



Readability of Online Materials Related to Laryngectomy

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Introduction

Laryngeal cancer is one of the most frequently diagnosed head and neck malignancies, with approximately 13,000 cases and 4,000 deaths recorded annually.¹ While the early-stage disease is highly curable and managed with radiation or laryngeal-preserving surgery, the late-stage disease is associated with significant morbidity and mortality and is managed with a combination of radiation, chemotherapy, and surgery.¹

Total laryngectomy is a complex surgical procedure that removes the voice box, or larynx. While total laryngectomy is considered the gold-standard treatment modality for eradication of the malignancy, it can have profound effects on the physical and mental well-being of the patient. For example, patients will suffer loss of normal voice, which can lead to social and psychological distress.² Consequently, it is imperative that the patient has a clear understanding of the potential risks and benefits associated with undergoing a laryngectomy.

Increasingly, patients are turning to online resources to learn more about medical conditions and surgical procedures.³ While these resources can be helpful, they are often unregulated and widely varied in the information they provide. This can lead to patient confusion and discordance between what is discussed in the clinic and what is read online. The purpose of this study was to assess the readability of the top 60 Googled websites for the term *laryngectomy* to better determine if the internet is providing patients with easily digestible health information. We hypothesize that the websites analyzed will have an average readability level significantly higher than the reading level recommended by the American Medical Association for patient educational materials.⁴ With this data, we hope to offer insight to how online resources can improve the dissemination of information, and to offer suggestions of alternative resources that physicians can provide patients.

Methods

Website Selection

This study was exempt from the institutional review board because no patient-protected data was accessed. A Google search was conducted for the term *laryngectomy*. The first 60 websites from the search were selected for the study. We excluded websites with broken links, duplicate websites, pages without text, or websites that were not directly related to laryngectomies or laryngeal cancer. After exclusion, a total of 49 websites were analyzed for readability. Websites were also parsed into groups based on whether they were targeted towards patients or towards providers. The readability assessments described below were performed and averaged amongst all websites, amongst the patient-targeted cohort, and amongst the provider-targeted cohort of websites.

Readability Analysis

Readability was assessed using the Flesch-Kincaid Grade Level (FKGL), Gunning Fog Index (GFI), Coleman-Liau Index (CLI), Simple Measure of Gobbledygook (SMOG) Readability Test, and Automated Readability Test (ART). The FKGL is a readability test that assesses the approximate number of years of US education required to comprehend a text based on the ratio of the total number of words to the total number of sentences, and the ratio of the total number of syllables to the total number of words. The GFI is a linguistics test that evaluates sentence length and syllables to determine reading level. The CLI evaluates the readability of a text based on the number of characters per word. The SMOG Readability Test evaluates reading level based on sentence length and the number of polysyllabic words per sentence. The ART compares the number of letters per word with the number of words per sentence. The formulas for each readability algorithm are shown in **Table 1**. All readability formulas are graded along a numerical scale that corresponds to US academic grade level. For example, a text that could be read by the average person with 9 years of US education would be given a score of 9.0.

The text from each website was pasted into an online readability calculator that provided FKGL, GFI, CLI, SMOG, and ART scores. Once readability was calculated for each website using the tests above, each readability test had their scores averaged across all 49 website to generate an average readability score. Average scores for each test were also calculated amongst patient-targeted and provider-targeted websites. Three single-sample t-tests were performed using the mean readability level across all indices amongst all websites, the mean readability level from provider-targeted websites, and the mean readability level from the patient-target websites to determine if the average reading level was greater than the 6th grade reading level recommended by the AMA to a statistically significant degree.

Test	Formula
Flesch-Kincaid Reading Level	$= 0.39(\text{total words/total sentences}) + 11.8(\text{total syllables/total words}) - 15.59$
Gunning Fog Index	$= 0.4[(\text{words/sentences}) + 100(\text{complex words/words})]$
Coleman Liau Index	$= (0.0588 * \text{average number of letters per 100 words}) - (0.296 * \text{average number of sentences per 100 words}) - 15.8$
Simple Measurement of Gobbledygook	$= 1.0430 * \sqrt{(\text{number of words with 3 syllables} * (30/\text{number of sentences}))} + 3$
Automatic Readability Index	$= 4.71(\text{characters/words}) + 0.5(\text{words/sentences}) - 21.43$

Table 1: Readability tests with their associated formula

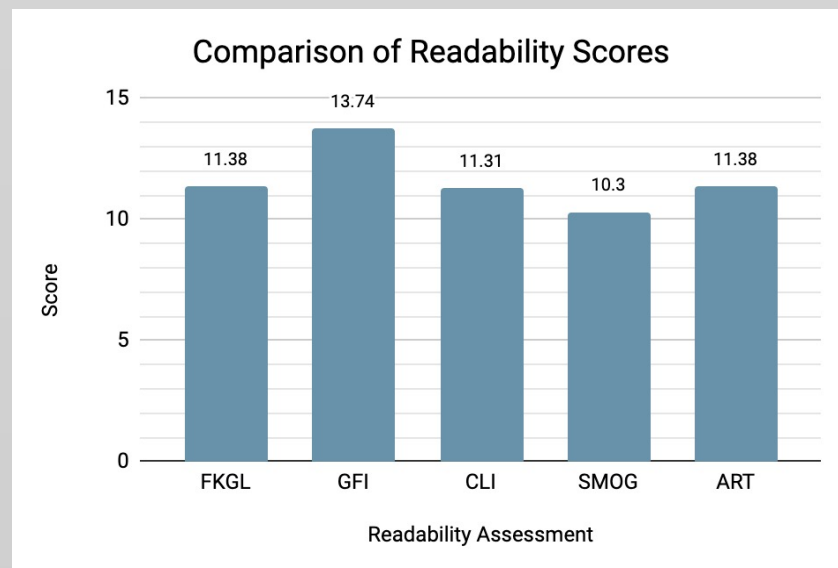


Figure 1: Mean readability scores of top searched websites

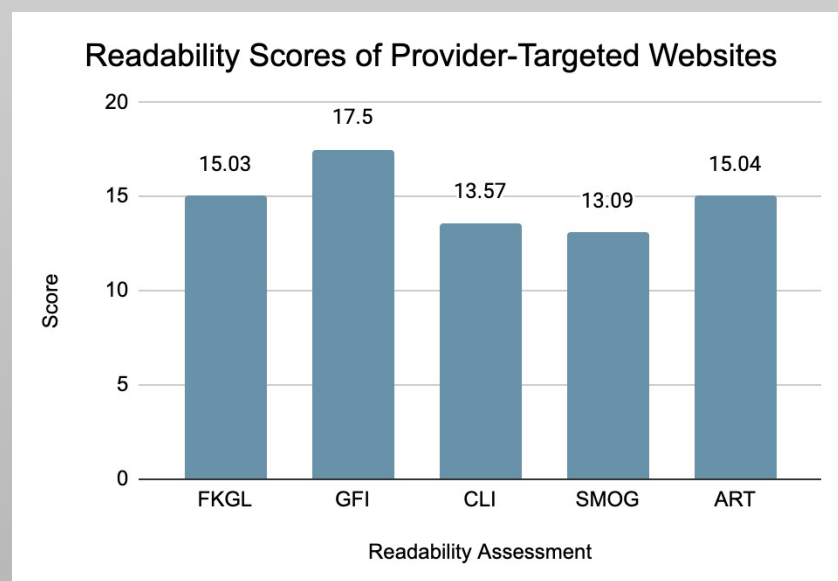


Figure 2: Mean readability scores of provider-targeted websites

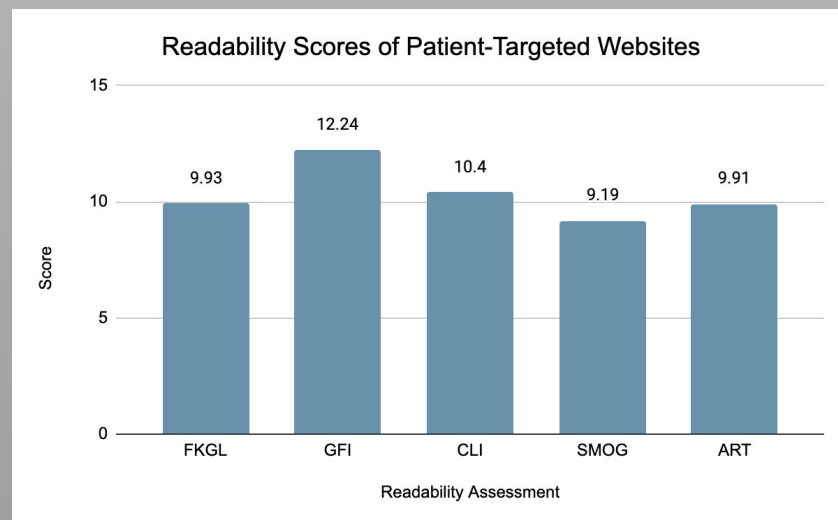


Figure 3: Mean readability scores of patient-targeted websites

Readability Index	Mean	Standard Deviation
FKGL	11.38	3.46
GFI	13.74	3.42
CLI	11.31	2.20
SMOG	10.30	2.48
ART	11.38	3.86
Average	11.62	3.08

Table 2: Mean and standard deviation of readability scores for top searched websites

Readability Index	Mean	Standard Deviation
FKGL	15.03	2.86
GFI	17.50	2.75
CLI	13.57	1.87
SMOG	13.09	1.83
ART	15.04	3.55
Average	14.85	2.57

Table 3: Mean and standard deviation of readability scores for provider-targeted websites

Readability Index	Mean	Standard Deviation
FKGL	9.93	2.46
GFI	12.24	2.34
CLI	10.40	1.59
SMOG	9.19	1.72
ART	9.91	2.92
Average	10.33	2.21

Table 4: Mean and standard deviation of readability scores for patient-targeted websites

Results

A total of 49 websites were analyzed for their readability. The mean (SD) FKGL was 11.38 (3.46); GFI 13.74 (3.42); CLI 11.31 (2.20); SMOG 10.30 (2.48); and ART 11.38 (3.86).(**Figure 1, Table 2**) The average score across all readability indices was 11.62, indicating that the websites analyzed were written at the reading level of an individual with about 11 years of US education. A single sample t-test performed demonstrated the top 49 Googled websites for "laryngectomy" required a significantly higher ($M = 11.62$, $SD = 3.32$) reading level than the sixth-grade reading level recommended by the ADA, $t(244) = 26.48$, $p < 0.01$.

The websites were then placed into cohorts based on whether they were targeted towards patients or towards medical providers. The 14 provider-targeted websites had a mean (SD) FKGL score of 15.03 (2.86); GFI 17.50 (2.75); CLI 13.57 (1.87); SMOG 13.09 (1.83); and ART of 15.04 (3.55).(**Figure 2, Table 3**) The average score across all readability indices was 14.85, indicating the provider-targeted websites were written at the reading level of the average third-year college student. A single sample t-test demonstrated the most frequently Googled provider-targeted websites for "laryngectomy" required a significantly higher ($M = 14.85$, $SD = 3.00$) reading level than the sixth-grade reading level recommended by the ADA, $t(69) = 24.64$, $p < 0.01$.

The 35 patient-targeted websites had lower readability scores across all indices, with a mean (SD) FKGL score of 9.93 (2.46); GFI 12.24 (2.34); CLI 10.40 (1.59); SMOG 9.19 (1.72); and ART of 9.91 (2.92).(**Figure 3, Table 4**) The average score across all readability indices was 10.33, indicating the patient-targeted websites were written at the reading level of the average tenth-grade student. A single sample t-test demonstrated the most frequently Googled patient-targeted websites for "laryngectomy" required a significantly higher ($M = 10.33$, $SD = 2.46$) reading level than the level recommended by the ADA, $t(174) = 23.28$, $p < 0.01$.

Discussion

As the internet has rapidly grown in popularity in recent years, a larger number of Americans are utilizing online search engines to seek important health information.³ With the influx of online educational materials available for patients, physicians must provide information that is both highly informative and highly readable. Readability is defined as the ease in which a text can be read and understood.⁵ In 2003, the US Department of Education conducted a nationwide study demonstrating that 36% of Americans either had basic or below basic health literacy, meaning they could not interpret a child immunization chart or determine when to take prescription drugs based on the information listed on the label.⁶ These deficits in health literacy are more pronounced in patients of low socioeconomic status, patients from minority ethnic backgrounds, geriatric patients, and patients from rural communities.⁵ Importantly, tobacco consumption, the number one risk factor for laryngeal cancer, is on average more prevalent in the subpopulations listed above, providing an even greater necessity for health information with high readability amongst these groups.⁷ Based on the average American reading level and the subpopulations most at risk for disease, the AMA recommends that educational material designed for patients be written at the sixth-grade level.

In our assessment of the top Googled websites detailing the laryngectomy, we found that most materials were written at a reading level too advanced for the average American adult to understand. The mean readability scores across all indices and websites, as well as the average scores of the provider-targeted websites and the patient-targeted websites significantly exceeded the sixth-grade reading level recommended by the AMA. The websites we analyzed had a readability level designed for the average US twelfth-grade student. After controlling for provider-targeted websites, the readability index for the patient-targeted websites was at the level of the average eleventh-grade student.

The results found in this study are congruent with those found in other studies measuring the readability of online resources describing common otolaryngology procedures.⁸⁻¹¹ Based on the findings of our study and the previous studies performed on other otolaryngology topics, an effort should be made to improve the readability of online resources provided for patients undergoing common head and neck procedures.

Our study had several limitations. First, Google was the only search engine utilized in this study. Aggregating search results from Bing, Yahoo, or DuckDuckGo could have increased the scope of websites included in our analysis. Patients may also utilize more search terms than "laryngectomy". Also, while our study focuses on the readability of the information provided on the websites, it does not assess its veracity. Lastly, we compare the readability of the websites to the readability standards set by the AMA without demonstrating patient understanding directly suffered as a result of the high reading level of the websites in our study. A follow-up study could assess readability by presenting two randomized groups with two different websites with information about laryngectomies. One website would be written based on AMA readability standards, and one would be written at a reading level consistent with those analyzed in our study. After reading the assigned webpage, each patient would take a short quiz about the laryngectomy procedure and the results could be compared between groups to determine which website did a better job conveying the necessary information.

- References
1. Korolukis A. Laryngeal Cancer. StatPearls. <https://www.ncbi.nlm.nih.gov/books/NBK526076/?report=classic>. Published August 10, 2020.
 2. Misono S, Peterson CB, Meredith L, et al. Psychosocial distress in patients presenting with voice concerns. J Voice. 2014;28(6):753-761.
 3. Fox S, Duggan M. Health Online 2013. Pew Research Center: Internet, Science & Tech. <https://www.pewresearch.org/internet/2013/01/15/health-online-2013/>. Published August 14, 2020.
 4. Weiss BD. Health Literacy A Manual for Clinicians. Part of an educational program about health literacy. American Medical Association.
 5. Narwan V, Nalamada K, Lee M, Kothari P, Lakshmi R. Readability and quality assessment of internet-based patient education materials related to laryngeal cancer. Head Neck. 2016;38(4):601-605.
 6. U.S. Department of Education. The Health Literacy of America's Adults. <https://nces.ed.gov/pubst/2006/2006483.pdf>. Published September 2006.
 7. Drope J, Liber AC, Cahn Z, et al. Who's still smoking? Disparities in adult cigarette smoking prevalence in the United States. CA Cancer J Clin. 2018;68(2):106-115.
 8. Schwarzbach HL, Mady LJ, Kaffenberger TM, Duvvuri U, Jabbour N. Quality and Readability Assessment of Websites on Human Papillomavirus and Oropharyngeal Cancer. Laryngoscope. 2021;131(1):87-94.
 9. Svolder PF, Agarwal N, Choudhry OJ, et al. Readability assessment of online patient education materials from academic otolaryngology-head and neck surgery departments. Am J Otolaryngol. 2013;34(1):31-35.
 10. Eloy JA, Li S, Kasabawa K, et al. Readability assessment of patient education materials on major otolaryngology association websites. Otolaryngol Head Neck Surg. 2012;147(3):848-854.
 11. Grose EM, Holmes CP, Aravinthan KA, Wu V, Lee JM. Readability and quality assessment of internet-based patient education materials related to nasal septoplasty. J Otolaryngol Head Neck Surg. 2021;50(1):16. Published 2021 Mar 17.