Readability Assessment of Internet-based Patient Education Materials Related to Mammography for Breast Cancer Screening

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Rationale and Objectives: The US Department of Health and Human Services (USDHHS) recommends that Internet-based patient education materials (IPEMs) be written below the sixth-grade reading level to target the average American adult. This study was designed to determine the readability of IPEMs regarding mammography for breast cancer screening.

Materials and Methods: Three-hundred mammography-related Web sites were reviewed for IPEMs. Forty-two IPEMs that met the Health on the Net Foundation Code of Conduct were assessed for readability level with four readability indices that use existing algorithms based on word and sentence length to quantitatively analyze Internet sources for language intricacy including the following: Flesch–Kincaid Grade Level (FKGL), Flesch Reading Ease Score (FRES), Simple Measure of Gobbledygook (SMOG), and Gunning Frequency of Gobbledygook (Gunning FOG; GFOG). Results were compared to national recommendations, and intergroup analysis was performed.

Results: No IPEMs (0%) regarding mammography were written at or below the sixth-grade reading level, based on FKGL. The mean readability scores were as follows: FRES, 49.04 ± 10.62; FKGL, 10.71 ± 2.01; SMOG, 13.33 ± 1.67; and Gunning FOG, 14.32 ± 2.18. These scores indicate that the readability of mammography IPEMs is written at a "difficult" level, significantly above the recommended sixth-grade reading level ($P < .05$) determined by the USDHHS.

Conclusions: IPEMs related to mammography are written well above the recommended sixth-grade level and likely reflect other IPEMs in diagnostic radiology.

Key Words: Mammography; readability; Internet-based patient education materials (IPEMs); Flesch–Kincaid grade level; Flesch reading Ease score; Gobbledygook.

The availability of Internet resources has allowed >113 million Americans (of various ethnic backgrounds, socioeconomic status, and so forth) to access the Internet for health care–related information (1,2). A majority of people who access Internet-based education materials (IPEMs) state that they influence medical treatment decision making (1). Health care professionals must keep the poor rates of health literacy—the "degree to which individuals have the capacity to obtain, process, and understand the basic health information and services needed to make appropriate health decisions" (3)—in the United States in mind when authoring the IPEMs. Furthermore, health literacy is a "measure of patients' ability to read, comprehend, and act on medical instructions" (4). It is a direct prognostic measurement of a patient's health (5). Unfortunately, the average American adult reads only at a seventh–eighth grade level (6–8). Direct consequences of poor health literacy include increase risk of being admitted to the hospital and poorer self health maintenance, both of which lead to poorer patient outcomes and increased cost of health care (9).

Tackling the epidemic of poor health literacy may be a long and difficult process; however, health care physicians may be able to improve patient comprehension of IPEMs by improving readability—the level of comprehension a person must have to understand written materials (7). The US Department of Health and Human Services (USDHHS), American Medical Association, and the National Institutes of Health recommend that IPEMs be written at or below the sixth-grade level (6). Readability analyses have been established to evaluate IPEMs available to patients (1,6). Readability assessments have been used by the various fields

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of medicine to calculate readability of IPEMs available to their patient population (10–12). Readability assessments have recently been published in the radiology literature (13,14). Within radiology, mammography has been established as an effective tool for breast cancer screening. There are guidelines that exist, which provide physicians (and thus their patients) with recommendations for breast cancer screening. Thus, patients are inevitably exposed to mammography and may turn to IPEMs for medical information. In this study, we assess the readability of IPEMs from US hospitals and universities, professional societies, clinical practices, and miscellaneous health care–associated Web sites related to mammography.

MATERIALS AND METHODS

Experimental Design

This study qualifies as exempt status as per the "non-human subject research" protocol set by the Institutional Review Board at our institution. Internet-based patient education material, IPEM was defined as any mammography-related material on the Internet targeted toward the general public (ie, not health care personnel). Inclusion criteria required the IPEMs to be authored or critically reviewed by at least one Doctor of Medicine (MD degree) and/or the meeting criteria set by Health on the Net Foundation Code of Conduct (HONcode) standards for reliable information regarding mammography. The HON Foundation is a nonprofit organization that aims to improve health care–related information on the Internet (15).

Search Procedure. From May 14th to May 16th, 2012, the term "mammogram" or "mammography" was searched using the Google search engine (www.google.com) to find IPEMs to be included in our study. The first individual 300 Web sites from the resulting search were evaluated for readability. A database was created with Web sites from the following sources: US hospitals and universities, professional societies, clinical practices, and miscellaneous health care–associated Web sites regarding mammography meeting the HONcode criteria. Among the US hospitals and universities were sources such as the Johns Hopkins Hospital, Massachusetts General Hospital, and Mayo Clinic. Examples of professional societies include National Cancer Institute, Radiological Society of North America/American College of Radiology, and American Cancer Society. Miscellaneous health care–associated Web sites included popular sources such as WebMD, Drugs.com, and MEDLINE. Web sites that were written in non-English languages, predominantly in graphic or pictorial forms, predominantly in table or list format, or Web sites with <25 sentences were excluded from this study. Redundant Web sites were also excluded in analyses.

Text Editing. Microsoft Office Word software (version 2010; Microsoft, Redmond, WA) was used to create documents for web page readability analyses. Methods for text editing have been previously described (16). Text from each web page was copied onto a unique document. Subsequent editing included the following:

1) Irrelevant script not relaying information related to "mammogram" (web page navigation, copyright notice, disclaimers, date stamps, author information, feedback questionnaires, hyperlinks, citations, Web site uniform resource locators, address fields, and telephone numbers) was removed from the document.
2) Punctuation including semicolons and colons (which interfere with the readability analyses and skew readability scores) were removed from the document.
3) Delete all web pages that do not have 25 sentences.

Data Analysis

Readability Analyses. Readability calculations determine language intricacy applying existing algorithms based on word and sentence length to written text (17). Different descriptive and correlational algorithms are available for calculating readability, including 1) Flesch Reading Ease Score (FRES) (18), 2) Flesch–Kincaid Grade Formula (FKGL) (19), 3) Simple Measure of Gobbledygook (SMOG) (17), and 4) Gunning Frequency of Gobbledygook (Gunning FOG, GFOG) (20). These algorithms are described in Table 1.

The Microsoft Office Word Software has an integrated function which calculates FRES and FKGL. The readability feature is activated by the following:

1) The commands "Tools," "Option," "Spelling and Grammar," were selected.
2) The option "Show readability statistics" was chosen.
3) The "Spelling and Grammar" icon was selected from the toolbar.
4) The "spelling and grammar" check was completed by ignoring all suggested corrections (as to not change the original written text); the FKGL and FRES readability scores were then displayed.

The Microsoft Office Excel Software was used to calculate SMOG and GFOG. The readability feature is activated by the following:

1) Calculate the number of polysyllabic words (ie, words more than three syllables).
2) Enter this information into the equations in listed in Table 1 using columns in Microsoft Office Excel.

Statistical Analysis. Statistical comparisons for subcategories of mammography-related IPEMs (US hospitals and universities, clinical practices, and miscellaneous health care–associated Web sites) were performed using Microsoft Office Excel. One-tailed one-sample t test and two-tailed Student t test were used for analyses of all continuous variables, and significance was set at the $P < .05$ level.