# What Is the Quality of Surgery-Related Information on the Internet? Lessons Learned from a Standardized Evaluation of 10 Common Operations

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**BACKGROUND:** Although there is high-quality information on the Internet, it is difficult for patients to identify high-quality Web sites from those with inaccurate or misleading information. Our goal was to determine specific characteristics of Web search results that yield high-quality information and can be discerned easily by patients.

**STUDY DESIGN:** A validated rating system was used to evaluate surgical Web sites for appropriateness and adequacy. Web sites were identified using three search term types (technical, descriptive, and layperson) for 10 common surgical procedures. The top three sponsored (paid) and unsponsored (unpaid) Web site matches were identified. The search and analysis were repeated 1 month later.

**RESULTS:** One hundred forty-five Web sites were retrieved: 90 unsponsored and 55 sponsored. Unsponsored sites had higher mean composite scores than sponsored Web sites (50.6% versus 25%, $p < 0.0001$). Searches using layperson terms had lower mean composite scores compared with those using technical terms (36.9% versus 47.5%, $p < 0.02$). Professional Web sites had the highest mean composite scores (66.3%); legal Web sites had the lowest (6.3%). On regression analysis, unsponsored Web sites were associated with higher composite scores ($p < 0.0001$); number 1 match results ($p < 0.02$) and using layperson search terms ($p < 0.052$) were associated with lower mean composite scores. Repeat search results demonstrated no significant differences, except number 3 match results were no longer significant.

**CONCLUSIONS:** To optimize patients' Web searches, surgeons should recommend unsponsored sites; suggest professional society sites, if available; and provide technical search terms. But information on some topics, such as risks of not undergoing surgery, remains poor and requires discussion between the surgeon and patient. (J Am Coll Surg 2008;207:580–586. © 2008 by the American College of Surgeons)

By providing reliable and accurate information to patients, the Internet has the capability to increase the quality of care in surgical practice by improving efficiency and increasing awareness of risks and benefits. The majority of our patients are spending more time obtaining information from the Internet, a resource with information of variable quality and no credibly established rating system. A study by the Pew Internet and American Life Project showed that 80%

of Internet users, or more than 110 million adults, had searched online for health information.[1] Two-thirds of these patients begin their search inquiry at a search engine, such as Google or MSN, rather than directly accessing a specific Web site.[1] Google is the most commonly used search engine, representing 56% of all searches performed in the US.[2]

The Internet is a powerful resource with the potential to allow patients to make more informed treatment-related decisions. But the quality of health-related Web sites is not monitored, so the quality of the information remains variable. In fact, studies examining Web site quality have found some Web sites presenting inaccurate information.[3-6] Additionally, advertisements for products or services are commonly encountered when searching using a medical term.[7,8]

Internet use by physicians also has increased in recent years. The number of searches performed using PubMed

has steadily increased since 1996 to more than 70 million per month.[9] But physicians use not only formal literature search engines such as PubMed to access clinical information; it is not uncommon for a physician to use an Internet search engine to aid in patient diagnosis.[10] This practice has become so common, in fact, that a study was performed using only the Google search engine to solve diagnostic cases that had been presented in the *New England Journal of Medicine*. Google searches identified the correct diagnosis in 58% of these "zebra" cases, demonstrating that physicians are able to find valuable and accurate health-related information on the Internet.[11]

When physicians search for health-related information on the Internet, they are able to disregard information that is untrue or unreliable, as is evidenced by the success rate of the study by Tang and Ng.[11] It is likely that there are characteristics of high-quality, health-related Web sites that assure physicians that the information is reliable, just as there should be certain aspects of poor-quality Web sites that "flag" these sites as inaccurate. If these high-quality characteristics could be determined, a patient, rather than being provided with a specific Web site for each surgical procedure, could be informed of these characteristics to search for reliable information. The aim of this study was to identify characteristics of high-quality, surgery-related Web sites through the evaluation of the top three matches on the Google search engine using an established surgery-related Web site rating system.

## METHODS

All Web searches in this study were performed in May 2007 on the Google search engine using the Mozilla Firefox and Microsoft Internet Explorer browsers on personal computers running Microsoft XP Professional. Searches were conducted for 10 common elective general surgical procedures: Roux-en-Y gastric bypass, inguinal hernia repair, pancreaticoduodenectomy, liver resection, epidermal cyst excision, cholecystectomy, hemorrhoidectomy, gastrostomy tube placement, Nissen fundoplication, and colectomy. Three search terms were created for each procedure: a technical or medical term, a descriptive term, and a layperson term (Table 1).

Google search results are divided into two categories: unsponsored and sponsored links. Both unsponsored and sponsored Web matches were evaluated. Unsponsored links do not provide payment to Google and are listed in order based on Google's search algorithm, which considers the Web page "importance" and its relevance to the search terms.[12] On the other hand, advertisers pay for placement of sponsored links, which are listed in order of what advertisers are willing to pay for the ad and the frequency that

**Table 1.** Search Terms

| Technical term | Descriptive term | Layperson term |
|---|---|---|
| Cholecystectomy | Gallbladder surgery | Gall bag operation |
| Colectomy | Colon surgery | Large intestine surgery |
| Epidermal cyst excision | Sebaceous cyst surgery | Skin cyst surgery |
| Gastrostomy tube placement | G-tube surgery | Feeding tube surgery |
| Hemorrhoidectomy | Hemorrhoid banding | Hemorrhoid surgery |
| Inguinal hernia repair | Hernia surgery | Groin lump surgery |
| Liver resection | Liver surgery | Liver disease surgery |
| Nissen fundoplication | Reflux surgery | Heartburn surgery |
| Pancreaticoduodenectomy | Whipple surgery | Pancreatic cancer surgery |
| Roux-en-Y gastric bypass | Gastric bypass | Stomach stapling |

users click on the links.[13] Sponsored and unsponsored matches are displayed in separate sections of the Google search results, and sponsored matches are clearly labeled.

For each of the three search term types, three unsponsored and three sponsored Web site matches were evaluated, for a total of 18 possible Web site matches per surgical procedure. We searched 10 surgical procedures, potentially yielding 180 Web sites. A repeat search was performed 1 month after the initial search. Two independent reviewers evaluated the Web matches, including links within the sites; no links to external sites were investigated. Web sites evaluated by both reviewers demonstrated a kappa statistic of 0.91.

To evaluate Web site quality, we used a previously validated rating system consisting of a composite score with a total of 16 clinical and nonclinical criteria (Table 2).[14] These criteria are all specific to patients undergoing elective surgical procedures and were developed using both Agency for Healthcare Research and Quality guidelines and metrics from previously published Web site rating scales. Validation of the composite score was accomplished by comparing the categorical scores (ie, excellent, good, fair, poor) of a panel of surgeons with the composite scores for a selection of Web sites. The kappa score was found to be 1.0 between the surgeon panel and the composite score. All 16 criteria of the composite score were given a score of 0 or 1, with a higher score reflecting the desired outcomes. The highest possible score was 16; the lowest was 0. This score is reported as a percentage of the total possible score of 16.

**Table 2.** Web Site Rating Criteria: Components of Composite Score

| Criterion | Score | Description |
|---|---|---|
| Topic | 1 | Main topic of site is our search term or our search was a subset of the site. |
| | 0 | Main topic is health information; search was mixed in with other information and not a discrete category, or limited and/or unrelated information to our search term. |
| Limited advertising | 1 | Primary purpose informational, < 25% advertising. |
| | 0 | Primary purpose institutional or referrals, extensive (> 25%) advertising, or primary purpose is advertisement of a product or service. |
| Currency | 1 | Last update date listed. |
| Authorship | 1 | Author of health information listed on site. |
| Indications | 1 | Indications for operation listed. |
| Risks | 1 | Risks of operation described. |
| Benefits | 1 | Benefits of operation described. |
| Anesthesia | 1 | Type of anesthesia listed. |
| Recovery | 1 | Description of recovery given. |
| Recovery length | 1 | Length of expected recovery time listed. |
| Alternatives | 1 | Alternatives to operation listed. |
| No procedure | 1 | Consequences if operation not performed. |
| Second opinion | 1 | Where to obtain second opinion listed. |
| Cost | 1 | Cost of operation listed. |
| Accuracy | 1 | No false statements on site. |
| Conflict of interest | 1 | No conflict of interest of site. |

In addition to the data necessary to calculate the composite score, we collected the date of search, match order, PageRank (Google), sponsorship, and type of Web site (ie, professional society, advertisement, legal). The match order describes the order that the Web site appeared in the search results; because there were only 3 Web sites evaluated for each search term, the Web sites were referred to as the number 1, 2, or 3 match result. The heart of Google's search engine is the PageRank algorithm, which it uses to rank Web pages on a scale of 0 to 10. Although complete details of this system are unavailable, PageRank determines the "importance" of a Web page by the number of links to that page and the "importance" of those links.[15,16] A PageRank could be missing, because the Web site is new, Google is unable to index the Web site, or the Web site has been banned from the Google search engine.[17] Google Toolbar was installed into the Web browsers to display each Web site's PageRank.

All Web sites were tabulated; the number of actual sites was compared with possible sites. Additionally, the composite score was calculated for all sites and analyzed according to Web site type. Univariate analysis comparing sponsored and unsponsored Web sites was performed on the mean composite score and its individual components. Additionally, univariate analysis was used to compare the mean composite scores of the results of the technical, descriptive, and layperson Web searches. PubMed site matches were excluded from the analysis, because a patient would not have access to these articles, so 2 Web site

matches were excluded from the analysis at time 0, and 6 were removed from the 1-month analysis. *T*-test analyses of both means and proportions were completed, comparing the sponsored and unsponsored Web sites. Statistical significance was established at p < 0.05. Multivariate linear regression with robust standard errors was performed to identify predictors of the composite score; covariates included Google PageRank, match order, sponsorship, and search term type. All statistical analyses were performed for both time 0 and 1-month samples using STATA 9.2 (Stata Corp).

## RESULTS

One hundred forty-five of 180 possible Web site matches were retrieved: 90 were unsponsored sites and 55 of 90 possible were sponsored sites. With respect to the sponsored Web sites only, searches performed with descriptive terms (24 of 30) produced more matches than searches performed with technical (11 of 30) or layperson (20 of 30) terms. Additionally, there were more sponsored Web site matches for the number 1 (23 of 30) and 2 match (20 of 30) results than for the number 3 match results (12 of 30).

The mean composite scores by Web site type ranged from 6.3% to 66.3% and can be seen in Figure 1. The number of sites in each Web site category ranged from 1 to 13. The categories with the highest mean composite scores included professional societies (66.3%) and Medline or government Web sites (60.6%). The categories with the
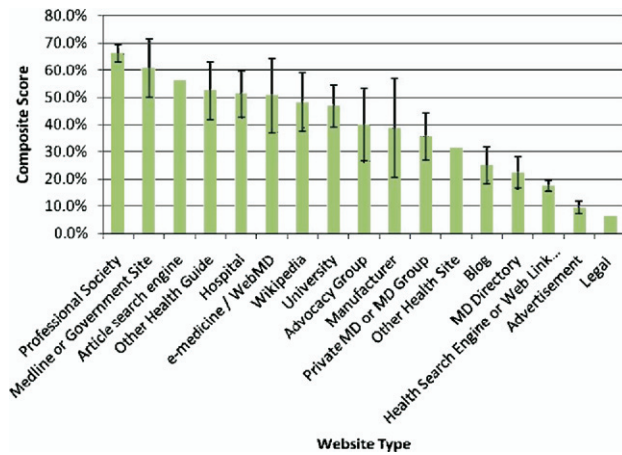
**Figure 1.** Mean composite scores by Web site type. Error bars represent 95% confidence intervals.

lowest mean composite scores were advertisement (9.4%) and legal (6.3%) sites. When the composite scores of all Web site types were pooled and compared with those of the professional society Web sites, we found the composite scores of professional society Web sites (66.3%) to be significantly higher than those of the remaining Web site types (38.3%, p < 0.0001). Web site matches to PubMed were treated as incomplete matches and no analysis was performed because patients would generally not have access to this information.

**Table 4.** Sponsored Versus Unsponsored Web Sites: Components of Composite Score

| Variable | Sponsored (n = 55), % | Unsponsored (n = 88), % | p Values |
|---|---|---|---|
| Mean composite score | 25.0 | 50.6 | < 0.0001 |
| Google PageRank | | | |
|    Mean | 1.9 | 3.5 | < 0.0001 |
|    Standard error | 0.3 | 1.3 | |
| Topic | 47.3 | 81.8 | < 0.0001 |
| Limited advertisement | 25.5 | 84.1 | < 0.0001 |
| Last update listed | 14.6 | 55.7 | < 0.0001 |
| Authorship | 5.5 | 50.0 | < 0.0001 |
| Indications | 36.4 | 69.3 | 0.0001 |
| Risks | 14.6 | 52.3 | < 0.0001 |
| Benefits | 36.4 | 43.2 | NS |
| False statements | 16.4 | 3.4 | 0.006 |
| Conflict of interest | 72.7 | 18.2 | < 0.0001 |
| Alternatives | 32.7 | 33.0 | NS |
| Cost listed | 3.6 | 1.1 | NS |
| No operation | 12.7 | 21.6 | NS |
| Second opinion | 23.6 | 6.8 | 0.004 |
| Typeof anesthesia | 7.3 | 36.4 | 0.0001 |
| Describe recovery | 12.7 | 47.7 | < 0.0001 |
| How long recovery | 18.2 | 52.3 | < 0.0001 |

**Table 3.** Sponsored Versus Unsponsored Web Sites: Comparison by Type of Site

| Type of site | Sponsored, % (n = 55) | Unsponsored, % (n = 90) | p Value |
|---|---|---|---|
| University | 5.5 | 17.8 | 0.03 |
| Hospital | 5.5 | 7.8 | NS |
| eMedicine/WebMD | 0.0 | 8.9 | 0.02 |
| Professional society | 0.0 | 14.4 | 0.003 |
| Legal | 3.6 | 0.0 | NS |
| Wikipedia | 0.0 | 3.3 | NS |
| Advocacy group | 3.6 | 5.6 | NS |
| Advertisement | 20.0 | 2.2 | < 0.0001 |
| Medline/government | 0.0 | 11.1 | 0.01 |
| Private physician or group | 12.7 | 6.7 | NS |
| Other health guide | 5.5 | 10.0 | NS |
| Health search engine or Web link collection | 14.5 | 0.0 | 0.0002 |
| Manufacturer | 14.5 | 2.2 | 0.004 |
| Blog | 0.0 | 5.6 | NS |
| Physician directory | 14.5 | 0.0 | 0.0002 |
| Other health site | 0.0 | 1.1 | NS |
| Article search engine | 0.0 | 1.1 | NS |
| PubMed—required login | 0.0 | 2.2 | NS |

The types of Web sites encountered differed between sponsored and unsponsored searches (Table 3). There were significantly more unsponsored matches for university (17.8% versus 5.5%, p < 0.03), eMedicine/WebMD (8.9% versus 0%, p < 0.02), professional society (14.4% versus 0%, p < 0.003), and Medline/government (11.1% versus 0%, p < 0.01) Web site matches; in fact, there were no sponsored matches for eMedicine/WebMD, professional society, and Medline/government categories. Conversely, there were Web site categories that were significantly more popular in the results of sponsored Web site searches, including advertisement (20.0% versus 2.2%, p < 0.0001), health search engine (14.5% versus 0%, p < 0.0002), manufacturer (14.5% versus 2.2%, p < 0.004), and physician directory (14.5% versus 0%, p < 0.0002). The health search engine and physician directory categories did not have any unsponsored matches.

On further comparison of the unsponsored and sponsored Web site matches, the mean composite score (50.6% versus 25.0%, p < 0.0001) and many of its components were found to be significantly different (Table 4). The elements of the composite score that were significantly greater for the unsponsored Web sites included topic, advertisement, last update, authorship, indications, risks, anesthesia, recovery, and expected length of recovery. Sponsored Web sites were more likely to provide information to obtain a second opinion, but they were also more likely to

**Table 5.** Multivariate Linear Regression to Identify Predictors of High Composite Score

| Variable | Initial search (n = 114) | | | 1 month (n = 103) | | |
|---|---|---|---|---|---|---|
| | Coefficient | 95% CI | p Value | Coefficient | 95% CI | p Value |
| Google PageRank | −0.05 | −0.45, 0.35 | NS | 0.05 | −0.50, 0.60 | NS |
| No. 1 match | 0.00 | | | 0.00 | | |
| No. 2 match | −0.94 | −2.25, 0.36 | NS | −0.01 | −1.49, 1.46 | NS |
| No. 3 match | −1.60 | −2.90, −0.29 | 0.02 | −0.15 | −1.67, 1.38 | NS |
| Sponsored Web sites | 0.00 | | | 0.00 | | |
| Unsponsored Web sites | 4.16 | 2.70, 5.62 | < 0.0001 | 4.11 | 2.58, 5.64 | < 0.0001 |
| Technical search terms | 0.00 | | | 0.00 | | |
| Descriptive search terms | −0.59 | −1.97, 0.79 | NS | −1.17 | −2.69, 0.35 | NS |
| Layperson's search terms | −1.37 | −2.75, 0.014 | 0.052 | −1.93 | −3.46, −0.40 | 0.01 |

contain false statements and conflict of interest. Examples of sites considered to have conflict of interest include Web sites selling products, those run by private physicians or hospitals, and those run by manufacturers or pharmaceutical companies. Finally, the mean Google PageRank was significantly greater for unsponsored Web sites than for sponsored Web site matches (3.5 versus 1.9, $p < 0.0001$). The Google PageRank was not available for all Web sites evaluated; Google provided a PageRank for 114 of 145 Web sites.

There were also differences in search results yielded by using the three different search term types. Searches performed with the technical search term had significantly higher mean composite scores than those using the layperson term (47.5% versus 36.9%, $p < 0.02$). No other significant differences were seen among the search term types.

Multivariate linear regression with robust standard errors demonstrated that unsponsored Web sites were associated with a higher composite score (coefficient = 4.16, $p < 0.0001$). Additionally, the number 3 match results were associated with significantly lower mean composite scores (coefficient = −1.60, $p < 0.02$) than the number 1 match results. Searches using the layperson search term were associated with lower mean composite scores (coefficient = −1.37, $p < 0.052$) compared with those using the technical search term, but this was only marginally significant. The Google PageRank ($p < 0.72$) was not associated with a higher composite score (Table 5).

A repeat search using the same search terms was performed approximately 1 month after the initial search. This new search yielded 151 out of a possible 180 Web site matches (100% of possible unsponsored and 68% of possible sponsored sites). Compared with the initial search, 37 Web sites were new, with 70.2% of these sponsored. On calculating the mean composite score by Web site type, Medline/government (68.8%) and professional society (66.9%) Web sites remained the 2 categories with the highest mean composite scores; advertisement (7.5%), and legal (6.3%) continued to have the lowest. The Web site types in

the sponsored and unsponsored groups differed slightly at 1 month; for example, the difference in prevalence of university Web sites between sponsored and unsponsored searches was no longer significant at 1 month. Conversely, the difference in prevalence of legal and PubMed sites in the sponsored and unsponsored searches did become significant (6.6% versus 0%, $p < 0.02$ and 4.9% versus 0%, $p < 0.04$, respectively). The mean composite score of unsponsored Web sites continued to be significantly greater than that of the sponsored Web sites (51.3% versus 20.6%, $p < 0.0001$), and the individual components of the composite score showed only minor changes; the difference in information on the consequences of no procedure was found to be significantly greater for the unsponsored Web sites (9.8% versus 22.7%, $p < 0.04$), and there was no longer a significant difference between the sponsored and unsponsored Web sites with respect to obtaining a second opinion. As in the initial search, there were significantly higher composite scores associated with using the technical term than the layperson term (45.0% versus 33.8%, $p < 0.02$). Multivariate linear regression again demonstrated that unsponsored Web sites were associated with higher mean composite scores (coefficient = 4.11, $p < 0.0001$), but it failed to show that the number 3 match results were associated with lower composite scores. The regression analysis did show an association between searches performed using the layperson term and lower composite scores (coefficient = −1.93, $p < 0.01$). The Google PageRank continued to be not associated with a higher composite score (Table 5).

## DISCUSSION

Research has shown improved outcomes when patients are well informed.[18] In fact, a recent publication through the American College of Surgeons assists patients in being well informed by not only providing general information but also by recommending key questions for patients to ask.[19] A surgeon can answer all of a patient's questions in the office,

but the patient might have more questions or desire further clarification after leaving the office. Providing patients with a source allows them to go through the information at their own pace. Empowering the patient with a trusted source of information will lead to a better informed patient and, in turn, improved expectations and outcomes. Given the widespread use of the Internet for health-related searches, we set out to determine characteristics of the first three Web site matches on Google that were discernable by patients to guide patients to high-quality, elective surgery-related Web sites.

We found that unsponsored matches were of significantly higher quality than sponsored matches. Using the technical search term rather than the descriptive or layperson term also produced higher composite scores. With respect to Web site types, those representing professional societies were found to have significantly higher composite scores; Web sites representing law firms and advertisements were among the lowest scoring Web site types. Poor quality information was not rare; there were false statements on 8.3% of the Web sites evaluated. Last, the results of a repeat search 1 month later using the same search terms were not significantly different from results of the initial search. Although there were a number of new Web sites that appeared on the followup search, the overall quality of the information remained equivalent.

On evaluating the percentage of Web site matches and the different types of search terms, unsponsored searches always produced more than three Web sites. In contrast, sponsored searches often did not produce three or more results. In fact, using the technical term matched 37% of possible sponsored sites; searching using the descriptive term yielded 80% matching of possible sponsored sites. We have found sponsored Web sites to be of lower quality than their unsponsored counterparts. Given that there are fewer sponsored matches for the technical search term, when provided with the technical search term, the patient is likely to encounter fewer of these poorer quality sponsored Web sites.

This study is unique in several aspects. We compared the quality of health-related information on both sponsored and unsponsored Web sites, which previous studies have not done. Additionally, this study examined different types of search terms (medical, descriptive, and layperson); by grading the quality of health information retrieved with each search term, physicians can now advise patients to use technical search terms for anticipated procedures. Finally, in this study, all Web site matches were evaluated without using exclusion criteria; this unfiltered method produced more realistic results by examining all Web sites that patients would encounter.

At this time, there is not an overriding governing body or seal of credibility that evaluates the quality of health-related information on the Internet. Many organizations, such as the Food and Drug Administration, the National Cancer Institute, and the National Library of Medicine, make recommendations to patients about using the Internet for health-related sites based on the Health on the Net Code of Conduct (HONCode).[20] Unfortunately, no system exists to ensure that a Web site displaying the HONCode logo is compliant with the standards and to force offending Web sites from removing the logo. In addition, the HONCode is not intended to guarantee quality information.[21] A governing body to evaluate and endorse health-related Web sites would improve patient education and efficiency in the surgeon's office, but because this type of endorsement system is not currently available, we believe steering patients to high-quality, surgery-related Web sites through the use of our findings is a useful stepping stone until a far-reaching seal of credibility is established.

Limitations of this study include those inherent to performing research on fluid media such as the Internet. For example, if another researcher were to repeat our search, he would be unlikely to obtain the same Web site matches. Although our Web site rating scale has not undergone a rigorous validation process, it was validated by a group of physicians using a qualitative scale, the results of which correlated with our composite score. Last, the Google PageRank was not available for all of the Web site matches, so to include the Google PageRank in our multivariate analysis, only Web sites with a PageRank score were included. This lack of PageRank could be explained by the sites being new, unable to be indexed by the search engine, or banned by Google.

In summary, although the quality of health-related information on the Internet varies, surgeons can encourage patients to perform Web searches without providing specific Web sites for each surgical diagnosis. To increase the likelihood that patients will obtain reliable information, surgeons should encourage patients to focus on unsponsored Web sites and attempt to provide the correct technical term for the surgical procedure. Additionally, physicians should recommend that patients use Web sites of professional societies, if they are provided among the search results. A combination of information sources available to patients can increase investment in their own care. That said, the information on the Internet does not replace information provided by the surgeon; surgeons should continue to inquire about information patients encounter on the Internet to correct potential inaccuracies.

## Author Contributions

Study conception and design: Yermilov, Chow, Devgan, Makary, Ko

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