Part I

OPTIMIZING DIEP FLAP BREAST RECONSTRUCTION IN PATIENTS WITH SCANT ABDOMINAL TISSUE
Online Patient Resources for Breast Reconstruction: An Analysis of Readability

Vargas C, Koolen PGL, Chuang DJ, Ganor O, Lee BT
Abstract

Background
Online resources for health information are commonly used by many patients. The discrepancy between functional health literacy and available patient information is recognized as an important contributor to health disparities. To provide understandable patient information, the National Institutes of Health and the American Medical Association have advised that health literature for patients be written at a sixth-grade reading level. This study identifies the most popular, online, patient-targeted resources for breast reconstruction information, and evaluates readability of these sites in the context of literacy in the United States.

Methods
A Web search for “breast reconstruction” was performed using the two largest Internet search engines, and the top 10 websites common to both were identified. Patient-targeted content was downloaded from all relevant articles immediately available from the main sites. A total of 114 articles were assessed for readability using 10 established analyses. Readability scores were also calculated for the groups of articles arranged by website for comparison.

Results
The average reading level was 11.5 across all evaluated sites (Coleman-Liau, 11.8; Flesch-Kincaid, 10.9; FORCAST, 10.7; Fry, 12; Gunning Fog, 12.7; New Dale-Chall, 10.6; New Fog Count, 9.7; Raygor Estimate, 12; and Simple Measure of Gobbledygook, 13). Readability comparison by individual website demonstrated disparity in average reading level from 9.7 to 14.9.

Conclusions
Online patient resources for breast reconstruction exceed recommended reading levels and are too difficult to be understood by a large portion of the population. Significant variability between sites provides an opportunity to direct patients to appropriate websites for their level of health literacy.
Introduction

Americans are using the Internet for health information more than ever. When the first Health Information National Trends Survey was performed in 2003, 63 percent of U.S. adults had used the Internet (up from 22.2 percent in 1997), and 40 percent had looked for health information online.\(^1\) Even a decade ago, the traditional role of the physician as sole provider of health information was changing as patients became more informed health care consumers and shared decision makers. Five years later, the 2008 Pew Internet and American Life Project reported that 74 percent of adults used the Internet and 61 percent (80 percent of Internet users) had looked for online health information. Sixty percent of those patients said the online information they found affected a decision about how they treated a condition; 38 percent said it helped them decide whether to see a doctor.\(^2\) The 2005 Health Information National Trends Survey data set asked patients what they actually used first for health information: 60 percent had used the Internet and only 20.8 percent had asked their doctor.\(^3\)

Several studies suggest that increasing patient use of “supplemental” educational material actually contributes to more patient involvement, increasing satisfaction, and improved health outcomes.\(^4\)–\(^9\) Despite fewer discrepancies in Internet access across demographic groups, several studies have indicated that lower health literacy contributes to overall health disparities, negatively impacts outcomes, acts as a barrier to receiving care, and increases mortality.\(^10\)–\(^14\) The American Medical Association recognized these relationships in the 1999 Health Literacy Report of the Council on Scientific Affairs, recommending increasing physician awareness of the approximately one-fourth of patients with limited literacy, and encouraging routine literacy assessment while providing care.\(^5\)

In 2003, the recommendation for writing patient information at or below a sixth-grade level was published in the American Medical Association *Health Literacy: A Manual for Clinicians*.\(^14\) Moreover, the National Institutes of Health has also recommended that patient materials should be written at a sixth-grade reading level to improve accessibility.\(^15\) Even so, some studies have reported that many patient demographic groups read at a level 3 or more years lower than expected based on self-reported educational years completed.\(^14\)–\(^16\) The importance of the issue of health literacy has also been recognized in several objectives of the Healthy People 2020 program.\(^17\) Previous studies published in the medical literature have looked at the readability of content from professional sites and some public sites, and have suggested that the information was frequently too difficult for the average patient to read.\(^18\)–\(^23\) Most of these studies, however, were conducted a number of years ago, do not generalize to real patient searches, and used only a few of the available and well-established readability analyses. As the Internet and its accessibility continue to expand, critical evaluation of the information available to patients is important both for content improvement and for physician-patient interactions.
counseling. Several well-established instruments are available for assessing the readability of educational content; however, no published data are available regarding the readability of currently available online patient resources for postmastectomy breast reconstruction. The primary aim of this study was to evaluate the readability of available Internet resources for patient information about breast reconstruction in a way that would simulate typical patient searches. We planned to identify the most popular websites for breast reconstruction, and assess their readability in the context of average American reading ability. In addition, to provide physicians with a way of determining appropriate-level sites for their patients’ levels of education, we compared the readability of the patient content by website. We hope to characterize the patient literature that is currently available and commonly used to aid in its improvement, and to highlight ways to better use available resources for breast reconstruction.

Patients and Methods

A Web search for “breast reconstruction” was performed using the two largest Internet search engines (Google and Bing), and the top 10 sites common to both were identified. Location, cookies, and user account information were disabled before each search to avoid inadvertent bias in the results returned. Sponsored hits were excluded. The included sites were the following: Nlm.nih.gov, Cancer.org, Breastcancer.org, Cancer.gov, Komen.org, BraDayUSA.org, MayoClinic.com, WebMD.com, Plasticsurgery.org, and Wikipedia.org (Table 1).

Table 1. Websites Accessed

<table>
<thead>
<tr>
<th>Website</th>
<th>Organization</th>
<th>Number of Articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nlm.nih.gov</td>
<td>Medline Plus/National Library of Medicine</td>
<td>8</td>
</tr>
<tr>
<td>Cancer.org</td>
<td>American Cancer Society</td>
<td>13</td>
</tr>
<tr>
<td>Breastcancer.org</td>
<td>Breastcancer.org</td>
<td>40</td>
</tr>
<tr>
<td>Cancer.gov</td>
<td>National Cancer Institute</td>
<td>5</td>
</tr>
<tr>
<td>Komen.org</td>
<td>Susan G. Komen</td>
<td>12</td>
</tr>
<tr>
<td>BraDayUSA.org</td>
<td>BRA Day USA</td>
<td>13</td>
</tr>
<tr>
<td>MayoClinic.com</td>
<td>Mayo Clinic</td>
<td>7</td>
</tr>
<tr>
<td>WebMD.com</td>
<td>WebMD</td>
<td>6</td>
</tr>
<tr>
<td>Plasticsurgery.org</td>
<td>American Society of Plastic Surgeons</td>
<td>6</td>
</tr>
<tr>
<td>Wikipedia.org</td>
<td>Wikipedia</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>114</strong></td>
</tr>
</tbody>
</table>
All sites were accessed on August 5, 2013. Patient-directed content from all relevant articles directly accessible from the original parent site was downloaded and formatted into plain text in separate Microsoft Word 2007 documents (Microsoft Corp., Redmond, Wash.). A total of 114 articles were downloaded and organized by website. Each article was then edited to exclude images, videos, figures, captions, advertisements, references, links, disclaimers, and acknowledgements. Readability assessment was performed using methods similar to those previously established using the Readability Studio Professional Edition v2012.1 software (Oleander Software, Ltd., Vandalia, Ohio). First, all 114 breast reconstruction articles were analyzed together; subsequent analysis was performed on each group of articles arranged by parent website for comparison. The readability of each group was assessed using 10 established tests: Coleman-Liau Index, Flesch-Kincaid Grade Level, FORCAST Readability Formula, Fry Graph, Gunning Fog Index, New Dale-Chall, New Fog Count, Raygor Readability Estimate, Simple Measure of Gobbledygook Readability Formula, and Flesch Reading Ease (Table 2). Statistical analysis was performed using IBM SPSS software version 21.0 (IBM Corp., Armonk, N.Y.). One-way analysis of variance tests were conducted to compare assessment scale metrics between the aforementioned Internet sites. Significant group sample differences were further analyzed using post hoc Tukey honestly significant difference tests. A value of $p < 0.05$ was deemed statistically significant.

**Table 2.** Tests for Readability Analysis

<table>
<thead>
<tr>
<th>Test</th>
<th>Score Type</th>
<th>Qualities Assessed</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coleman-Liau</td>
<td>Grade Level</td>
<td>Word Length, Sentence Length</td>
<td>$G = \left(\frac{5.88 \cdot C}{W}\right) - \left(\frac{29.5 \cdot S}{W}\right) - 15.8$</td>
</tr>
<tr>
<td>Flesch-Kincaid</td>
<td>Grade Level</td>
<td>Word Complexity, Sentence Length</td>
<td>$G = (11.8 \cdot (B/W)) + (0.39 \cdot (W/S)) - 15.59$</td>
</tr>
<tr>
<td>Flesch Reading Ease</td>
<td>Index Score Range</td>
<td>Word Complexity, Sentence Length</td>
<td>$I = 206.835 - (84.6 \cdot (B/W)) - (1.015 \cdot (W/S))$</td>
</tr>
<tr>
<td>FORCAST</td>
<td>Grade Level</td>
<td>Word Complexity</td>
<td>$G = 20 - (M/10)$</td>
</tr>
</tbody>
</table>
| Fry Graph             | Grade Level        | Word Complexity, Sentence Length           | 1. Extract 100 word samples  
2. Count number of sentences  
3. Count number of syllables  
4. Plot on the Fry graph  
5. Fry score = average of samples |
| Gunning Fog           | Grade Level        | Word Complexity, Sentence Length           | $G = 0.4 \cdot \left(\frac{W}{S + (X/W) \cdot 100}\right)$             |
| New Dale-Chall        | Grade Level        | Word Familiarity, Sentence Length          | $G = (0.0496 \cdot (W/S)) + (0.1579 \cdot (U/W)) + 3.6365$             |
| New Fog Count         | Grade Level        | Word Complexity, Sentence Length           | $G = \left(\frac{((E + (3 \cdot X))/S - 3)/2}{2}\right)$              |
CHAPTER 2

<table>
<thead>
<tr>
<th>Raygor Estimate</th>
<th>Grade Level</th>
<th>Word Length</th>
<th>Sentence Length</th>
<th>1. Extract 100 word samples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Count number of sentences</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Count number of words &gt;6 letters</td>
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<td></td>
<td></td>
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<td></td>
<td>4. Plot on the Raygor graph</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5. Raygor Estimate = average of samples</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SMOG</th>
<th>Grade Level</th>
<th>Word Complexity</th>
<th>Sentence Length</th>
<th>G = 1.0430* VX + 3.1291</th>
</tr>
</thead>
</table>

G, grade level; I, index; W, no. of words; C, no. of characters; S, no. of sentences; B, no. of syllables; M, no. of monosyllabic words; X, no. of complex words (>3 syllables); E, no. of easy words; U, no. of unfamiliar words (based on a list of 3000 common words known to average fourth grade students); SMOG, Simple Measure of Gobbledygook

Results

Health information available from the 10 most frequently used websites about breast reconstruction had an overall average reading level of 11.5. The mean Coleman-Liau grade level was 11.8, with a range of 8 to 18.1. The Flesch-Kincaid analysis, originally designed for the U.S. Navy and the subsequent standard of the Department of Defense, produced a score of 10.9. The mean FORCAST score, also initially commissioned by the U.S. military, and which incorporates a vocabulary analysis to better analyze lists and phrases, was 10.7. Fry score estimates overall had an average grade level of 12, ranging from 7 to 17 (Fig. 1). Gunning Fog readability for all articles was 12.7, with a range from 8.3 to 19. The New Dale-Chall and New Fog Count mean grade levels were 10.6 and 9.7, respectively. The Raygor Readability Estimate, another of the graphic tools for analysis, was 12, with a range from 7 to 17 (Fig. 2). The Simple Measure of Gobbledygook analysis revealed an average readability level of 13, with a range from 9.2 to 17.3. The Simple Measure of Gobbledygook tests for 100 percent comprehension, in contrast to the other tests, which test for 50 to 75 percent. Flesch Reading Ease evaluation, which provides an index score from 0 to 100, with 100 being easiest to read, had an average of 51, classified as “difficult” (Fig. 3). Analysis by parent site revealed a spectrum of readability, both by Flesch Reading Ease (Fig. 3) and by average grade level (Fig. 4). Flesch Reading Ease index score ranged from 61 (Nlm.nih.gov) to 29 (Wikipedia.org). Site difficulty was consistent with analysis by overall average reading level, which ranged from 9.7 (Nlm.nih.gov) to 14.9 (Wikipedia.org). When analysis of variance was performed, three sites were significantly easier to read than the rest (p < 0.05): Nlm.nih.org, Cancer.org, and Breastcancer.
Figure 1. Fry Readability Graph

Figure 2. Raygor Readability Estimate
Figure 3. Flesch Reading Ease Index Comparison by Website

Figure 4. Mean Readability Grade Level Comparison by Website
Discussion

Limited health literacy is a problem for a significant number of American adults. In a large pooled analysis of 31,129 individuals in 2005, the prevalence of low health literacy was 26 percent, and marginal health literacy was another 20 percent. In the context of increasingly widespread Internet access and evidence of growing patient use as health care consumers, an important barrier in the form of health literacy has been recognized. In fact, when patients with cancer seeking online cancer information were characterized, the authors of the study were unable to distinguish “e-patients” from “offline” cancer patients using sociodemographic variables. The authors concluded that their study, contrary to previous reports, demonstrated little evidence that cancer e-patients are more competent online health consumers than cancer patients who did not use the Internet. This finding suggests that there has been a change from the previously described “elite” population of Internet health consumers to a larger, less literate group of e-patients looking for online health resources. Because physicians no longer serve as the sole gatekeepers of health information, a large proportion of patients with Internet access but limited health literacy are attempting to meet their health information needs with available online health resources. Each readability analysis evaluates different aspects of the articles we collected (Table 2). The Fry Graph, which plots the average number of sentences and the average number of syllables per 100 words to determine grade level, reveals that most of the articles assessed fall between the high school and college levels (Fig. 1). The test was designed for a broad range of text including literature and technical articles and is well suited to evaluate most health care articles, as is the Raygor Readability Estimate, which plots the number of sentences and the number of long words per 100 words (Fig. 2). The overall means of both analyses fell at the twelfth-grade level. Figure 3 displays the mean Flesch Reading Ease index score by website. The Flesch Reading Ease instrument is intended to evaluate secondary and adult-level documents and is considered a standard for U.S. government agencies. The goal index score for “plain English” is between 60 and 70; however, only one site fell into that category. Appropriately, this was the MedlinePlus website, maintained by the U.S. National Library of Medicine, with a score of 61. Index scores for the remaining nine sites fell between “fairly difficult” and “very difficult.” Summary analysis of the most popular online breast reconstruction articles reveals a significant discrepancy between the readability of available content and average American literacy. There is a range of difficulty among the 10 sites analyzed, which may contribute to the frustration reported by patients searching for information, as it did not correlate with site popularity. Figure 5 displays the mean readability for each website analyzed by each of the eight numeric tests evaluating grade level. The sites are arranged in order of increasing overall difficulty; however, some variability is seen with the average New Fog Count relative to the other tests. This readability test was designed and primarily used by the U.S. Navy in evaluating technical documents and manuals. Although this is well-suited for some of the articles we found
featuring descriptions of algorithms and surgical procedures, it may be less ideal for others with more traditional prose. Interestingly, three sites - Nlm.nih.org, Cancer.org, and Breastcancer.org - were significantly easier to read than the other seven ($p < 0.05$). This finding highlights an opportunity to guide patients with lower health literacy to more appropriate websites. Our findings are in line with published data from other specialties regarding the average readability of patient information from professional societies and several public websites. The information evaluated in our study, as a function of its design, encompasses professional surgical society websites, government maintained sites, and public domain sites. Contrary to most prior studies, we chose a search term in lay language and used popular Internet search engines to simulate a patient search for information about breast reconstruction. It has been shown previously that quality and accuracy of the information returned correlates with the sophistication of the search term.\textsuperscript{37} The articles returned included information about a range of topics, from preoperative evaluation to types of reconstruction, risks, complications, and expected recovery. The websites we analyzed are part of a constantly evolving body of information, and to our knowledge, there is no previously published literature examining the readability of online articles about breast reconstruction. The issue of breast reconstruction is also unique relative to the other topics surveyed previously. Patients with breast cancer are typically referred for outpatient consultation after meeting their breast surgeon, providing ample opportunity to search for information independently either before or after meeting with a reconstructive surgeon. Breast cancer has been reported as one of the most searched health topics online\textsuperscript{6} and has many public awareness, fundraising, advocacy, and support organizations with patient-directed websites. Breast reconstruction is an inherently complex subject, full of acronyms and medical terms, and unlike many other topics, it is not limited to more educated or wealthier patient demographics that frequently correlate with higher health literacy. Reconstruction also typically provides that patients are highly involved in choosing their preferred method of reconstruction. In a prior study of patients undergoing postmastectomy breast reconstruction, 85 percent of those who chose microsurgical techniques reported having used the Internet as their primary educational resource, a significantly higher proportion than patients who chose other types of reconstruction. The authors of the study noted that patients who chose microsurgical approaches tended to self-identify as active participants in their health choices and reported heavy reliance on Internet sites for medical information before self-referring for surgical consultation.\textsuperscript{39} The secondary aim of this study was to evaluate the most popular websites’ readability relative to one another in the hope of identifying which sites are most appropriate for which patients. Indeed, three of the sites, though still above the target reading level, were significantly easier to read than the others. Physicians should consider quickly assessing the functional health literacy of their patients during consultation to counsel them more effectively and to direct patients and families to more appropriate supplemental information. Several studies have reported simple assessment tools for identifying patients
with limited literacy. As health literacy has been well-described as a contributor to patient outcomes, the importance of recognizing those at risk should be emphasized. Identifying patients with limited functional health literacy may also present opportunities to tailor preoperative consultation and the consent process more appropriately. Surgeons may find that collecting or developing their own library of supplemental patient material at a reading level suitable for their patients improves communication of complex topics surrounding breast reconstruction. Many groups already maintain websites with links to supplemental patient information; perhaps including a rating of their level of difficulty could help direct patients to the most appropriate content. The extent of the information needed during consultation may vary from patient to patient and from provider to provider. Acknowledging this variation and counseling patients proactively can encourage use of understandable supplemental resources and prevent patient attempts to sift through dense online search results. It may also contribute to more patient participation, a positive provider-patient relationship, more completely informed consent, and improved patient satisfaction. Although designed to simulate a typical patient’s search for health information, this study should be interpreted in a manner consistent with its methods. Our choice of search term could potentially influence both the content and the difficulty of the sites returned. A broad range of subjects related to breast reconstruction were included in the search results and could potentially affect an individual article’s readability; overall topics were fairly consistent across sites, however. As a result of examining only the text of each article, potential aids in the form of pictures, videos, chat rooms, outside links, and other multimedia adjuncts were not assessed, and could contribute to better than calculated patient comprehension. The quality and accuracy of information was not evaluated. Readability analyses were performed using well-established tests; however, their formulas do not consider a patient’s prior knowledge or motivation, and are not perfect substitutes for comprehensibility. Internet health resources are available 24 hours per day, 7 days per week, and offer immediate, anonymous access to problem-specific, patient-directed information. Patient reliance on Web-based health resources for information about breast reconstruction continues to increase as Internet access becomes nearly universal. Unnecessary communication barriers have developed as the result of overly complex online health materials and contribute to significant health disparities in the United States. Medical information presents inherently challenging, complex information, difficult even for highly educated patients with a background in health care.

This study confirms that the readability of available online breast reconstruction resources is well above the recommended reading grade level and identifies three of the 10 most popular sites that are significantly easier to read. Improving access to readable health information can empower patients to take an active role in decisions surrounding their health care, and subsequently improve quality of life. On average, online patient information about breast reconstruction requires a reading grade level of 11.5 and is too difficult for
many Americans to understand. Significant variation among websites was noted, and may provide one opportunity to guide patients to easier to read material. Surgeons are in a position to proactively assess both the health literacy and supplemental needs of their patients, and should consider providing or directing patients to appropriate level information. Acknowledging the need for access to readable resources during surgical counseling for breast reconstruction can encourage patient participation and informed consent and may contribute to improved satisfaction and overall outcomes.
References


