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What is This?
Readability Assessment of Patient Education Materials from the American Academy of Otolaryngology—Head and Neck Surgery Foundation

Khushabu Kasabwala¹, Nitin Agarwal², David R. Hansberry, PhD², Soly Baredes, MD¹,³, and Jean Anderson Eloy, MD¹,²,³

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Abstract

Objective. Americans are increasingly turning to the Internet as a source of health care information. These online resources should be written at a level readily understood by the average American. This study evaluates the readability of online patient education information available from the American Academy of Otolaryngology—Head and Neck Surgery Foundation (AAO-HNSF) professional Web site using 7 different assessment tools that analyze the materials for reading ease and grade level of its target audience.

Study Design and Setting. Analysis of Internet-based patient education material from the AAO-HNSF Web site.

Methods. Online patient education material from the AAO-HNSF was downloaded in January 2012 and assessed for level of readability using the Flesch Reading Ease, Flesch-Kincaid Grade Level, SMOG grading, Coleman-Liau Index, Gunning-Fog Index, Raygor Readability Estimate graph, and Fry Readability graph. The text from each subsection was pasted as plain text into Microsoft Word document, and each subsection was subjected to readability analysis using the software package Readability Studio Professional Edition Version 2012.1.

Results. All health care education material assessed is written between an 11th grade and graduate reading level and is considered “difficult to read” by the assessment scales.

Conclusions. Online patient education materials on the AAO-HNSF Web site are written above the recommended 6th grade level and may need to be revised to make them more easily understood by a broader audience.

Keywords
readability, patient education material, Flesch-Kincaid Grade Level, Flesch Reading Ease score, Internet, otolaryngology, patient education, AAO-HNSF patient education materials, Internet-based patient education material
such as the American Medical Association (AMA) and US National Institutes of Health (NIH) recommend that the readability of patient information material be no higher than a 4th to 6th grade level. The US Department of Health and Human Services (USDHHS) states that material is considered easy to read only if written below the 6th grade level, whereas material between the 7th and 9th grade levels is viewed as average difficulty, and material above the 9th grade level is regarded as difficult.

Internet literacy is playing an increasing role in otolaryngology as well as every other medical specialty given patients’ desire to become more informed. According to data compiled by the Pew Internet and American Life Project in 2011, 78% of adults in the United States have access to the Internet. Specifically, 83% of Internet users search for health information. Recent surveys have shown that the main reasons individuals go online for health information are (1) someone they know has been diagnosed with a health condition (81%); (2) they have been diagnosed with a health condition of their own (58%); or (3) they are being prescribed a new medication or course of treatment (56%).

The Internet sources available for otolaryngology patients are diverse and abundant. Organizational Web sites are among the first sites that appear in a Web search of “otolaryngology.” The purpose of this study was to evaluate the readability of online patient education information available from the American Academy of Otolaryngology—Head and Neck Surgery Foundation (AAO-HNSF) professional Web site using 7 different assessment tools that analyze the materials for reading ease and grade level of the target audience.

Materials and Methods

In January 2012, patient education resources available to the public were retrieved from the AAO-HNSF Web site. A total of 152 education articles from 6 different subsections linked from the patient pages were downloaded. The subsections included in this study were Ears, Throat, Nose and Mouth, Head and Neck, Cancer, and Pediatrics. Non-English and media-directed materials like press release templates were omitted. Some articles overlapped topic matter and were displayed on more than 1 subsection page. For example, an article pertaining to head and neck cancers appeared in 2 subsections, Head and Neck and Cancer, such articles were included in the analysis of both subsections. The text from each subsection was pasted as plain text into a new Microsoft Word (Microsoft Corp, Redmond, Washington) document. Only the patient-directed text was considered in the analysis. Exclusion criteria included any information related to Web page navigation, copyright notices, disclaimers, acknowledgments, author information, citations, or references, all of which were removed from the text.

Each subsection was then subjected to readability analysis using the software package Readability Studio Professional Edition Version 2012.1 for Windows (Oleander Software, Ltd, Vandalia, Ohio). Inclusion criteria for scales were those designed to evaluate educational or health care-oriented material. Alternative scales tests that are not frequently used for the material being studied were excluded.

The assessments used included the following methods to numerically calculate the readability score (Table 1):

1. The Flesch Reading Ease formula describes ease of reading and has been widely used in evaluating medical literature. It is influenced by sentence length and syllable count and comprises a score from 0 to 100, with a higher score corresponding to greater ease of reading (Table 2).

2. The Flesch-Kincaid Grade Level formula indicates the required academic grade of the reader and is determined by sentence length and syllable count. The SMOG readability formula determines the grade level based on the sentence length and number of complex words (words with 3 or more syllables).

3. The Coleman-Liau Index formula determines the grade level of a written document based on sentence length and character count.

4. The Gunning-Fog Index calculates the grade level of a document based on its number of sentences and complex words. Gunning-Fog hard words, are defined as words containing 3 or more syllables. Exceptions are made for proper nouns, words made 3 syllables by adding -ed or -es, and compound words.

In addition to these assessments, 2 graphical tools, the Raygor Readability Estimate graph and the Fry Readability graph, were used to visually display the calculated grade level. The Raygor Readability Estimate graph and the Fry Readability graph depend on 2 distinctive variables and visually present the grade level. Both have been used previously to evaluate medical literature. The Raygor Readability Estimate graph, designed for most texts including literature and technical documents, calculates a document’s grade level from its average number of sentences and long (6 or more characters) words per hundred words. Medical experts, including the Center for Disease Control and Prevention, favor the Fry Readability graph. This tool calculates a document’s grade level from the average number of sentences and syllables per hundred words. For both graphical tools, the averages of the 2 variables are plotted and intersect at a point that indicates the reading level of the content (Table 1). This study qualifies as exempt status as per the “nonhuman subject research” protocol set by the Institutional Review Board of UMDNJ–New Jersey Medical School.

Results

One hundred fifty-two articles from the AAO-HNSF Web site were analyzed for their level of readability. The articles were separated by subsections (Ears, Throat, Nose and Mouth, Head and Neck, Cancer, and Pediatrics), and each was evaluated independently using the 7 assessment techniques for readability level. The average scores for all the
assessment tools showed that each of the subsections had readability scores between the 11th and 13th grade, which is considered graduate level (Table 3). The Flesch Reading Ease score was similar for each of the subsections with a mean value of 46.5; this value corresponded to “difficult to read” (Table 3, Figure 1). The Raygor Readability Estimate graph displays the reading level of the literature as evaluated by the intersection of the amount of long words per 100 words and sentences per 100 words. All 6 literature subsections were similar in their Raygor Readability Estimate scores as shown by the clustering. The plot demonstrates the average reading level of 12.5, or graduate level (Table 3, Figure 2). The Fry Readability graph shows similar clustering; however, the average grade level was higher at 13.3 as evaluated by an independent formula (Table 3, Figure 3).

The analysis also evaluated the types of difficult text present in the literature (Table 4). More than 16% of words were determined to be complex (3 or more syllables) in all of the subsections. When assessed by the Gunning-Fog formula, the difficult word percentages were slightly lower at just over 15%. The percentage of long words (6 or more characters) was similar across the subspecialties, with an average of 37.5%.

**Discussion**

Individuals are becoming more involved in the management of their health care. The ease of finding information on the Internet has turned this information medium into a prime source of health materials for patients and caregivers. Although the information on the Internet is exhaustive, ultimately the comprehension by the users determines their ability to apply and benefit from its content. Research on online patient education materials has reliably shown the

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**Table 1. Instruments and Calculations Used in Assessing the Readability of Otolaryngology Patient Material from the AAO-HNS Web Site**

<table>
<thead>
<tr>
<th>Assessment Scale</th>
<th>Variables</th>
<th>Formula</th>
</tr>
</thead>
</table>
| Flesch Reading Ease | Average number of syllables per word and average number of words per sentence | Flesch Reading Ease score = 206.835 – 
\((1.015 \times \text{average No. of words per sentence}) – \) 
\((84.6 \times \text{average No. of syllables per word})\) |
| Flesch Kincaid Grade Level | Average number of syllables per word and average number of words per sentence | Flesch Kincaid Grade Level = (0.39 \times \text{average No. of words per sentence}) + (11.8 \times \text{average No. of syllables per word}) – 15.59 |
| SMOG readability formula | Number of words with 3 or more syllables | SMOG readability score = \(1.043 \times \sqrt{\text{[no. of polysyllables \times (30/No. of sentences)]} + 3.1291}\) |
| Coleman-Liau Index | Average number of letters and sentences per 100 words | Coleman-Liau Index = 0.0588 \times \text{average No. of letters per 100 words} – 0.296 \times \text{average No. of sentences per 100 words} – 15.8 |
| Gunning-Fog Index | Average number of words per sentence, average number of Gunning-Fog hard words (3+ syllables) | Gunning-Fog Index = 0.4 (average No. of words per sentence + \([100 \times \text{average No. of 3+ syllable words}]\)) |
| Raygor Readability Estimate graph | Average number of sentences and long (6 or more characters) words per 100 words | 1. Select a 100-word passage from the selection 
2. Count the number of sentences, estimated to the nearest tenth 
3. Count the number of words that are 6 or more letters 
4. Find the point on the chart 
(3 samples recommended for best results) |
| Fry Readability graph | Number of sentences and syllables per 100 words | 1. Extract a 100-word passage from the selection 
2. Count the number of sentences in each passage 
(Count a half sentence as 0.5) 
3. Count the number of syllables in each passage 
4. Find the point on the chart 
(3 samples recommended for best results) |

**Table 2. Flesch Reading Ease Score and Corresponding Reading Ease**

<table>
<thead>
<tr>
<th>Flesch Reading Ease Score</th>
<th>Readability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-30</td>
<td>Very difficult</td>
</tr>
<tr>
<td>30-50</td>
<td>Difficult</td>
</tr>
<tr>
<td>50-60</td>
<td>Fairly difficult</td>
</tr>
<tr>
<td>60-70</td>
<td>Standard</td>
</tr>
<tr>
<td>70-80</td>
<td>Fairly easy</td>
</tr>
<tr>
<td>80-90</td>
<td>Easy</td>
</tr>
<tr>
<td>90-100</td>
<td>Very easy</td>
</tr>
</tbody>
</table>

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468 Otolaryngology–Head and Neck Surgery 147(3)
readability to exceed the 8th grade reading level of the average American, even after the removal of medical terms that can confound the data.23,24

Our analysis of the AAO-HNSF Web site similarly showed that the patient information is written at a level more complex than the 4th to 6th grade level recommended by the AMA and NIH. The Flesch-Kincaid Grade Level, SMOG grading, Coleman-Liau Index, and Gunning-Fog Index showed the materials to be written at greater than an 11th grade level in all 6 subsections. The Flesch Reading Ease deemed the information difficult to read according to its formula. The comprehension may also be hampered by obstacles such as the use of complex wording. The analysis showed that nearly 40% of the words in the otolaryngology patient literature were long, defined as being 6 or more characters. Also, 13% of the words were greater than 3 syllables. Although medical terms may be difficult to avoid, similar words may be able to be substituted in some instances to improve understanding. This analysis demonstrated that overall, the patient education material on the AAO-HNSF Web site is too advanced for the average American to comprehend.

Although several tools were used in this study to maximize the validity of the results, some variables were not explored by this study.3,20 Firstly, all the readability scales used to evaluate the AAO-HNSF Web site exclusively analyzed the text of the articles. Readability level is an important, but not the sole, component of literacy. Other factors such as images, fonts, and content organization like bullet-pointing and layout also play a role in a patient’s understanding of the literature.20,25-27 Although yet to be fully validated in medical literature, tools such as Suitability Assessment of Materials (SAM) can be used to assess the influence of multimedia, such as images and videos.3 Additionally, 4 of our numerical scales (Flesch Reading Ease, Flesch-Kincaid Grade Level, SMOG, Coleman-Liau) are influenced by syllables in a word, a property that may not properly reflect the reading level in medical literature. Low-syllable words, such as larynx and polyps, which are unfamiliar to the average American, may miscalculate and underestimate the reading level required to comprehend such text.26 This study used tests based on both syllables and word count to improve the

<table>
<thead>
<tr>
<th>Subsection</th>
<th>No. of Articles</th>
<th>FRE</th>
<th>FKGL</th>
<th>SMOG</th>
<th>CLI</th>
<th>GFI</th>
<th>RRE</th>
<th>Fry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ears</td>
<td>34</td>
<td>47</td>
<td>11.2</td>
<td>13.2</td>
<td>12</td>
<td>12.4</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Throat</td>
<td>25</td>
<td>44</td>
<td>11.7</td>
<td>13.6</td>
<td>12.9</td>
<td>12.9</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Nose and mouth</td>
<td>39</td>
<td>45</td>
<td>11.3</td>
<td>13.3</td>
<td>12.9</td>
<td>12.6</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Head and neck</td>
<td>18</td>
<td>48</td>
<td>11.3</td>
<td>13.2</td>
<td>12.1</td>
<td>12.2</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Cancer</td>
<td>12</td>
<td>49</td>
<td>11.5</td>
<td>13.4</td>
<td>11.9</td>
<td>12.2</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Pediatric</td>
<td>24</td>
<td>46</td>
<td>11.6</td>
<td>13.5</td>
<td>12.5</td>
<td>12.8</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Mean ± standard error of the mean</td>
<td>46.5 ± 0.76</td>
<td>11.4 ± 0.08</td>
<td>13.4 ± 0.07</td>
<td>12.4 ± 0.18</td>
<td>12.5 ± 0.12</td>
<td>12.5 ± 0.22</td>
<td>13.3 ± 0.21</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1. The Flesch Reading Ease score was similar for each of the otolaryngology subsections from the AAO-HNS Web site with a mean value of 46.5, which corresponds to “difficult to read.”

Figure 2. The Raygor Readability Estimate graph displays the reading level of the literature evaluated by the intersection of the amount of long words per 100 words and sentences per 100 words.
validity of the results. Tests not exclusively calculating sentence length and structure may be able to further evaluate the material for comprehension.3

Accessing readily available medical information on the Internet has many benefits, which include increasing patients’ understanding of their medical condition, empowering them to make informed health decisions, and facilitating the patient–physician dialogue.28 Despite these benefits, the information offered by many unofficial Internet Web sites may be inaccurate, misleading, and not subject to peer review by knowledgeable experts in health care and medicine. According to the criteria set forth by the Journal of the American Medical Association patient page, the AAO-HNSF is considered a high-quality and reliable health care information source.29 Thus, it becomes important to identify and rectify factors limiting comprehension of information to online health consumers on this highly regarded source. Recommendations on methods to improve the presentation of health education information include alterations of word choice and structure. Because of the technical nature of otolaryngology, medical terms may be hard to avoid. However, descriptive or instructive phrases can be substituted to enhance readability. Longer or complicated words could be replaced with commonly used words to circumvent wordiness.4,6 Replacing the word, incapacitating with weakening is a way to make an explanation more accessible to the average reader. In addition, longer words could be replaced with shorter, more commonly used synonyms. Contiguous could be replaced with close to to increase the readability of patient education materials. These simple exchanges are a straightforward way to make the language on the Web site clear to more readers.30 Additionally, incorporating a survey that allows for public feedback on the online education materials developed and posted by the AAO-HNSF would be a useful way to assess whether the information conveyed is perceived as helpful and informative.

Conclusion
Otolaryngology professionals often see patients who vary widely in age and in education level. Readability assessments of the material from the specialty’s main organizational Web site showed that the information provided may be too complex for satisfactory patient understanding. Given that the reading level of the average American is less than 8th grade, it may be beneficial to revise online patient education materials on the AAO-HNSF Web site to make them more easily understood by a broader audience.

Author Contributions
Khushabu Kasabwala, data acquisition, analysis; drafting of article; final approval; Nitin Agarwal, analysis; revision; final approval; David R. Hansberry, analysis; revision; final approval; Soly Baredes, analysis; revision; final approval; Jean Anderson Eloy, conception, design, data acquisition, analysis, and interpretation; drafting of article; final approval.

Disclosures
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Table 4. Difficult Words Found in the Literature for Each Otolaryngology Subsection from the AAO-HNSF Web Site

<table>
<thead>
<tr>
<th>Subsection</th>
<th>% of Complex (3+ Syllables) Words</th>
<th>% of Gunning-Fog Hard Words</th>
<th>% of Long (6+ Characters) Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ears</td>
<td>17.4</td>
<td>15.4</td>
<td>36.9</td>
</tr>
<tr>
<td>Throat</td>
<td>18.1</td>
<td>16.3</td>
<td>38.1</td>
</tr>
<tr>
<td>Nose and mouth</td>
<td>19.1</td>
<td>16.4</td>
<td>38.9</td>
</tr>
<tr>
<td>Head and neck</td>
<td>16.5</td>
<td>14.2</td>
<td>37.0</td>
</tr>
<tr>
<td>Cancer</td>
<td>16.6</td>
<td>13.5</td>
<td>36.4</td>
</tr>
<tr>
<td>Pediatric</td>
<td>17.4</td>
<td>15.3</td>
<td>37.9</td>
</tr>
<tr>
<td>Mean ± standard error of the mean</td>
<td>17.5% ± 0.4%</td>
<td>15.2% ± 0.5%</td>
<td>37.5% ± 0.4%</td>
</tr>
</tbody>
</table>

Figure 3. The Fry Readability graph displays the reading level of the 6 subsections as evaluated by the intersection of the number of syllables per 100 words and sentences per 100 words.
References


