Evaluating the complexity of online patient education materials about brain aneurysms published by major academic institutions

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OBJECTIVE Health care education resources are increasingly available on the Internet. A majority of people reference these resources at one point or another. A threshold literacy level is needed to comprehend the information presented within these materials. A key component of health literacy is the readability of educational resources. The National Institutes of Health (NIH) and the American Medical Association have recommended that patient education materials be written between a 4th- and a 6th-grade education level. The authors assessed the readability of online patient education materials about brain aneurysms that have been published by several academic institutions across the US.

METHODS Online patient education materials about brain aneurysms were downloaded from the websites of 20 academic institutions. The materials were assessed via 8 readability scales using Readability Studio software (Oleander Software Solutions), and then were statistically analyzed.

RESULTS None of the patient education materials were written at or below the NIH’s recommended 6th-grade reading level. The average educational level required to comprehend the texts across all institutions, as assessed by 7 of the readability scales, was 12.4 ± 2.5 (mean ± SD). The Flesch Reading Ease Scale classified the materials as “difficult” to understand, correlating with a college-level education or higher. An ANOVA test found that there were no significant differences in readability among the materials from the institutions (p = 0.215).

CONCLUSIONS Brain aneurysms affect 3.2% of adults 50 years or older across the world and can cause significant patient anxiety and uncertainty. Current patient education materials are not written at or below the NIH’s recommended 4th- to 6th-grade education level.

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KEY WORDS cerebral aneurysm; readability; patient education materials; health literacy; vascular disorders
Readability of brain aneurysm patient education materials

**Results**

**Collection of Patient Education Materials**

Seventeen (85%) of the 20 websites had educational materials pertinent to brain aneurysms that were targeted toward patients and were incorporated into the statistical analysis.

**Readability Analysis**

The average grade level at which the patient education materials were written was evaluated using the Coleman-Liau, Flesch-Kincaid, FORCAST, Fry, Gunning Fog, Raygor Estimate, Simple Measure of Gobbledygook (SMOG), and Flesch Reading Ease (Table 1). SPSS version 21.0 (IBM Corp.) was used to perform statistical analyses. The Kruskal-Wallis H test (1-way ANOVA) was used to compare the average readability scores across the various scales and websites. Statistical significance was defined by a p value < 0.05.

**Discussion**

Analysis of the readability of patient education materials began nearly 4 decades ago with the evaluation of public health messages disseminated by prominent magazines including *Readers’ Digest*, *TIME*, and *Newsweek*. The Internet has evolved to become a powerful tool for communication and has enabled patients to access a wealth of health care material. In theory, such changes would produce a more informed public. The ease with which a text can be read and understood, referred to as its readability, is directly related to literacy and comprehension. The Nation-
al Adult Literacy Surveys found that nearly half of the US population can be classified into 2 categories: functionally illiterate and marginally literate. The first category refers to being able to read at a 5th-grade level or below, whereas the second category refers to being able to read at a level between the 6th and the 8th grade. Considering the fact that functional illiteracy is prevalent within pockets of poverty and lower socioeconomic status, health care education materials may be incomprehensible for many patients. It can be argued that the use of the Internet is probably predominant among more highly educated and wealthier members of the public, and the fact that these are the people who are more likely to be accessing the materials, mitigates the effects of complex texts on comprehension. A recent analysis would seem to support this theory, in finding that those with a higher level of educational attainment and/or greater affluence are more likely to adopt the use of this medium. Internet penetration has been rising consistently over the past decade and a half within lower-income households and among less-educated individuals.

The results from this study indicate that almost all patient education materials related to brain aneurysms are written significantly above the NIH- and AMA-recommended 6th-grade level. In fact, the readability assessments indicate that, on average, a 12th-grade education or higher would be needed to comprehend these materials. This would imply a required education level of twice what is recommended by the NIH. Most importantly, none of the institutions published materials at or below the 6th-grade level.

For a preliminary assessment of the readability of brain aneurysm–related patient education resources disseminated in pamphlet form, materials published by the Brain Aneurysm Foundation were evaluated. This foundation is one of the nation’s largest nonprofit organizations dedicated to brain aneurysm research and education. The tests indicated that, on average, these materials were written at or above the 12th-grade reading level (mean 12.3), corroborating the results obtained from online patient education materials. This further supported our finding that all patients, including those with and without access to the Internet, are affected by current health education resources. Given the significant anxiety and uncertainty that is associated with brain aneurysms, it is especially important that online patient education materials are adapted so that they are easily understandable by the lay community. Furthermore, many of these educational materials discuss modifiable risk factors (such as smoking), and if the warn-
ings are adhered to, can lower the chances that a patient may develop an aneurysm.

A study by Dutta-Bergman et al. assessed consumer evaluations of the trustworthiness of different sources of health care information on the Internet. Nearly half of the respondents revealed that they considered medical universities as among the top 3 most trusted sources of online patient education materials. Our study specifically assessed the readability of text downloaded from academic institutions, further underscoring the need to intervene and simplify these materials, given the number of people who are likely refer to these resources. Given the complex pathologies and anatomical terms typically associated with cerebrovascular conditions, this is especially important to consider. Previous studies on the readability of patient education materials for patients undergoing neurosurgical procedures, including those relevant to skull base tumors, have found similar results.

Future interventions aimed at improving the readability of patient education materials can have system-wide effects, given the ability of these resources to potentially lessen the need to treat preventable diseases across an array of medical subspecialties. Furthermore, this information can aid patients in better understanding the potential benefits and risks associated with various medical procedures, thereby increasing the likelihood that they will make informed decisions in the clinical setting (i.e., prior to any health intervention). There are legal implications to consider as well: a demonstrated lack of informed consent can serve as the basis for medical malpractice claims. Neurosurgeons are at high risk among their peers for being implicated in malpractice suits. By enabling patients to better understand their diagnoses and potential treatment options, interventions aimed at improving the readability of patient education materials may indirectly serve an important role in decreasing the frequency with which malpractice litigation occurs. However, it is important to note that these interventions cannot replace obtaining informed consent, and that physicians cannot make any assumptions regarding patient comprehension within the clinical setting in relation to these materials.

There are a number of ways to improve the readability of existing patient education resources. The use of simpler and more concise sentences and the elimination of lengthy, complex neuroanatomical terms can serve as methods of improvement. Avoiding the frequent use of polysyllabic words and complex sentence structures is also essential. Illustrations as visual aids to these resources can influence comprehension of textual information.

**Limitations of the Study**

We recognize that although readability is an important part of comprehension and functional health literacy, other factors including socioeconomic status, race, education, and income can all contribute. Readability, however, serves as an important and feasible area for future direct intervention. Likewise, although this study incorporates patient education materials published by a number of major academic institutions, published materials from other resources (including MEDLINE, Wikipedia, and WebMD) may influence patient decision making in the clinical setting, and should be considered for analysis in future studies. Finally, other factors, including the presentation and the layout of textual information, can influence under-

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**TABLE 2. Readability scores of online patient education materials for brain aneurysms, by institution**

<table>
<thead>
<tr>
<th>Academic Institution</th>
<th>Coleman-Liau</th>
<th>Flesch-Kincaid</th>
<th>FORCAST</th>
<th>Fry</th>
<th>Gunning Fog</th>
<th>Raygor Estimate</th>
<th>SMOG</th>
<th>Mean</th>
<th>SD</th>
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<td>12.0</td>
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<td>11.0</td>
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<td>11.0</td>
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<td>12.8</td>
<td>13.8</td>
<td>12.5</td>
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<tr>
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<tr>
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</table>

NYU = New York University; RWJ = Robert Wood Johnson; UCLA = University of California Los Angeles; UCSF = UC San Francisco.
standing. Therefore, simply increasing the readability of existing materials may not suffice on its own.

Conclusions

Brain aneurysm–related patient education materials published by major academic institutions are written at a reading level significantly higher than that recommended by the NIH and AMA. This may adversely affect comprehension, preventing patients from fully understanding the scope of their existing condition(s). Future health literacy interventions should focus on improving the readability of patient education materials on brain aneurysms, given the increasing rate at which these lesions are being diagnosed.

References


Disclosures
The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions
Conception and design: Gupta. Acquisition of data: Gupta, Kim. Analysis and interpretation of data: Gupta, Kim. Drafting the article: Gupta, Patel. Critically revising the article: Ogilvy, Adeeb, Griessenauer, Moore, Patel. Reviewed submitted version of manuscript: Ogilvy, Adeeb, Griessenauer, Moore, Thomas. Approved the final version of the manuscript on behalf of all authors: Ogilvy. Administrative/technical/material support: Adeeb, Griessenauer, Moore, Thomas. Study supervision: Ogilvy, Adeeb, Griessenauer, Moore, Thomas.

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