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Readability Assessment of Internet-Based Patient Education Materials Related to Endoscopic Sinus Surgery

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Objectives/Hypothesis: Numerous professional societies, clinical practices, and hospitals provide Internet-based patient education materials (PEMs) to the general public, but not all of this information is written at a reading level appropriate for the average patient. The National Institutes of Health and the US Department of Health and Human Services recommend that PEMs be written at or below the sixth-grade level. Our purpose was to assess the readability of endoscopic sinus surgery (ESS)-related PEMs available on the Internet and compare readability levels of PEMs provided by three sources: professional societies, clinical practices, and hospitals.

Study Design: A descriptive and correlational design was used for this study.

Methods: The readability of 31 ESS-related PEMs was assessed with four different readability indices: Flesch-Kincaid Grade Level (FKGL), Flesch Reading Ease Score (FRES), Simple Measure of Gobbledygook (SMOG), and Gunning Frequency of Gobbledygook (Gunning FOG). Averages were evaluated against national recommendations and between each source using analysis of variance and *t* tests.

Results: The majority of PEMs (96.8%) were written above the recommended sixth-grade reading level, based on FKGL ($P < .001$). Only one article (3.2%) had an FKGL at or below the sixth-grade level. The mean readability values were: FRES 47.1 $\pm$ 13.4, FKGL 10.7 $\pm$ 2.4, SMOG 13.7 $\pm$ 1.6, and Gunning FOG 12.4 $\pm$ 2.7.

Conclusions: Current Internet-based PEMs related to ESS, regardless of source type, were written well above the recommended sixth-grade level. Materials from the hospitals/university-affiliated websites had lower readability scores, but were still above recommended levels. Web-based PEMs pertaining to ESS should be written with the average patient in mind.

Key Words: Endoscopic sinus surgery, readability, Flesch-Kincaid Grade Level, Flesch Reading Ease Score, gobbledygook, sinus surgery education material.

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INTRODUCTION

Endoscopic sinus surgery (ESS) is a minimally invasive endonasal technique that has largely replaced open sinus surgery in the treatment of various conditions, including chronic rhinosinusitis. Since its introduction in the United States in 1985, the procedure has been shown to have comparable effectiveness to long-term medical management[1] and is now routinely performed in the outpatient setting with minimal postoperative pain, less blood loss, and shorter inpatient stays when compared to open approaches. The rates of ESS have been rapidly increasing, largely due to the increased safety and lesser morbidity of this minimally invasive technique.[2]

The use of Internet-based patient education materials (PEMs) as a source of health-related information has also been rising. National surveys indicate that >8 million Americans seek health information from the Internet every day to make decisions directly related to their health care.[3] Internet-based PEMs may supplement the physician–patient encounter by providing information away from an office setting associated with anxiety,[4] time constraints, and fear. Patients may also utilize Internet PEMs to build their medical knowledge and increase their understanding of possible procedures to effectively provide informed consent.[5,6]

Due to the increasing importance of the Internet as a learning resource for the modern patient, health care providers must provide information that is easy to read.[7] However, a recent survey showed that American physicians underestimated the percentage of patients with low health literacy by approximately 33%.[8] Overestimation of patient literacy levels may cause a physician, who may already be accustomed to writing for a professional audience well versed with technical terminology and medical vocabulary, to provide medical information that is not comfortably understood by patients.[9] PEMs

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TABLE I.
Categorization of Reading Difficulty as Determined by the US Department of Health and Human Services and FRES Interpretation.

Measure	Easy to Read	Average Difficulty	Difficult
Grade level	Below 6th	7th–9th	Above 9th
FRES	80–90: easy (6th grade)	60–70: standard (8th–9th grade); 70–80: fairly easy (7th grade)	0–30: very difficult (college graduate); 30–40: difficult (13th–16th grade); 40–50: fairly difficult (10th–11th grade)

Modified with permission from Wilson M. Readability and patient education materials used for low-income populations. *Clin Nurse Spec* 2009;23:33–40.
FRES = Flesch Reading Ease Score.

must therefore be written at a comprehensible level to educate individuals outside of the medical profession.

According to the National Center for Education Statistics, the average American reads between the seventh-grade and eighth-grade levels.[10] Various health-related organizations, including the American Medical Association, the National Institute of Health, and the US Department of Health and Human Services (USDHHS), therefore recommend that the readability of PEMs be equivalent to or less than the sixth-grade level.[7,11] Previous studies, however, have demonstrated that Internet-based PEMs are consistently written above this level in the fields of orthopedics, neurosurgery, pediatrics, and psychiatry.[12–16] Additionally, a large percentage of patients find Internet-based PEMs confusing and overly technical.[17]

Health literacy is the best predictor of an individual's health status[18] and is defined as the "degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions."[19] The Institute of Medicine 2004 Health Literacy Report found that 90 million American adults "may lack the needed literacy skills to effectively use the US health care system" and suggested that physicians reduce the negative consequences of limited health literacy[19,20] by, among other methods, increasing the simplicity and understandability of PEMs. Because patients with low levels of health literacy receive fewer preventive services,[21,22] often fail to follow medical instructions,[23] use inefficient but more expensive services,[24] and have inferior health outcomes,[25] providing patients accessible PEMs that are easy to comprehend may influence patient outcomes.

The readability of a text is the reading comprehension level a person must have to understand specific written material[26,27] and is related to health literacy. There are >40 different readability formulas that analyze the readability of a text through analysis of word and sentence complexity[28]; some of the most common reading assessment tools are the Flesch Reading Ease Score (FRES), Flesch-Kincaid Grade Level (FKGL), Simple Measure of Gobbledygook (SMOG), and Gunning Frequency of Gobbledygook (Gunning FOG).[9] These measures cannot be used for tables, charts, or word lists, and do not assess text organization, layout, graphics, and cultural appropriateness.[28] The FRES is associated with an estimated grade level and provides scores that range from 0 to 100; the higher the rating, the easier it is to read the selected text (Table I).[28] The FKGL is one of the most commonly used methods of assessing readability[13,26,27,29] and indicates the reading level that can be comprehended by a person who has graduated from that grade level. For example, a PEM with an FKGL of 8.6 will be understood by a patient who has graduated from the eighth grade. The FKGL factors in sentence and word length.[9] The SMOG formula, the tool of choice of the American Cancer Institute, is directly influenced by the number of polysyllabic words (words that contain at least three syllables).[30] The more polysyllabic words, the higher the SMOG score. The Gunning FOG formula calculates reading ability based on sentence length and percentage of polysyllabic words.[31]

To date, no study has extensively evaluated the readability of Internet-based PEMs on ESS. The purpose of this study was to assess the readability of ESS-related PEMs available from three different sources: professional societies, clinical practices, and US hospitals/academic medical centers.

MATERIALS AND METHODS

A descriptive and correlational design was used for this study. Using the Google search engine, the key phrase "endoscopic sinus surgery" was typed and the "hit" list was examined for websites designed by professional societies, clinical practices, and hospitals. PEMs were defined as articles posted on a physician website targeted to the lay public rather than medical professionals. Articles were excluded if they were written in languages other than English, presented only in graphic or pictorial form, presented only in table or list format, or consisted of <30 sentences. After screening the top 100 sites, a total of 31 sites had PEMs that met the inclusion criteria.

The available text for each topic was saved in individual Microsoft Word (version 2010; Microsoft, Redmond, WA) documents. Text that was unrelated to the educational topic, such as webpage navigation, copyright notice, disclaimers, author information, feedback questionnaires, hyperlinks, website URLs, addresses, and telephone numbers, was deleted to avoid influencing the readability scores. Follow-up editing of the text was performed as per recommendations by Flesch by removing colons and semicolons from sentences, because these may lead to overestimation of the reading difficulty.[13,32]

Microsoft Office Word software was used to calculate the FKGL and FRES for all retrieved PEMs. The underlying formula for calculation of FKGL is as follows: (0.39 × average number of words per sentence) + (11.8 × average number of syllables per word) − 15.59.[13] The FRES can be calculated with the formula 206.835 − (1.015 × average sentence length) − (84.6 × average number of syllables per word).[28] The following equation was used to obtain the SMOG score: 3.1291 + 1.043 × square root (total number of polysyllabic words × [30/total number of sentences]).[33] The Gunning FOG score was determined with the equation 0.4 × (average number of words per sentence + 100 [number of polysyllabic words/total number of words]).[33]

TABLE II.
FRES, FKGL, SMOG, and Gunning FOG Scores of Society-Affiliated, US Practice/Clinic-Affiliated, and US Hospital/University-Affiliated Internet-Available Patient Education Materials Pertaining to Endoscopic Sinus Surgery.

Webpage Source	Professional Society, n = 3	Clinical Practice, n = 17	Hospital, n = 11
FRES			
Average	43.6	41	58
Range	32.1–58	25.6–60.3	36.1–66.7
95% CI	32.7	5.5	6.9
FKGL			
Average	11.7	11.8*	8.8*
Range	9.5–13.8	7.7–15.3	5.9–12.2
95% CI	5.4	1.0	1.2
SMOG			
Average	14.0	14.4†	12.6†
Range	12.3–15.7	11.4–17.1	10.2–14.3
95% CI	4.2	0.8	0.7
Gunning FOG			
Average	15.2	12.2	12.0
Range	12.8–17.6	8.1–17.6	8.3–15.9
95% CI	5.9	1.5	1.4

*FKGLs of PEMs provided by clinical practices are higher than those of PEMs provided by hospitals/universities at a statistically significant level ($P < .0001$).

†SMOG scores of PEMs provided by clinical practices are higher than those of PEMs provided by hospitals/universities at a statistically significant level ($P = .001$).

FRES = Flesch Reading Ease Score; CI = confidence interval; FKGL = Flesch-Kincaid Grade Level; SMOG = Simple Measure of Gobbledygook; Gunning FOG = Gunning Frequency of Gobbledygook; PEM = patient education material.

Data were analyzed using VassarStats (available at http://faculty.vassar.edu/lowry/VassarStats.html). ESS-related PEMs were assessed for mean readability scores by FRES, FKGL, SMOG, and Gunning FOG values. Subgroup analysis was performed comparing the readability scores from the following website sources: professional society, clinical practice, and hospitals. A one-sided t test was used to evaluate the mean readability level against the recommended USDHHS standards. To determine whether there were any differences in the readability of PEMs developed by the various sources, t tests for independent samples assuming unequal variances were used.

RESULTS

A total of 31 PEMs from various websites that met inclusion criteria were analyzed. Web content was derived from three different categories: professional societies (n = 3), clinical practices (n = 17), and hospitals (n = 11). The mean readability values (and 95% confidence intervals) for FRES, FKGL, SMOG, and Gunning FOG indices are presented in Table II.

All three categories had average FKGL >8. Thirteen (41.9%) PEMs had FKGL between the seventh-grade and ninth-grade levels, and 17 (54.8%) PEMs were written above the ninth-grade level (Table III). Only one article (3.2%) was found to be at or below the recommended sixth-grade level.[33] There was a statistically significant difference between the number of articles falling within the easy-to-read versus difficult-to-read categories by FKGL scores ($P < .05$).

TABLE III.
Categorization of Reading Difficulty of Selected Endoscopic Sinus Surgery Webpages as Determined by the US Department of Health and Human Services (n = 31).

Measure	Easy to Read	Average Difficulty	Difficult
FKGL	<6th	7th–9th	>9th
Number of Webpages	1 (3.2%)*	13 (41.9%)	17 (54.8%)*

*A statistically significant difference existed between easy-to-read PEM articles and difficult-to-read PEM articles ($P < .05$).

FKGL = Flesch-Kincaid Grade Level; PEM = patient education material.

The overall mean FKGL of all 31 PEMs was 10.7 (±2.4 standard deviation), which was significantly above the recommended sixth-grade level ($P < .001$; Table IV). The overall mean SMOG score was 13.7, and the mean Gunning FOG score was 12.4, which are both above the 12th-grade level. Reading grade level by SMOG was found to consistently measure at least two grade levels higher when the same PEM was measured with FKGL. The average FRES for all PEMs was 47.1, which falls into the "fairly difficult" category (10th- to 11th-grade level; Table I).

Subgroup analysis between the 3 different categories demonstrated that clinical practice PEMs were written at a statistically significantly higher level than hospital PEMs in terms of FKGLs and SMOG scores ($P < .0001$ and $P = 0.001$, respectively). All differences between the source categories on other readability indices were not statistically significant by independent samples t tests (Table II), but differences in FRES,

TABLE IV.
FRESs, FKGLs, SMOG Scores, and Gunning FOG Scores of All Internet-Available Patient Education Materials Pertaining to Endoscopic Sinus Surgery.

Measure	Value
FRES	
Average	47.1
Range	25.6–66.7
95% CI	4.9
FKGL	
Average	10.7
Range	5.9–15.3
95% CI	0.9
SMOG	
Average	13.7
Range	10.2–17.1
95% CI	0.6
Gunning FOG	
Average	12.4
Range	8.1–17.6
95% CI	1.0

FRES = Flesch Reading Ease Score; CI = confidence interval; FKGL = Flesch-Kincaid Grade Level; SMOG = Simple Measure of Gobbledygook; Gunning FOG = Gunning Frequency of Gobbledygook.

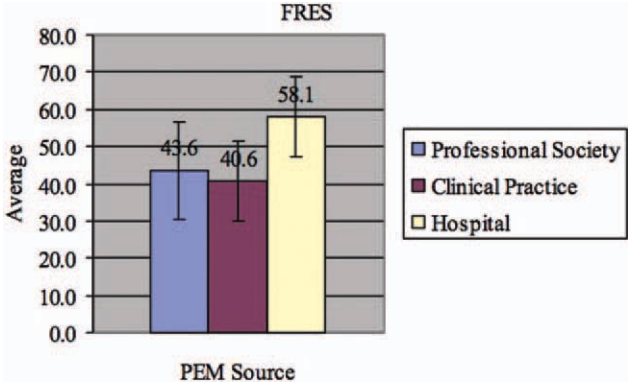


Fig. 1. Mean Flesch Reading Ease Score (FRE; ±1 standard deviation) of Internet-based patient education materials (PEMs) concerning endoscopic sinus surgery is categorized by source. There was a significant difference in FRES between samples (independent samples analysis of variance, $P = .001$). Professional society, n = 3; clinical practice, n = 17; hospital, n = 11.

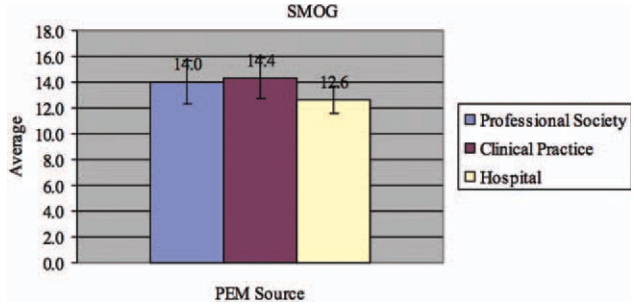


Fig. 3. Mean Simple Measure of Gobbledygook (SMOG) score (±1 standard deviation) of Internet-based patient education materials (PEMs) concerning endoscopic sinus surgery is categorized by source. There was a significant difference in SMOG score between samples (independent samples analysis of variance, $P = .015$). Professional society, n = 3; clinical practice, n = 17; hospital, n = 11.

FKGL, and SMOG values were found when all three groups were compared (independent samples analysis of variance, Figs. 1–4). Although hospital PEMs had the lowest mean readability value of 8.8 by FKGL, this was still considered an "average difficulty" category (seventh- to ninth-grade level). As measured by FRES, hospital PEMs averaged in the "standard" category (eighth- to ninth-grade level), whereas professional society and clinical practice PEMs averaged in the "fairly difficult" category (10th- to 11th-grade level).

DISCUSSION

The results of the present study suggest that most online PEMs related to ESS have readability above the recommended sixth-grade level. In our subgroup analysis of the three different categories, hospital PEMs had relatively lower readability scores than professional society and clinical practice PEMs. These differences may have been due to PEMs authored by physicians from professional societies and clinical practices, which may have a tendency to use more medical jargon. Conversely, hospitals affiliated with universities may also benefit from partnerships with libraries and multidisciplinary health providers to deliver health information.[34] Collaborations between professional societies, clinical practices, and university hospitals may improve the dissemination of understandable medical information concerning ESS.

In evaluating PEMs, SMOG has been found to consistently provide readability levels two to four grade levels higher than FKGL.[28,35,36] SMOG scores may be consistently higher due to the incorporation of the specific number of polysyllabic medical terms. Conversely, removal of medical terms may not lower the reading level to the recommended sixth-grade reading level.[37] In our study, ESS-related PEMs were found to be consistently above the recommended sixth-grade reading level using four different readability indices. This suggests that patient-directed medical information be rewritten at more understandable levels.

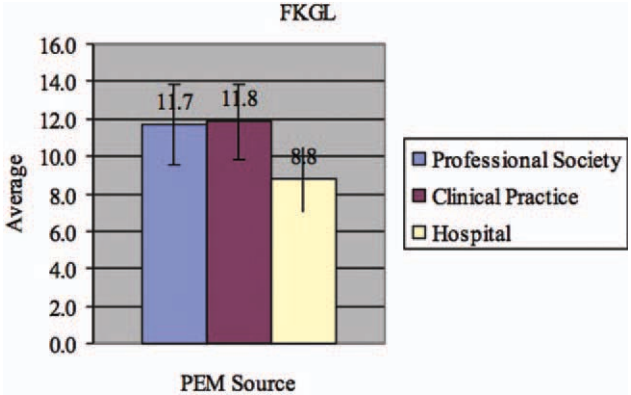


Fig. 2. Mean Flesch-Kincaid Grade Level (FKGL; ±1 standard deviation) of Internet-based patient education materials (PEMs) concerning endoscopic sinus surgery is categorized by source. There was a significant difference in FKGL between samples (independent samples analysis of variance, $P = .001$). Professional society, n = 3; clinical practice, n = 17; hospital, n = 11.

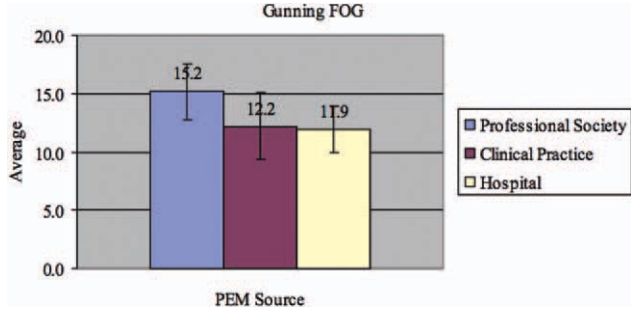


Fig. 4. Mean Gunning Frequency of Gobbledygook (Gunning FOG) score (±1 standard deviation) of Internet-based patient education materials (PEMs) concerning endoscopic sinus surgery is categorized by source. There was no significant difference in Gunning FOG scores between samples (independent samples analysis of variance). Professional society, n = 3; clinical practice, n = 17; hospital, n = 11.

As described in our methodology, the authors of PEMs can assess and quality check the readability of their texts by using keystroke instructions available on most personal computers. Suggestions for improving the readability of health information include limiting sentences to eight to 10 words,[38] replacing complex medical terms with simpler words, and lay term substitutes, using strategic formatting and variations in color, font type, and size,[26] and inclusion of illustrative diagrams.[39] PEMs from all sources must be assessed for appropriate reading levels using standard and objective criteria. Although FKGL is accessible and easy to use, medical personnel must be aware that this method provides lower estimates of readability measures than do other measures such as SMOG and FRES scores. FKGL can be used as an initial measure of reading grade level, but additional measures such as SMOG may be better to ensure that PEMs are presented at a reading level appropriate for patients.[28]

Some limitations of this study are noted. The reading skills of the patient population was not measured, and the assumption can be made that previously published observations on the reading and comprehension skills of the general public reflect the average patient population seeking ESS. However, these general guidelines may not take into consideration the difference in education levels in different areas. Given that the main purpose of PEMs is to satisfy the need of the population they are directed toward, PEMs written at the recommended grade levels may be inadequate in areas with patients of higher education levels by not providing them with enough information regarding their conditions. Consequently, one can make a strong argument that not all PEMs should be written at the recommended grade levels. Another limitation is that by entering a complex search term such as "endoscopic sinus surgery" into a Web-based search engine, more complex sites may be drawn. In addition, pictures, diagrams, webpage design, and audiovisual material that were excluded would likely help with comprehension of the accompanying text. By using other tools such as the Suitability Assessment of Materials, we can assess the effectiveness of pictures, diagrams, and written text.[40–42] However, these instruments are relatively new, not well validated, more subjective, and more time-consuming.[39] Future studies can explore comprehensive tools, such as the Readability Assessment Instrument, which assesses reading grade level and readability using 14 variables that affect comprehension, including global and local coherence, unity, audience appropriateness, writing style, illustrations, adjunct questions, and layout.[28] Other individualized health literacy assessment tools, such as the Rapid Estimate of Adult Literacy in Medicine,[43] Test of Functional Health Literacy in Adults,[44] and Wide Range Achievement Test,[45] are not beneficial for determining readability scores for large populations due to the extensive time needed for adequate administration and are not designed to assess Internet articles.[9]

To our knowledge, the present study is the first attempt to evaluate Internet-based PEMs discussing ESS. Our findings suggest that most Internet-available PEMs available for patients seeking information about ESS are written above the recommended sixth-grade level. We believe the methods described above can help authors effectively produce online education materials that most patients can understand. Such efforts should improve the quality of communication between physicians and their patients and promote better health outcomes. Our findings were consistent with other studies that have assessed PEM reading levels in other disciplines of medicine.[15,16,28,46]

CONCLUSION

Current Internet-based PEMs on ESS are written well above the recommended sixth-grade reading level. Consideration should be given to writing PEMs at a lower reading level to overcome low literacy barriers and to improve communication between otolaryngologists and their patients. Future studies should address the difference between readability of materials and the recommended level by exploring the benefit of illustrations and videos.

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