Original Investigation

Is the Internet a Suitable Patient Resource for Information on Common Radiological Investigations?: Radiology-Related Information on the Internet

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Rationale and Objective:: This study aimed to assess the quality of Internet information about common radiological investigations.

Materials and Methods: Four search engines (Google, Bing, Yahoo, and Duckduckgo) were searched using the terms "X-ray," "cat scan," "MRI," "ultrasound," and "pet scan." The first 10 webpage results returned for each search term were recorded, and their quality and readability were analyzed by two independent reviewers (DJB and LCY), with discrepancies resolved by consensus. Analysis of information quality was conducted using validated instruments for the assessment of health-care information (DISCERN score is a multi-domain tool for assessment of health-care information quality by health-care professionals and laypeople (max 80 points)) and readability (Flesch-Kincaid and SMOG or Simple Measure of Gobbledygook scores). The search result pages were further classified into categories as follows: commercial, academic (educational/institutional), and news/magazine. Several organizations offer website accreditation for health-care information, and accreditation is recognized by the presence of a hallmark or logo on the website. The presence of any valid accreditation marks on each website was recorded. Mean scores between groups were compared for significance using the Student *t* test.

Results: A total of 200 webpages returned (108 unique website addresses). The average DISCERN score was <50 points for all modalities and search engines. No significant difference was seen in readability between modalities or between search engines. Websites carrying validated accreditation marks were associated with higher average DISCERN scores: X-ray (39.36 vs 25.35), computed tomography (45.45 vs 31.33), and ultrasound (40.91 vs 27.62) ($P < .01$). Academic/government institutions produced material with higher DISCERN scores: X-ray (40.06 vs 22.23), magnetic resonance imaging (44.69 vs 29), ultrasound (46 vs 31.91), and positron emission tomography (45.93 vs 38.31) ($P < .01$). Commercial websites produced material with lower mean DISCERN scores: X-ray (17.25 vs 31.69), magnetic resonance imaging (20.8 vs 40.1), ultrasound (24.11 vs 42.35), and positron emission tomography (24.5 vs 44.45) ($P < .01$).

Conclusions: Although readability is adequate, the overall quality of radiology-related health-care information on the Internet is poor. High-quality online resources should be identified so that patients may avoid the use of poor-quality information derived from general search engine queries.

Key Words: Internet information; health informatics; patient education; health-care information.

INTRODUCTION

Patients increasingly turn to the Internet for health-care information. Some analysts have concluded that as much as 4.5% of all queries to general Internet search engines are health care related in origin (1). The Pew Research Center in 2014 estimated that 87% of US adults use the Internet regularly and that 72% of those had searched online for health-care information within the previous year (2). Evidence has also demonstrated that although patients have a high degree of trust for the information that their doctor may

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provide, as few as 11% of patients will make their doctor their first port of call for that information, with most choosing online sources first (3).

There is an enormous amount of undifferentiated health-care information readily available online, but we continue to have a poor understanding of its implications for ongoing medical care and for how medical care is understood by our patients (4).

To date, work has been undertaken in a variety of medical specialty areas to characterize and describe the quality of health-care information online as it pertains to those areas (5–9). Validated instruments such as the DISCERN score (10) have been developed to allow consistent evaluation of health-care information quality. The findings in these works suggest that online health-care information across these domains can be inaccurate, overly commercial, and potentially harmful.

This study aimed to characterize the quality of online health-care information as it pertains to five common radiological investigations.

METHODS

Three general search engines were used: Google, Bing, and Yahoo. These were selected because they have the highest Internet traffic share, as indicated by their Alexa ranking at the time of writing (11). Most commercial search engines track user behavior through the use of cookies, small packets of software left on the user's computer to allow them to be identified on repeated subsequent website visits. This can potentially influence search engine results. To control for this and to assess the influence of cookie tracking behavior on search results, a fourth search engine called Duckduckgo, which does not engage in cookie tracking behavior, was included.

Five modalities were chosen for study: X-ray, computed axial tomography, magnetic resonance imaging (MRI), ultrasound, and positron emission tomography (PET). The search terms used were, without parentheses, X-ray, cat scan, MRI, ultrasound, and pet scan.

Each search term was used on each search engine. The first 10 results for each search were collected for analysis. Web browser cache and cookies were cleared before searching on a MacBook Pro, 2.4GHz Intel Core i5 using Safari running on MacOs (Apple Inc. 1983–2016). All searches were conducted between May 9 and 10, 2016.

For each webpage result, the following data were extracted or developed:

DISCERN score: A multi-domain validated tool for assessment of health-care information quality, giving a score from 15 to 80 points). DISCERN scores were calculated independently by two reviewers (DJB, LCY), with discrepancies resolved by consensus.

Flesch-Kincaid grade level: A validated tool for calculating the reading level of a piece of text that returns an estimate of the equivalent American high-school grade at which an individual would be expected to be able to read that text.

SMOG score: Simple Measure of Gobbledygook also provides an estimated reading grade for the text.

Mean DISCERN, Flesch-Kincaid, and SMOG scores for each term on each search engine were calculated. The Student *t* test was used to compare differences in means between groups with a *P* value of <.01 taken to represent statistical significance.

Several foundations provide online accreditation of information quality for health-care websites, certifying that the website meets a certain standard for information quality. Accreditation is typically signified by the presence of a logo or hallmark on the website landing page. The presence of verified accreditation marks on websites was recorded.

All websites were classified as belonging to one of three groups: commercial, academic (educational/institutional), and news/magazine. Commercial websites were those with overt advertisement of a product or treatment or investigation. Educational/institutional websites were those produced by universities, national health authorities, or medical associations.

RESULTS

A total of 200 search results were returned (4 search engines × 5 modalities × 10 results per search). These comprised 40 webpage results for each individual term. There were 108 unique webpages when repeated websites were excluded (Table 1).

Quality and Readability

The mean DISCERN score and range for each modality on each search engine are given in Table 2. No modality had a mean score above 50 points, indicating a poor overall information quality. Average readability scores did not differ significantly across search engines and modalities. The Flesch-Kincaid grade level ranged from 5.79 to 8.74, whereas the SMOG score ranged from 5.99 to 7.56.

Accreditation Markings

Websites displaying quality accreditations or hallmarks were associated with higher mean DISCERN scores for information on X-ray (39.36 vs 25.35), computed tomography (CT) (45.45 vs 31.33), and ultrasound (40.91 vs 27.62) ($P < .01$), but not for MRI (37.48 vs 27.67; $P = .22$) or PET (44.14 vs 37.25; $P = .07$).

TABLE 1. Total Webpage Results for Each Modality

	X-ray	CT	MRI	Ultrasound	PET	Total
Total no. of websites	40	40	40	40	40	200
No. of unique results	24	19	25	22	18	108

CT, computed tomography; MRI, magnetic resonance imaging; PET, positron emission tomography.