading level of 6th to 8th grade, with 1 (0.3 %) OPEM meeting the AMA guideline of at or below 6th grade reading level. Calculations using the GPM formula showed that approximately 162 (51 %) of OPEMs were below 6th to 8th grade level, with 25 (8 %) at or below a 6th grade reading level. (Fig. 2).

OPEMs were analyzed by source type (Fig. 3). One-way ANOVA showed a statistically significant difference in readability by source type ($p < 0.001$) This was confirmed with Tukey-Kramer post-hoc analysis. The governmental OPEMs (mean readability 9.3 ± 0.9) were written at a significantly lower grade level than all other associations. Moreover, pharmaceutical OPEMs (mean readability 11.0 ± 0.5) required a

Table 1
Spanish Readability Formulas.

Name	Formula
Spanish Modified Simple Measure of Gobbledygook (SOL/SMOG)	$SMOG\ grade = 1.0430 \times \sqrt{\{number\ of\ polysyllabic\ words\}} + 3.129$ $SOL/SMOG = -2.51 + 0.74*[SMOG\ grade]$
Gilliam-Peña-Mountain (GPM)	X axis = # of syllables per 100 words – 67 Y-axis = # of sentences per 100 words

Figure 1: Online Patient Education Materials Characteristics
A) By Source B) By Cancer
* Documents general in nature and not related to a specific cancer type were excluded from analysis
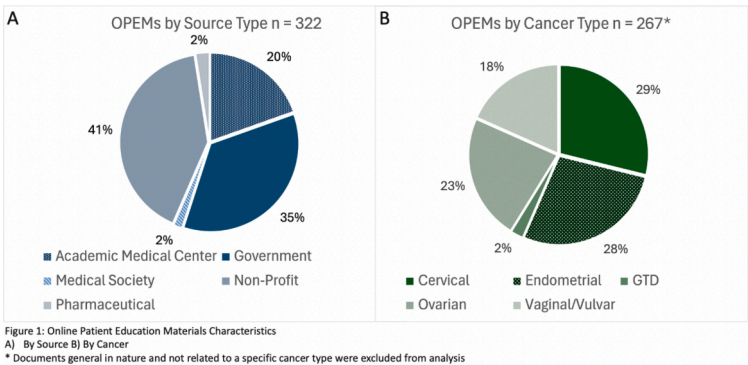
Fig. 1. Online Patient Education Materials Characteristics. A) By Source B) By Cancer * Documents general in nature and not related to a specific cancer type were excluded from analysis.

Table 2
Mean grade level including standard deviation by organization.

Source Type	Grade Level (GPM Formula)	Grade Level (SOL/SMOG Formula)	Organization
Academic Medical Center	8 ± 1.0	9.1 ± 0.6	Mayo Clinic
	8. ± 1.3	8.6 ± 0.6	Memorial Sloan Kettering
	12 ± 2.9	10.8 ± 1.5	Miami Cancer Institute
	7 ± 1.7	8.3 ± 1.1	University of California San Diego
Governmental	8 ± 1.8	9.4 ± 0.8	Center for Disease Control
	8 ± 1.0	8.5 ± 0.5	Medline Plus
	8 ± 1.5	9.8 ± 0.8	National Cancer Institute
Non-Profit Organizations	9 ± 1.7	10.3 ± 1.1	American Cancer Society
	7 ± 1.0	9.1 ± 0.8	Planned Parenthood
Medical Society	10 ± 0.5	10.5 ± 0.2	American Society of Clinical Oncology
Pharmaceutical	10 ± 0.5	11 ± 0.5	Merck Manuals

significantly greater reading grade than all other associations. OPEMs were also analyzed by cancer type. Differences in readability level in OPEMs by cancer type were not statistically significant. Interestingly, the two cancer types with the fewest number of OPEMs trended toward the extremes of scores with vaginal/vulvar cancers having the lowest mean reading level (9.6 ± 1.2) and gestational trophoblastic disease having the highest (10.7 ± 1.5).

Comparison of SMOG and GPM scores for all OPEMs yielded a Spearman correlation coefficient of 0.79, indicating a strong monotonic relationship with similar OPEM rankings between variables (Fig. 4). SMOG scores tended to be higher across OPEMs and confined to a narrower range compared to GPM scores that demonstrated a lower mean but greater standard deviation across OPEMs.

4. Discussion

Our data demonstrate that nearly all Spanish gynecologic oncology OPEMs from eleven different organizations across five different source types are written above the reading level of the average patient, requiring a mean 9th grade reading level for understanding. Only 0.3 % and 8 % (SMOG and GPM respectively) of the 322 OPEMs analyzed met the AMA's criteria for educational material readability, while 14 % and 51 % (SMOG and GPM respectively) met NIH criteria. Taken together, our results show that Spanish OPEMs in gynecologic oncology contain the same readability deficits as comparable OPEMs in English in gynecologic oncology (Samuel et al., 2019; Fahimuddin et al., 2019 May; Martin et al., 2019; Nattam et al., 2023; Okuhara, 2021) and as comparable OPEMs in Spanish in other disease areas.(Bea-Muñoz et al., 2015; Ballesteros-Peña and Fernández-Aedo, 2013; Castillo-Ortiz et al., 2017).

Several previous studies have evaluated the readability of OPEMs in gynecologic oncology, either as a standalone search or as part of a broader evaluation of OPEMs in obstetrics and gynecology and/or related to human papillomavirus-related cancers.(Samuel et al., 2019; Fahimuddin et al., 2019 May; Martin et al., 2019; Nattam et al., 2023; Okuhara, 2021) Across studies, mean reading levels were consistently above AMA/NIH guidelines. Samuel et al (2019) also demonstrated differences in readability based on OPEM source type with OPEMs from pharmaceutical companies having the easiest readability and OPEMs
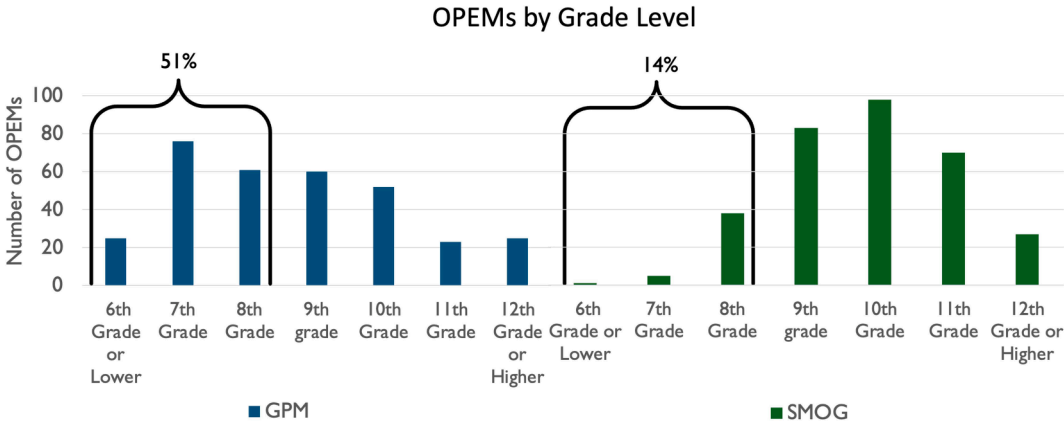

Fig. 2. Number of OPEMs at each grade level. Brackets denote OPEMS within the AMA/NIH guidelines of 6th-8th grade.
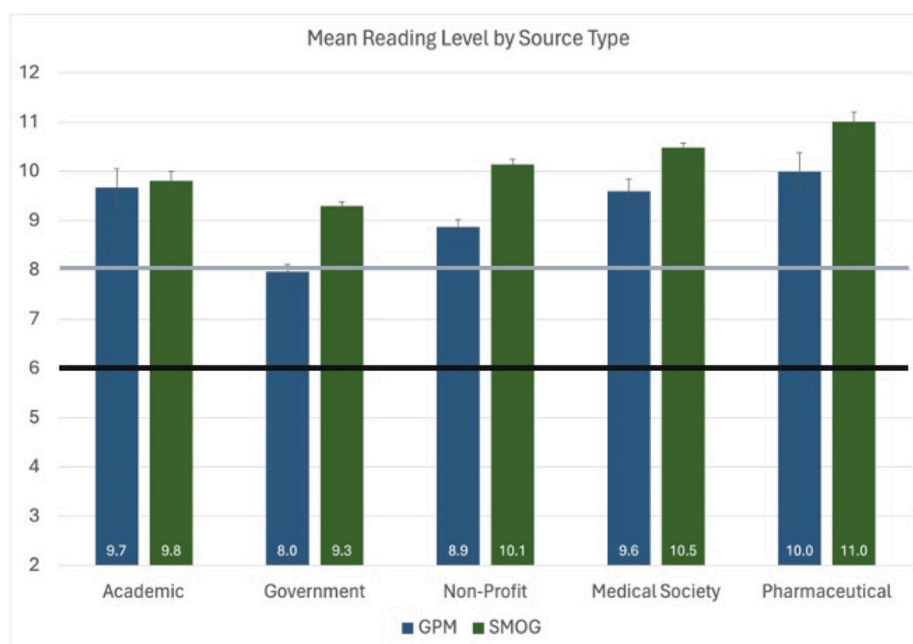
Fig. 3. Mean grade level by formula and source type. Whisker bars represent standard error of the mean. Results of one-way ANOVA $p < 0.001$.
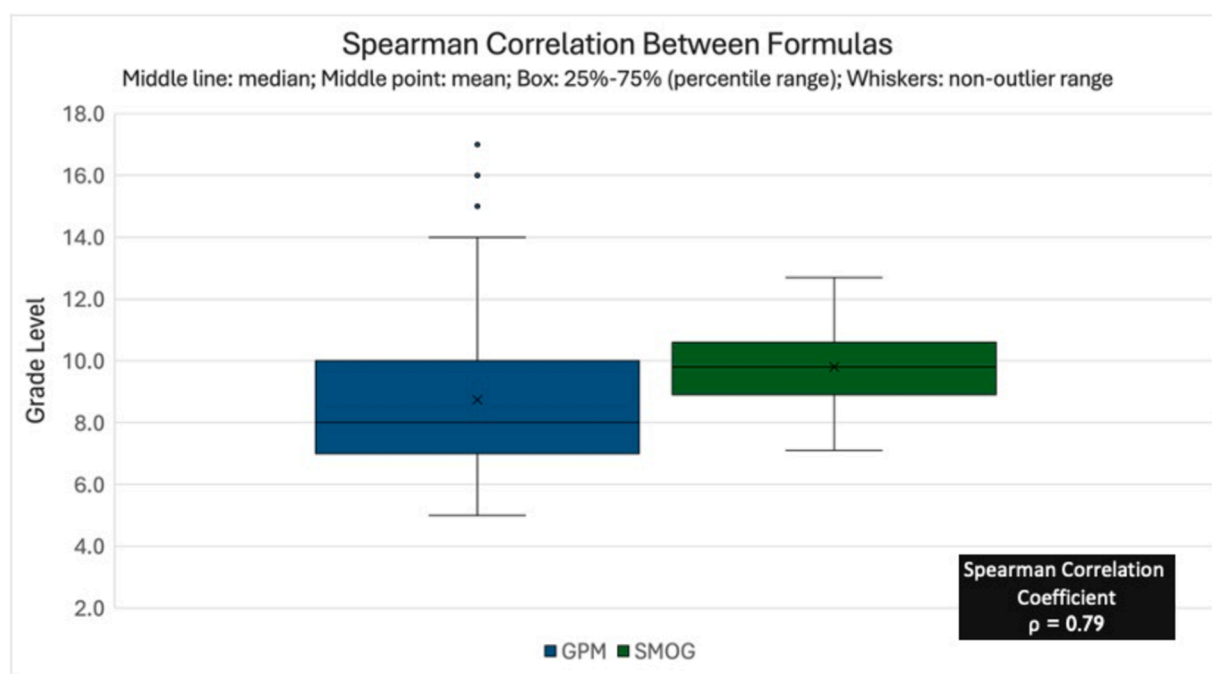

Figure 4: Spearman correlation between GPM and SOL/SMOG formulas

Fig. 4. Spearman correlation between GPM and SOL/SMOG formulas.

from professional medical societies and non-governmental organizations having the most challenging readability.(Samuel et al., 2019) Our results differ somewhat in that OPEMs from governmental organizations tended to have the easiest readability, whereas the pharmaceutical OPEMs we encountered had higher readability scores more similar to those from medical societies and non-profit non-governmental organizations. Multiple governmental groups have developed resources to aid clinicians and practices in developing OPEMs accessible to patients with low health literacy. This includes toolkits from the Agency for Healthcare Research and Quality (AHRQ), Centers for Medicare and Medicaid Services (CMS) as well as guides from the CDC and NCI.(National Institutes of Health, 2015; Agency for Healthcare Research and Quality., 2020; Toolkit for Making Written Material Clear and Effective SECTION 3, 2024; Centers for Disease Control and Prevention (U.S.), 2010) As a result, governmental organizations may have more centralized oversight and quality review to evaluate readability of their published materials. Though pharmaceutical companies have a vested interest to engage patients with readable materials to facilitate uptake of their relevant disease-specific therapies,(Samuel et al., 2019) materials are often evaluated on a qualitative basis using focus groups and surveys without quantitative readability assessment.

A limitation of prior studies on readability of OPEMs in gynecologic

oncology is their reliance on either systematic review of OPEMs from known academic and professional sources or vague or missing descriptions of the online search strategies employed. (Samuel et al., 2019; Fahimuddin et al., 2019; Okuhara, 2021) Though Nattam et al (2023) published their search strategy and used the same search engines deployed in this study, the keywords chosen ("OB/GYN" AND "Patient Education Materials") by the research team are unlikely to align with patient-generated internet search terms. (Nattam et al., 2023) Martin et al (2019) comprehensively analyzed the most common keywords searched in online search engines monthly and found that keywords most commonly utilized were the cancer types (e.g., cervical cancer, ovarian cancer, endometrial cancer, vulvar cancer) with or without qualifiers such as symptoms or treatment. (Martin et al., 2019) We used these findings to generate a comparable search strategy with Spanish keywords. Our study is the first in gynecologic oncology to evaluate Spanish OPEMs and is one of the first among studies evaluating Spanish OPEMs across subspecialty to use patient-generated Spanish search keywords. Keywords identified by Martin et al (2019) correlated most strongly with .org domains followed by .gov, and then lastly .com domains. (Martin et al., 2019) This aligns with our findings that governmental and non-profit non-governmental organizations tailor readability and searchability with greater intention toward patient ease of use and discovery.

In contrast, few academic medical centers had OPEMs that appeared among the top results in our standardized searches. This may be due to having geographic location and cookies disabled, and future studies may wish to replicate our search with region-specific search strategies to assess if local resources become more easily accessible. Furthermore, our study focused exclusively on OPEMs from U.S.-based institutions. Including OPEMs from Spanish-speaking countries would have expanded the scope and required adjustments for regional language differences, which were beyond the intended focus of our analysis. We acknowledge that online searches may return results from institutions worldwide, and future research that includes OPEMs from Spanish-speaking countries could provide a more inclusive picture of global OPEM readability. Despite these limitations, this information is critical for gynecologic oncologists and care providers. Searches in Google, Bing, or Yahoo comprise over 97 % of all internet search traffic. (Cisu et al., 2019; Rankings, 2024) Over half of patients expect physicians to recommend specific websites to support their learning about their medical diagnoses, even though oncologists believe that internet searches negatively impact their patients due to information overload and inaccurate content. (Centers for Disease Control and Prevention (U. S.), 2010; Storino et al., 2016; Joseph-Williams et al., 2014) Gynecologic oncologists with knowledge of our findings can develop curated search strategies and web resource lists for patients and can model their vocabulary and word choice to align with and educate patients on effective search language and vocabulary used in reputable internet sources.

An additional strength of our study was evaluation of Spanish OPEM readability using multiple readability formulas. Prior systematic reviews have demonstrated that using multiple readability formulas strengthens the validity of calculated readability scores. (Martin et al., 2019; Friedman and Hoffman-Goetz, 2006) Similar to prior studies, in the present investigation SMOG and GPM scores correlated well and provided similar global ratings of OPEM readability. However, there are subtle but significant differences between these readability instruments. GPM previously has been recommended due to its ease of administration, strong correlation with SMOG and other readability indices, and ability to generate a visual representation of data. (Friedman and Hoffman-Goetz, 2006; Fry, 1968) In contrast, SMOG was previously recommended by NCI specifically for its utility for health education materials. Importantly, SMOG scores tend to be one to two grade levels higher than other indices due to its requirement for 100 % comprehension as the threshold to meet grade level mastery. (Friedman and Hoffman-Goetz, 2006) Some experts recommend using the single highest calculated grade level readability estimate to impose the most

stringent threshold to prompt document review and editing. (Friedman and Hoffman-Goetz, 2006; Meade and Smith, 1991; Ley and Florio, 1996; Doak et al., 1996) SMOG's absolute comprehension criteria theoretically are also attractive as this standard may limit the potential for introduction of misunderstanding and misinformation in less rigorous attempts to simplify OPEMs. (Wang et al., 2013) However, one caution with universal adherence to stricter grade level assessment thresholds is that it introduces the possibility that OPEM creators may try to achieve readability thresholds by unduly simplifying the content and complexity of Spanish materials, thereby creating inequities in access to comprehensive patient information. Groups looking to institute quality improvement review and evaluation of Spanish OPEMs should ensure that they are concomitantly evaluating the quality of document content using tools such as the Patient Education Materials Assessment Tool for Print and Review and the Suitability Assessment of Materials. (Garfinkle et al., 2019 May; Shoemaker et al., 2014).

Another potential limitation of our study is the use of a single readability software to generate quantified readability assessments. This approach is subject to biases introduced by the software developers in coding and its training data set. Mac et al (2022) compared readability scores from multiple automated calculators, assessing their level of agreement relative to manual measures. (Mac et al., 2022) Readability Studio demonstrated strong agreement with its SMOG Index scores relative to a reference standard, specifically manual independent calculation of the SMOG Index score by two researchers. We also followed Centers for Medicare and Medicaid Services (CMS) guidelines for preparing text for readability analyses, which involved removal of incomplete sentences and adding periods to complete sentences contained in headings and bullet points. (US, 2010) This manual review and preparation of documents is associated with more reliable and consistent SMOG Index readability scores compared to unedited documents. (Mac et al., 2022).

Future research moving beyond mere documentation of deficiencies in the readability of Spanish and English OPEMs to reporting of how to create and evaluate OPEMs to improve readability and quality is needed urgently. Stenquist et al (2020) demonstrated one example of this workflow by employing the "4P's" approach (product, price, place, promotion) approach for OPEM creation with multiple rounds of systematic analysis and editing of readability and suitability by native Spanish speakers to ensure OPEM comprehension and acceptability. (Stenquist, 2020) This resulted in patient education materials written at a 5th grade reading level, with pilot testing showing patients found the material appropriate and appealing. Additional considerations for adapting this methodology in the context of gynecologic oncology include using a marketing framework and evidence-based government resources to create OPEMs, followed by multiple revisions from native Spanish speakers and patients to ensure readability and comprehension.

The strengths of our study include the use of a transparent and reproducible search strategy with use of patient-generated Spanish search terms and use of multiple common search engines with geography tracking hidden. We focused on use of a real-world search strategy and prioritized readability assessment of Spanish OPEMs most likely to be found and used by patients rather than emphasizing resources familiar to physicians but not easily accessible for patients. We also performed critical comparison of Spanish readability formulas and reviewed their strengths and limitations, which previously had only been assessed in English studies. Limitations of our study stem from the lack of comprehensive evaluation of all published Spanish OPEMs that were not readily searchable as well as lack of evaluation of content suitability, quality, and educational effectiveness. An additional key limitation is that a native Spanish speaker was not present among the study team, though both study members had previous training in medical Spanish and patient health literacy standards. Similarly, published formulas cannot assess variations in readability influenced by patients' dialects, culture, and geographic contexts.

In conclusion, our study demonstrated that over 86 % of all Spanish

OPEMs in gynecologic oncology are above AMA and NIH recommended reading levels. Further quality improvement work and research are urgently needed to close this significant health equity gap to improve health literacy of our Spanish-speaking patients and ultimately improve patient outcomes.

CRediT authorship contribution statement

Dionna Thomas: Visualization, Investigation, Formal analysis, Data curation. **Rubina Ratnaparkhi:** Writing – review & editing, Writing – original draft, Resources, Methodology, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Adepoju, O.E., Singh, M., Tipton, M., Peperone, G., Trujillo, M., Ojinnaka, C., 2024. Access to technology, internet usage, and online health information-seeking behaviors in a racially diverse, lower-income population. Front. Public Health. https://doi.org/10.3389/fpubh.2024.1328544. Published 2024 Feb 21.

Agency for Healthcare Research and Quality. (2020, September). AHRQ Health Literacy Universal Precautions Toolkit. www.ahrq.gov. =https://www.ahrq.gov/healthliteracy/improve/precautions/index.html.

Badarudeen, S., Sabharwal, S., 2010. Assessing readability of patient education materials: current role in orthopaedics. Clin Orthop Relat Res. 468 (10), 2572–2580. https://doi.org/10.1007/s11999-010-1380-y.

Ballesteros-Peña, S., Fernández-Aedo, I., 2013. Análisis de la legibilidad lingüística de los prospectos de los medicamentos mediante el índice de Flesch-Szigriszt y la escala Inflesz [Legibility analysis of drug package leaflets using Flesch-Sszigriszt index and Inflesz score]. An Sist Sanit Navar. 36 (3), 397–406. https://doi.org/10.4321/s1137-66272013000300005.

Bea-Muñoz, M., Medina-Sánchez, M., Flórez-García, M.T., 2015. Legibilidad de los documentos informativos en español dirigidos a lesionados medulares y accesibles por internet [Readability and internet accessibility of informative documents for spinal cord injury patients in Spanish]. An Sist Sanit Navar. 38 (2), 255–262. https://doi.org/10.23938/ASSN.0074.

Brice, J.H., Travers, D., Cowden, C.S., Young, M.D., Sanhueza, A., Dunston, Y., 2008. Health literacy among Spanish-speaking patients in the emergency department. J Natl Med Assoc. 100 (11), 1326–1332. https://doi.org/10.1016/s0027-9684(15)31512-1.

Castillo-Ortiz, J.D., Valdivia-Nuno, J.J., Ramirez-Gomez, A., et al., 2017. Readability, relevance and quality of the information in Spanish on the Web for patients with rheumatoid arthritis. Legibilidad, relevancia y calidad de la información en español en la Web para pacientes con artritis reumatoide. Reumatol Clin. 13 (3), 139–144. https://doi.org/10.1016/j.reuma.2016.04.009.

Centers for Disease Control and Prevention (U.S.). Office of the Associate Director for Communication. Strategic and Proactive Communication Branch. (2010). Simply put; a guide for creating easy-to-understand materials.

Cisu, T.I., Mingin, G.C., Baskin, L.S., 2019. An evaluation of the readability, quality, and accuracy of online health information regarding the treatment of hypospadias. J Pediatr Urol. 15 (1), 40.e1–40.e6. https://doi.org/10.1016/j.jpurol.2018.08.020.

Dewalt, D.A., Berkman, N.D., Sheridan, S., Lohr, K.N., Pignone, M.P., 2004. Literacy and health outcomes: a systematic review of the literature. J Gen Intern Med. 19 (12), 1228–1239. https://doi.org/10.1111/j.1525-1497.2004.40153.x.

Doak, C.C., Doak, L.G., Root, J.H., 1996. Teaching Patients With Low Literacy Skills, 2nd ed. J.B. Lippincott Company, Philadelphia, PA.

Fahimuddin, F.Z., Sidhu, S., Agrawal, A., 2019 May. Reading Level of Online Patient Education Materials From Major Obstetrics and Gynecology Societies. Obstet Gynecol. 133 (5), 987–993. https://doi.org/10.1097/AOG.0000000000003214. PMID: 30969212.

Friedman, D.B., Hoffman-Goetz, L., 2006. A systematic review of readability and comprehension instruments used for print and web-based cancer information. Health Educ Behav. 33 (3), 352–373. https://doi.org/10.1177/1090198105277329.

Fry, E., 1968. A Readability Formula That Saves Time. J. Read. 11 (7), 513–578. http://www.jstor.org/stable/40013635.

Garfinkle, R., Wong-Chong, N., Petrucci, A., Sylla, P., Wexner, S.D., Bhatnagar, S., Morin, N., Boutros, M., 2019 May. Assessing the readability, quality and accuracy of online health information for patients with low anterior resection syndrome following surgery for rectal cancer. Colorectal Dis. 21 (5), 523–531. https://doi.org/10.1111/codi.14548. Epub 2019 Feb 4 PMID: 30609222.

Ingledew P-A, El-Zammar D, Scali E, Brar B, Lin J (2014). Caught in the Web: The Quality of Online Resources for Cancer Patients. International Journal of Radiation Oncology*Biology*Physics. 2014;90(1):S604-S604. doi:https://doi.org/10.1016/j.ijrobp.2014.05.1808.

Joseph-Williams, N., Elwyn, G., Edwards, A., 2014. Knowledge is not power for patients: a systematic review and thematic synthesis of patient-reported barriers and facilitators to shared decision making. Patient Educ Couns. 94 (3), 291–309. https://doi.org/10.1016/j.pec.2013.10.031.

Kaplan, C.P., Nápoles, A., Davis, S., et al., 2016. Latinos and Cancer Information: Perspectives of Patients, Health Professionals and Telephone Cancer Information Specialists. J Health Dispar Res Pract. 9 (2), 154–167.

Ley, P., Florio, T., 1996. The use of readability formulas in health care. Psychol. Health Med. 1 (1), 7–28. https://doi.org/10.1080/13548509608400003.

Mac, O., Ayre, J., Bell, K., McCaffery, K., Muscat, D.M., 2022. Comparison of Readability Scores for Written Health Information Across Formulas Using Automated vs Manual Measures. JAMA Netw Open. 5 (12), e2246051.

Martin, A., Stewart, J.R., Gaskins, J., Medlin, E., 2019. A Systematic Assessment of Google Search Queries and Readability of Online Gynecologic Oncology Patient Education Materials. J Cancer Educ. 34 (3), 435–440. https://doi.org/10.1007/s13187-017-1319-z.

Meade, C.D., Smith, C.F., 1991. Readability formulas: cautions and criteria. Patient Educ Couns 17, 153–158.

National Institutes of Health, 2015. May 8). Clear & Simple, National Institutes of Health (NIH) https://www.nih.gov/institutes-nih/nih-office-director/office-communications-public-liaison/clear-communication/clear-simple.

Nattam A, Vithala T, Wu TC, et al. Assessing the Readability of Online Patient Education Materials in Obstetrics and Gynecology Using Traditional Measures: Comparative Analysis and Limitations. J Med Internet Res. 2023;25:e46346. Published 2023 Aug 30. doi:10.2196/46346.

Okuhara T, Okada H, Goto E, Kiuchi T. Readability Assessment of HPV Vaccination and Cervical Cancer Information: A Systematic Scoping Review. Healthcare (Basel). 2021;9(10):1246. Published 2021 Sep 22. doi:10.3390/healthcare9101246.

Rankings. (n.d.). Comscore, Inc. https://www.comscore.com/Insights/Rankings (Accessed 23 September 2024).

Samuel, D., Vilardo, N., Isani, S.S., Kuo, D.Y.S., Gressel, G.M., 2019. Readability assessment of online gynecologic oncology patient education materials from major governmental, non-profit and pharmaceutical organizations. Gynecol Oncol. 154 (3), 616–621. https://doi.org/10.1016/j.ygyno.2019.06.026.

Shoemaker, S.J., Wolf, M.S., Brach, C., 2014. Development of the Patient Education Materials Assessment Tool (PEMAT): a new measure of understandability and actionability for print and audiovisual patient information. Patient Educ Couns 96, 395–403.

Stenquist DS, Ready LV, Ghazinouri R, Beagan C, Wisdom A, Katz JN. Development of Patient Education Materials for Total Joint Replacement During an International Surgical Brigade. J Am Acad Orthop Surg Glob Res Rev. 2020;4(10):e20.00074. Published 2020 Oct 14. doi:10.5435/JAAOSGlobal-D-20-00074.

Storino, A., Castillo-Angeles, M., Watkins, A.A., et al., 2016. Assessing the Accuracy and Readability of Online Health Information for Patients With Pancreatic Cancer. JAMA Surg. 151 (9), 831–837. https://doi.org/10.1001/jamasurg.2016.0730.

Toolkit for Making Written Material Clear and Effective SECTION 3: Methods for testing written material with readers PART 6 Introduction to Toolkit Part 6. (n.d.). Retrieved September 22, 2024, from https://www.cms.gov/Outreach-and-Education/Outreach/WrittenMaterialsToolkit/Downloads/ToolkitPart06Chapter01.pdf.

US Department of Health and Human Services, Centers for Medicare & Medicaid Services . Using Readability Formulas: A Cautionary Note: Toolkit for Making Written Material Clear and Effective. US Dept of Health & Human Services; 2010. Accessed June 6, 2024. https://www.cms.gov/Outreach-and-Education/Outreach/WrittenMaterialsToolkit/index.html.

Wang LW, Miller MJ, Schmitt MR, Wen FK. Assessing readability formula differences with written health information materials: application, results, and recommendations. Res Social Adm Pharm. 2013 Sep-Oct;9(5):503-16. doi: 10.1016/j.sapharm.2012.05.009. Epub 2012 Jul 25. PMID: 22835706.

Weis, B.D., 2003. Health literacy: a manual for clinicians. American Medical Association Foundation and American Medical Association.