

Are we failing to communicate? Internet-based patient education materials and radiation safety



David R. Hansberry, Tekchand Ramchand, Shyam Patel, Carl Kraus, Jin Jung, Nitin Agarwal, Sharon F. Gonzales, Stephen R. Baker*

Department of Radiology, Rutgers, The State University of New Jersey, New Jersey Medical School, 150 Bergen Street, Room C320, Newark, NJ 07109, United States

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ABSTRACT

Introduction: Patients frequently turn to the Internet when seeking answers to healthcare related inquiries including questions about the effects of radiation when undergoing radiologic studies. We investigate the readability of online patient education materials concerning radiation safety from multiple Internet resources.

Methods: Patient education material regarding radiation safety was downloaded from 8 different websites encompassing: (1) the Centers for Disease Control and Prevention, (2) the Environmental Protection Agency, (3) the European Society of Radiology, (4) the Food and Drug Administration, (5) the Mayo Clinic, (6) MedlinePlus, (7) the Nuclear Regulatory Commission, and (8) the Society of Pediatric Radiology. From these 8 resources, a total of 45 articles were analyzed for their level of readability using 10 different readability scales.

Results: The 45 articles had a level of readability ranging from 9.4 to the 17.2 grade level. Only 3/45 (6.7%) were written below the 10th grade level. No statistical difference was seen between the readability level of the 8 different websites.

Conclusions: All 45 articles from all 8 websites failed to meet the recommendations set forth by the National Institutes of Health and American Medical Association that patient education resources be written between the 3rd and 7th grade level. Rewriting the patient education resources on radiation safety from each of these 8 websites would help many consumers of healthcare information adequately comprehend such material.

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1. Introduction

The Internet has become an important resource for patients and their families to help them better understand the diagnosis, the prognosis, and their treatment options of their diagnoses or disorders. Due to its ease, accessibility, and the extreme amount of information available, the Internet is frequently used both as an immediate reference and as a tool to assist with ongoing healthcare decisions. Two studies in 2011 found that 78% of Americans use the Internet and from 59% to 80% of Internet users will seek

information regarding healthcare [1,2]. Internet users who seek healthcare information deem it useful as evident in a 2006 study that found 55% of them thought it improved information accessibility, while 48% thought the information enhanced the management of their health, and 47% said the information they read influenced their healthcare decision making [3]. Another study found that half of those who use the Internet for medical information reported that the information they found had a significant effect on their subsequent decisions [4]. It is apparent that patients view the Internet as a valued form of education. Therefore it is imperative that the patient education materials available are comprehensible for the majority of patients.

However, seeking healthcare related information online isn't necessarily commensurate with an ability to understand it. In fact a report from the National Center for Educational Statistics found that 75 million Americans had either a basic or below basic health literacy level, which means that they would find it difficult to understand instructions on the label of a medication [5]. Health

* Corresponding author. Tel.: +1 973 972 5188; fax: +1 973 972 7429.

E-mail addresses: hansbedr@njms.rutgers.edu (D.R. Hansberry), ramchate@njms.rutgers.edu (T. Ramchand), patel288@njms.rutgers.edu (S. Patel), krauscf@njms.rutgers.edu (C. Kraus), jungjk@njms.rutgers.edu (J. Jung), nitin.agarwal@rutgers.edu (N. Agarwal), gonzalsh@njms.rutgers.edu (S.F. Gonzales), bakersr@njms.rutgers.edu (S.R. Baker).

literacy has been defined as someone's ability to read and understand healthcare information as well as their capability to make effective healthcare decisions [6]. Readability correlates with literacy and is a quantitative metric used to evaluate the ease of which text can be read and understood [7]. The effects of low health literacy are substantial with an estimated cost to the United States (US) economy of \$106–\$236 billion dollars annually [8]. Across the nation, the average American reads at a 7th to 8th grade level, which is typically 3–5 grade levels less than the highest grade level completed [6,7]. As a result, the National Institutes of Health (NIH) and the American Medical Association (AMA) recommend that patient education materials be written between a third and seventh grade reading level to allow for patients to more fully benefit from the information [9,10].

Nonetheless, despite the recommendations, a range of studies have revealed that the readability of patient education materials in several fields of medicine are written at a grade level that is much higher than the AMA and the NIH recommendations [11–17]. In fact, an article from 2013 in JAMA found that the readability of online patient education resources from 16 different medical disciplines were written well above the recommended grade level [18]. Another study analyzed 14 different major surgical subspecialty websites and found their patient education material was written between a 10th and 15th grade level [19]. Likewise a recent study that evaluated the readability of all patient education material from the American College of Radiology and Radiology Society of North America co-sponsored website, RadiologyInfo.org, found the overwhelming majority of the information to be pitched between the 10th and 14th grade level [20].

Patients routinely ask their healthcare providers to explain the risks and benefits of radiation associated with an imaging technique, and any health risks that may be associated with it [21]. The mainstream media has reported stories with headlines such as, "CT Scans in Children Linked to Cancer" in which patients are bluntly warned that of the 1.5 million children that received CT scans, "1500 of those will die later in life of radiation-induced cancer [22]." Another such article was published with the headline that "CT Scans in Kids Linked to Leukemia, Brain Cancer Risk [23]." Not surprisingly, articles and news reports like these will increase patients' concern about radiation safety. It is therefore understandable that they will turn to trusted and easily accessible Internet resources for more information about the risks, benefits, and potential harm of radiation from imaging exams.

It is the goal of this study to determine the readability of online patient education materials regarding radiation safety provided from 8 different web resources encompassing the Centers for Disease Control and Prevention (CDC), the Environmental Protection Agency (EPA), the European Society of Radiology (ESR), the Food and Drug Administration (FDA), the Mayo Clinic, MedlinePlus, the Nuclear Regulatory Commission (NRC), and the Society of Pediatric Radiology (SPR). Through the use of multiple quantitative readability metrics, we evaluate the reading level of the various Internet resources on radiation safety.

2. Methods

In 2013, online patient education resources were downloaded from 8 online resources, including the CDC, the EPA, the ESR, the FDA, the Mayo Clinic, MedlinePlus, the NRC, and the SPR. A total of 45 articles were copied and pasted individually into Microsoft Word (Microsoft Corp, Redmond, WA) files. Text not relevant to patient education, such as copyright notices, disclaimers, acknowledgements, text related to web page navigation, and references were removed. Each article was subsequently analyzed using 10 unique readability assessments with Readability Studio Professional

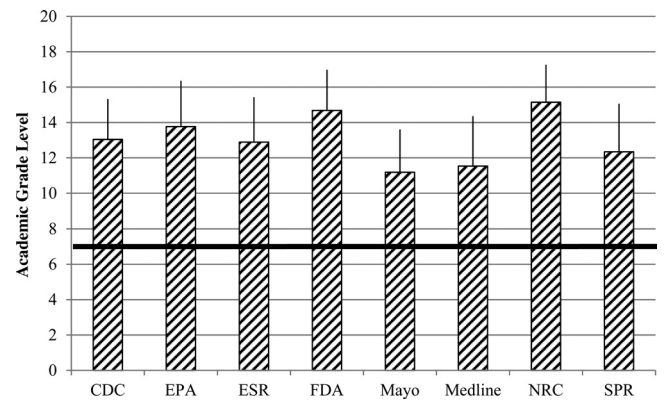


Fig. 1. The corresponding academic grade level, as averaged by all the readability scales except the FRE, for each of the 8 different web resources. The horizontal black line represents the NIH and the AMA recommended guideline that resources not be written higher than the 7th grade level. Centers for Disease Control and Prevention (CDC), Environmental Protection Agency (EPA), European Society of Radiology (ESR), Food and Drug Administration (FDA), Mayo Clinic (Mayo), MedlinePlus (Medline), Nuclear Regulatory Commission (NRC), Society of Pediatric Radiology (SPR).

Edition Version 2012.1 (Oleander Software, Ltd., Vandalia, OH). This included Flesch Reading Ease (FRE), Flesch-Kincaid Grade Level (FKGL), Simple Measure of Gobbledygook (SMOG), Coleman-Liau Index (CLI), Gunning Fog Index (GFI), New Dale-Chall (NDC), FORCAST formula, Fry graph, Raygor Reading Estimate (RRE), and New Fog Count (NFC).

The FRE scale is scored on a 0–100 scale with lower scores indicating more difficult text while higher scores demonstrate more readable text. FRE scores of 0–30 indicate *Very Difficult*, 30–50 are *Difficult*, 50–60 are *Fairly Difficult*, 60–70 are *Standard*, 70–80 are *Fairly Easy*, 80–90 are *Easy*, and 90–100 are *Very Easy*. The nine other readability scales correspond directly to academic grade level in their determinations (Table 1).

Statistical analysis using OriginPro (Northampton, MA) was conducted to compare the level of readability between the 8 different web resources. A one-way ANOVA and Tukey's Honestly Significant Difference (HSD) post hoc analysis was performed with $p < 0.05$.

3. Results

The 8 different online resources, comprising 45 individual patient education articles, were each written well above the NIH and the AMA recommendations that these resource be written no higher than a 7th grade level. The websites written at the lowest reading level were the Mayo Clinic and MedlinePlus, which demonstrated a grade level of 11.2 and 11.5, respectively, when averaged across the nine readability scales (Fig. 1 and Table 2). The NRC had text pitched at the most advanced level of 15.1 while the FDA, EPA, CDC, ESR, and SPR followed with average grade levels of 14.7, 13.8, 13.0, 12.9, and 12.3, respectively (Fig. 1 and Table 2). Similarly, the FRE readability scale found the textual material of three of the websites was written at a *Very Difficult* level with the remaining 5 websites performing just modestly better at the *Difficult* level (Fig. 2 and Table 2). The three least readable websites, according to the FRE, in increasing order of readability were the NRC, the FDA, and the EPA.

When evaluating the 45 patient education articles using the different readability scales, we found that the NFC scored the text at the lowest reading level; however, overall the NFC was still well above the recommended reading levels with a 10.4 average grade level. There was in fact one article, *X-Rays* from MedlinePlus that met the recommendations with a NFC score of 6.7 (Table 2). Despite this score, the remaining readability scales scored this

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