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Clinical Communications

Readability of online allergy and immunology educational resources for patients: Implications for physicians

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Clinical Implications

- A readability analysis of 168 articles focused on 17 common clinical conditions in allergy and immunology found only 2 written at the recommended third- to seventh-grade reading levels, limiting the accessibility of these educational materials to the average US patient population.

TO THE EDITOR:

Over the past decade, a growing repository of health information has become available on the Internet to the lay public.¹ *Health literacy* (HL), the ability to understand and use health information, is an important factor in public health, and readability is one component of HL that can be quantified to determine the complexity of text and educational level of written material.² The average reading ability of the US adult population is between the seventh- and eighth-grade levels,³ and to ensure comprehension for the typical US citizen, guidelines developed by the American Medical Association and the National Institutes of Health recommend that patient health information be written between the third- and seventh-grade levels.^{4,5}

Our objective was to quantitatively assess the readability of online educational resources for patients searching for information for common clinical conditions and treatments in the fields of allergy and immunology. More specifically, our aim was to quantify reading levels for these resources at the level of the individual article, clinical topic, and Web site domain. We hypothesized that average readability at all 3 levels (ie, article, topic, and Web site) would exceed the nationally recommended seventh-grade norm.

We selected 17 Internet search terms on common clinical conditions and treatments related to the field of allergy and immunology on the basis of convenience sampling, considering common and simple terms patients would likely type into a search engine. In August 2016, we searched Google for each term and copied the textual information from the first 10 unique patient health education Web sites listed on Google's search results, pasting it into Microsoft Word. We omitted supplementary material (eg, illustrations) and nonmedical information (eg, references). We recorded the exact URL address of all articles accessed, collecting only 1 article from each unique URL identified in our searches. Institutional review board approval was not required for the study because all articles were freely available online to the general public.

We performed the readability analysis using Readability Studio Professional Edition Version 2012 (Oleander Software, Ltd,

Vandalia, Ohio).¹ applying 9 validated scales to quantify readability (see Table E1 in this article's Online Repository at www.jaci-inpractice.org). We calculated the reading level for each article by averaging estimates derived from all 9 scales. We also calculated the reading level for each of the 17 clinical terms by averaging the individual article reading levels across all 10 articles for each term. Finally, we assessed the frequency with which unique URL domain names were accessed across all articles. For those identified 3 times or more, we calculated the average reading level at the Web site level by averaging the mean reading levels for all articles identified on that site.

We quantified readability for 168 of 170 articles identified; 2 articles of insufficient length (<100 words) were excluded. The average reading level across all 168 articles was 12.5 ± 0.77 , ranging from 6.5 ± 1.6 to 16.8 ± 2.1 . On the basis of averages of the 9 readability scales, we found that only 2 (1.2%) articles were written at the recommended third- to seventh-grade levels, with 114 (68%) written at or beyond a high school level. When articles were aggregated by clinical terms, average reading levels ranged from 9.6 ± 1.6 for *asthma* to 13.8 ± 1.1 for *systemic mastocytosis* (Table I). In identifying articles, we accessed 76 different Web site domains (48 once, 16 twice, and 12 thrice or more). The 3 most frequently accessed domains (n = access frequency) were aaaai.org (n = 13), mayoclinic.org (n = 13), and webmd.com (n = 10). Of the 12 domains accessed 3 times or more, 7 (58.3%) had an average reading level at or above the 12th-grade level and none had a reading level below the recommended 8th-grade level (Table II). The average readability of articles exceeded the 12th-grade level, suggesting that online resources addressing the 17 common clinical topics in allergy and immunology are not optimally meeting patients' health care educational needs. Web site domains webmd.com and lung.org had average reading levels of 9.6 and 9.0, respectively, suggesting that these sites are the closest to being most suitable in meeting patient informational needs for the topics that we studied.

Patients may face challenges in caring for their health. The effects of limited HL have been linked to poorer health outcomes, higher rates of hospitalization, and ultimately higher health care costs.⁶ Older adults, racial minorities, non-native English speakers, and individuals with diminished socioeconomic status are more likely to have low literacy levels.⁶ Certain patient behavior patterns may identify those at risk for low HL, including incorrectly or incompletely filled out medical forms and poor adherence to appointments or use of medication.⁷ One way to improve HL among vulnerable patient populations may be to revise online health care articles to meet recommended national guidelines. The inclusion of readability scores on articles may be useful in directing patients to preferred Web sites on the basis of readability. Alternatively, physicians could create their own readability-tested materials.

Physicians are encouraged to use and explain related terminology and context in conversation before referring patients to online resources. Relatively weak readers who are motivated to read about their condition and familiar with the associated terminology from multiple conversations with medical professionals may improve their comprehension with such background knowledge. This, in turn, would strengthen the patient-physician relationship. Our study has several

TABLE I. Readability levels for online patient-oriented articles related to common clinical topics in allergy and immunology

Clinical topics in allergy and immunology	Readability level,* mean $\pm$ SD	Range
Allergy	12.5 $\pm$ 1.6	8.8-14.2
Anaphylaxis	13.5 $\pm$ 1.6	10.7-16.2
Allergic rhinitis	12.4 $\pm$ 1.7	9.5-14.6
Asthma	9.6 $\pm$ 1.6	7.7-12.4
Primary immunodeficiency disease	13.7 $\pm$ 2.5	7.2-16.1
Allergic bronchopulmonary aspergillosis	11.8 $\pm$ 1.4	9.7-14.2
Chronic obstructive pulmonary disease	9.8 $\pm$ 2.6	6.7-14.6
Churg-Strauss syndrome	13.1 $\pm$ 1.8	10.6-15.7
Eosinophilic esophagitis	13.4 $\pm$ 1.7	10.9-15.5
Gastroesophageal reflux disease	12.6 $\pm$ 1.5	9.1-14.3
Histamine toxicity	13.0 $\pm$ 1.3	11.0-14.9
Hypereosinophilic syndrome	13.1 $\pm$ 1.8	8.6-14.6
Respiratory syncytial virus	11.2 $\pm$ 2.7	6.5-15.3
Systemic mastocytosis	13.8 $\pm$ 1.1	12.0-15.8
Vocal cord dysfunction	11.2 $\pm$ 2.7	7.9-15.1
Epinephrine	13.6 $\pm$ 1.3	12.0-16.1
Benadryl	13.3 $\pm$ 2.0	10.6-17.0

*Readability level of each clinical term was calculated by averaging the readability levels for the 10 articles collected per clinical term. Article readability was estimated using the average of 9 validated readability scales.

TABLE II. Readability levels for commonly accessed Web site domain names for patient-oriented articles related to common clinical topics in allergy and immunology

Domain name	Frequency of Web site access	Readability level,* mean $\pm$ SD	Range
aaaai.org	13	12.9 $\pm$ 1.2	11.0-14.5
mayoclinic.org	13	13.0 $\pm$ 1.4	9.3-14.9
webmd.com	10	9.6 $\pm$ 2.3	6.5-13.4
medicinenet.com	9	14.4 $\pm$ 1.1	12.8-16.1
medlineplus.gov	9	10.2 $\pm$ 2.0	7.3-13.1
merckmanuals.com	7	13.7 $\pm$ 0.6	13.0-14.6
nih.gov	7	12.2 $\pm$ 2.6	8.1-14.9
acaai.org	5	13.1 $\pm$ 1.3	11.7-14.8
healthline.com	4	10.5 $\pm$ 2.3	7.6-12.6
my.clevelandclinic.org	4	11.1 $\pm$ 2.2	8.1-13.1
patient.info	4	14.2 $\pm$ 1.4	12.3-15.6
lung.org	3	9.0 $\pm$ 1.1	7.9-10.2

*Readability level was calculated for the domain names accessed 3 times or more to identify patient-oriented educational articles of common topics in the fields of allergy and immunology. The readability level of each domain was estimated by averaging the readability levels of all articles collected from that domain. Article readability was estimated using the average of 9 validated readability scales.

limitations. We assessed the readability of educational articles identified using a single search engine for a convenience sample of clinical terms, limiting the generalizability of our findings to other clinical conditions or to articles identified using other search engines. Second, our assessment of readability did not consider nontextual, supplementary materials, such as illustrations or videos, and may not accurately reflect an individual's comprehension of information presented on sites that included such materials. More specifically, the 9 formulas used in this study are measures of the potential accuracy with which readers might identify words, which is related to, but a poor predictor of, the ability to understand what the words mean in context. In addition, our study did not factor in reader background and motivations. New literacy studies, which adopt a sociocultural approach in readability assessment, indicate that readers'

specific background, context, and motivations also influence the understanding of discourses, conventions, and meanings of words in a health context.⁸

In summary, our study shows that online patient education materials for common clinical conditions in the fields of allergy and immunology are written at a readability level that could compromise understanding depending on the presence of supportive text features (eg, images, definitions, and referential links), reader background knowledge, and knowledge of vocabulary. Authors responsible for writing educational articles for patients and the organizations responsible for the online posting of such information should ensure that these materials are written at a level comprehensible to the average adult population. Physicians may also play a role in familiarizing patients with vocabulary and context.

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APPENDIX

TABLE E1. Readability analysis formulas

Assessment scale	Formula	Description of evaluation
Flesch-Kincaid Grade Level	$(0.39 \times B) + (11.8 \times W) - 15.59$	Average number of syllables per word (<i>B</i>) and average number of words per sentence (<i>W</i>).
Simple Measure of Gobbledygook	$1.043 \times \sqrt{\{P \times (30/S)\}} + 3.1291$	Average number of words with 3 or more syllables (<i>P</i>) and average number of sentences (<i>S</i>).
Coleman-Liau Index	$(0.0588 \times L) - (0.296 \times T) - 15.8$	Average number of letters per 100 words (<i>L</i>) and average number of sentences per 100 words (<i>T</i>).
Gunning Fog Index	$0.4 \times \{W/S + 100 \times (P/W)\}$	Average number of sentences (<i>S</i>), average number of words per sentence (<i>W</i>), average number of words with 3 or more syllables (<i>C</i>).
FORCAST Formula	$20 - (SS/10)$	Number of single-syllable words in a 150-word sample (<i>SS</i>).
New Dale-Chall formula	$0.0496 \times (W/S) + 0.1579 \times (U/W) + 3.6365$	Average number of words (<i>W</i>), average number of sentences (<i>S</i>), and unfamiliar words (<i>U</i>) (words considered unfamiliar if not on preset list of 3000 common words understood by average fourth grader).
New Fog Count	$\{[E + (3 \times D)/U] - 3\}/2$	Number of easy words (<3 syllables) (<i>E</i>), number of complex words (>3 syllables) (<i>D</i>), number of sentences (<i>U</i>).
Fry Readability	1. Extract 100-word passage from selection. 2. Count number of sentences in passage, estimate to nearest tenth. 3. Count number of syllables in each passage. 4. Find graph point.	Average number of sentences and syllables per 100 words.
Raygor Readability Estimate	1. Select 100-word passage from selection. 2. Count number of sentences, estimated to nearest tenth. 3. Count number of words containing 6+ characters. 5. Find graph point.	Average number of sentences and long (6+ characters) words per 100 words.