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Clinical Investigation

Reputation Management and Content Control: An Analysis of Radiation Oncologists' Digital Identities

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Summary

The authors identified all Medicare-participating radiation oncologists in the United States and Puerto Rico and developed a customized Google-based search engine. Up to the top 10 search results for each physician were extracted and categorized. Results for academic and nonacademic radiation oncologists were compared. Most radiation oncologists lacked self-controlled online content in the first page of Google search results. Strategies for radiation oncologists to improve their digital presence are discussed.

Introduction: Google is the most popular search engine in the United States, and patients are increasingly relying on online webpages to seek information about individual physicians. This study aims to characterize what patients find when they search for radiation oncologists online.

Methods and Materials: The Centers for Medicare and Medicaid Services (CMS) Physician Comparable Downloadable File was used to identify all Medicare-participating radiation oncologists in the United States and Puerto Rico. Each radiation oncologist was characterized by medical school education, year of graduation, city of practice, gender, and affiliation with an academic institution. Using a custom Google-based search engine, up to the top 10 search results for each physician were extracted and categorized as relating to: (*1*) physician, hospital, or health care system; (*2*) third-party; (*3*) social media; (*4*) academic journal articles; or (*5*) other.

Results: Among all health care providers in the United States within CMS, 4443 self-identified as being radiation oncologists and yielded 40,764 search results. Of those, 1161 (26.1%) and 3282 (73.9%) were classified as academic and nonacademic radiation oncologists, respectively. At least 1 search result was obtained for 4398 physicians (99.0%). Physician, hospital, and health care—controlled websites (16,006; 39.3%) and third-party websites (10,494; 25.7%) were the 2 most often observed domain types. Social media platforms accounted for 2729 (6.7%) hits, and peer-reviewed academic journal websites accounted for 1397 (3.4%) results. About 6.8% and 6.7% of the top 10 links were social media websites for academic and nonacademic radiation oncologists, respectively.

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Conclusions: Most radiation oncologists lack self-controlled online content when patients search within the first page of Google search results. With the strong presence of third-party websites and lack of social media, opportunities exist for radiation oncologists to increase their online presence to improve patient−provider communication and better the image of the overall field. We discuss strategies to improve online visibility.

Introduction

Patients are increasingly turning to the Internet to search for information regarding their health and health care providers (1-3), and this trend is likely to continue with patients having an increased choice of provider. Google is the most popular search engine and website in the United States (4, 5). More than 90% of Americans do not look beyond the first page of results (first 10 website links) (6), suggesting that the information on the first page of Google may disproportionally influence patients' knowledge and opinions.

The online presence of physicians can be described in a variety of ways. One categorization looks at physician-controlled and -uncontrolled content. Physician-controlled content, as its name suggests, refers to media that physicians and hospitals can tailor to their individual or group's brand. This includes hospital or health care network sites and personal websites. By contrast, physician-uncontrolled content can be thought of as "online word of mouth" or webpages created about a physician but not directly controlled or influenced by that individual; examples include third-party health and physician information websites such as healthgrades.com or vitals.com (7).

This study aims to characterize what patients find when they search for radiation oncologists online using Google. We hypothesize that radiation oncologists' digital identities lack physician-controlled content and are dominated by physician-uncontrolled third-party websites.

Methods and Materials

This study did not require institutional review board approval because it used publicly available federal databases and web-accessible data sources. The methods of this study follow those presented by Vijayasarathi et al (8).

Study population

The Centers for Medicare and Medicaid Services (CMS) Physician Comparable Downloadable File (PCNDF) was used to generate a list of radiation oncologists (9). The data were accessed and de-duplicated using National Provider Identifier (NPI) numbers on September 23, 2016. All remaining entries were included for analysis (n = 4443). The PCNDF captures all physicians enrolled in Medicare fee-for-service, or about 91% of the physicians in the United States (10), and is comprehensive and representative of U.S. physicians.

Data collection

The PCNDF list of all radiation oncologists was downloaded as a.csv file and analyzed using Python (version 2.7) and Pandas, an open-source library for working with data in Python. Information on first name, last name, NPI number, gender, degree type (MD or DO), medical school graduation year, and practice location city and state was extracted from the PCNDF dataset. The following search term was generated for each radiation oncologist: [firstname] + [lastname] + [degree] + radiation + oncologist + [city] + [state]. The majority of radiation oncologists in the dataset were MDs rather than DOs; consequently, in cases where the degree was not reported in the PCNDF, an MD was assumed.

To search 4443 names efficiently, we set up a custom search engine (CSE) through Google. CSE allows users to submit searches to Google's servers programmatically, passing a list of queries through the CSE application programming interface (API). The default API parameters were used, and the duplicate content filter was used to prevent nearly identical links from being returned as separate entries. The search term for each radiation oncologist was sent to CSE and returned up to 10 website links, or URLs (total n = 40,764 results). These URLs were saved in another.csv file using the Python Data Analysis Library (Pandas) (11). The script used to send and receive data from Google was built using Python (version 2.7) (12). The April 2017 Association of Residents in Radiation Oncology (ARRO) Directory (13) and the departmental websites of academic programs were used to compile an external database listing academic radiation oncologists in the United States. Departmental websites were accessed in June and July 2017. This was then consulted to verify the academic status of physicians in this study.

The website domains (ie, first part of website URLs, such as facebook.com, doximity.com) that made up the 40,764 URL results were roughly split into 4 groups, and 4 reviewers manually categorized the domain names in 2 groups into 1 of 5 categories, which are presented in Table 1. In this way, each domain was reviewed by at least 2 reviewers. If a reviewer was uncertain about an assigned category or there was a discrepancy between 2 reviewers, a third reviewer would examine the domain name to reach a final consensus.

Table 1 Website categories with examples of each category

Type	Category	Examples
1	Hospital, health system, or physician-controlled content websites	Hospital or health care network sites, university sites, physician websites on provider domains (upmc.com, hopkins.com, hopkinsmedicine.org, medstarhealth.com)
2	Third-party health and physician information websites	healthgrades.com, vitals.com, webmd.com
3	Social media websites	twitter.com, doximity.com, linkedin.com, youtube.com, facebook.com
4	Primary academic journal websites	redjournal.com, practicalradonc.org
5	Other	Blogs, obituary sites, article repository websites, meeting programs, legal sites

Data analysis

We calculated the number and percentage of each of the 5 types of websites for all 40,764 URL results. We also determined how often each domain was the first Google search result. We analyzed the frequency of each type of website among academic versus nonacademic radiation oncologists; frequency was also compared across age ranges as estimated by medical school graduation year.

A χ^2 analysis was used to examine whether these frequencies were different between academic and nonacademic radiation oncologists. A 1-way χ^2 analysis was performed across the entire study population to assess the significance of differences between occurrence frequencies of the website categories. Data analysis was performed using Prism for Mac OS X version 7.0c (GraphPad Software, Inc, San Diego, CA). Significance was set at $P<.05$.

Results

The CMS database showed that 4443 out of 1,038,373 (0.43%) physicians self-identified as radiation oncologists. Of those, 1161 (26.1%) and 3282 (73.9%) were classified as academic and nonacademic radiation oncologists, respectively. At least 1 Google search result for each of 4398 radiation oncologists (99.0%) was retrieved. Demographics for the study population, as determined from the PCNDF database, are presented in Table 2. About 26% of all radiation oncologists were female, which is similar to a recent study by Ahmed et al (14) reporting roughly 28% of radiation oncology faculty in 2015 identifying as female.

All 40,764 URLs were categorized. The top 10 most frequently occurring domains are presented in Table 3. The most commonly occurring domain was healthgrades.com, with 4550 hits (~1.0 hit per radiation oncologist) and at least 1 hit for 2790 radiation oncologists (63.4%). Seven of the top 10 domains were social media (4) or third-party websites (3). No primary academic journal websites were listed in the top 10 domains.

Figure 1 presents the frequency of website types in the top search results for U.S. radiation oncologists. Hospital, health system, or physician-controlled websites (16,006; 39.3%) and third-party websites (10,494; 25.7%) were the 2 most commonly observed domain types. Websites belonging to social media platforms accounted for 2729 (6.7%) hits, and websites belonging to peer-reviewed academic journals accounted for 1397 (3.4%) results. A 1-way χ^2 analysis of the entire population showed that domains were not randomly distributed across the 5 categories ($P<.0001$). Also, academic and nonacademic radiation oncologists showed a statistically significant difference in the categories composing their top search results ($P<.0001$). In particular,

Table 2 Demographic characteristics of U.S. radiation oncologists

Characteristic	Value (%)
Total number of U.S. radiation oncologists	4443
Sex	
Male	3296 (74.2)
Female	1147 (25.8)
Degree type	
MD	1944 (43.8)
DO	32 (0.7)
None listed	2467 (55.5)
Academic affiliation	
Academic	1161 (26.1%)
Nonacademic	3282 (73.9%)
Graduation year from medical school	
Before 1965	47 (1.1)
1965-1984	1097 (24.7)
1985-1994	1243 (28.0)
1995-2004	1102 (24.8)
2005-2016	880 (19.8)
Graduation year not listed	74 (1.7)
Google search results retrieved	
0	45 (1.0)
1	48 (1.1)
2	48 (1.1)
3	49 (1.1)
4	66 (1.5)
5	97 (2.2)
6	110 (2.5)
7	122 (2.7)
8	122 (2.7)
9	124 (2.8)
10	3612 (81.3)

Table 3 Top 10 domains in the first page of Google search for U.S. radiation oncologists

Rank	Domain name	Domain type	Number of hits	Number (%) of radiation oncologists (n=4398)
1	healthgrades.com	Third-party	4550	2790 (63.4)
2	health.usnews.com	Third-party	2642	1881 (42.8)
3	vitals.com	Third-party	2243	1647 (37.4)
4	doximity.com	Social media	1180	1055 (24.0)
5	linkedin.com	Social media	672	619 (14.1)
6	onlinelibrary.wiley.com	Other	569	460 (10.5)
7	ncbi.nlm.nih.gov	Other	512	451 (10.3)
8	sharecare.com	Social media	471	411 (9.3)
9	issuu.com	Other	416	341 (7.8)
10	youtube.com	Social media	368	325 (7.4)

physician- or institution-controlled websites consisted of 40.6% of academic radiation oncologists' search results, compared with 38.7% of nonacademic radiation oncologists' search results.

Figure 2A depicts the frequency of each website category at each search position for the top 10 search results for U.S. radiation oncologists. In the top 8 search results, hospital, health system, or physician-controlled websites were the most commonly encountered website category, whereas in positions 9 and 10, other websites were the most commonly encountered websites. In positions 1 to 5, third-party websites were the second most common websites, and in positions 6 to 8, other websites were the second most common. In positions 9 to 10, hospital, health system, or physician-controlled websites and third-party websites formed the second and third most frequently encountered websites, respectively.

Figure 2B presents the frequency of website categories at each search position for the top 10 search results for academic versus nonacademic U.S. radiation oncologists. About 72.8% of first search results for academic radiation oncologists were hospital, health system, or physician-controlled websites, compared with 47.8% in the case of nonacademic radiation oncologists. Third-party websites consisted of 16.2% and 33.0% of first search results for academic and nonacademic radiation oncologists, respectively. The total physician- or institution-controlled and third-party websites in first search results for academic and nonacademic radiation oncologists was 89.0% and 80.8%, respectively. Interestingly, in the first search result for academic and nonacademic radiation oncologists, social media websites constituted only 0.6% and 4.1%, respectively; as a whole, 6.8% of all search results for academic radiation oncologists were social media websites, compared with 6.7% for nonacademic radiation oncologists. Figure 2B shows that as search positions decreased, the frequency of social media websites within each search position increased. It is worthwhile to note that in the case of academic radiation oncologists, the proportion of social media websites increased from 0.6% in the first search position to 5.4% in the second search position.

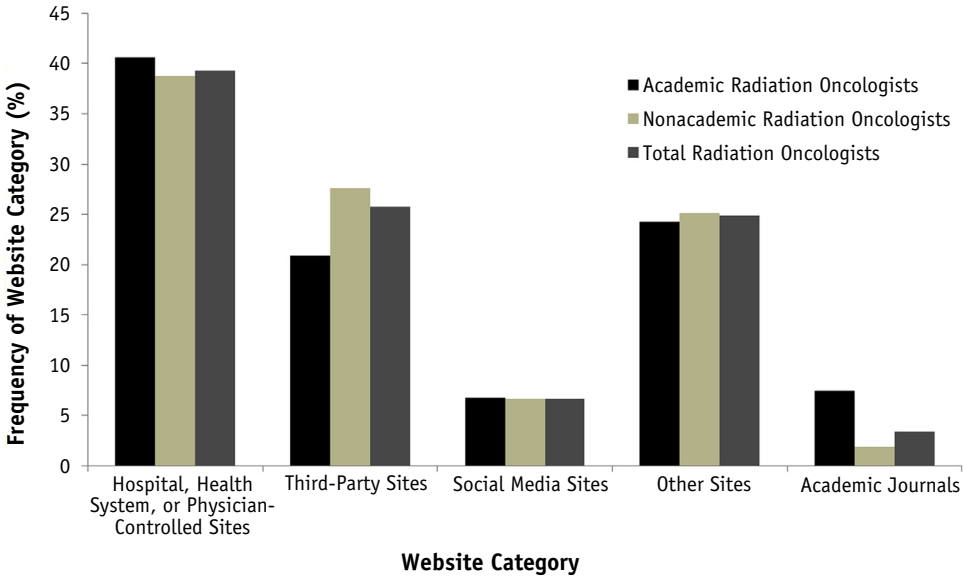

Fig. 1. Frequency of website types in top 10 search results for U.S. radiation oncologists.

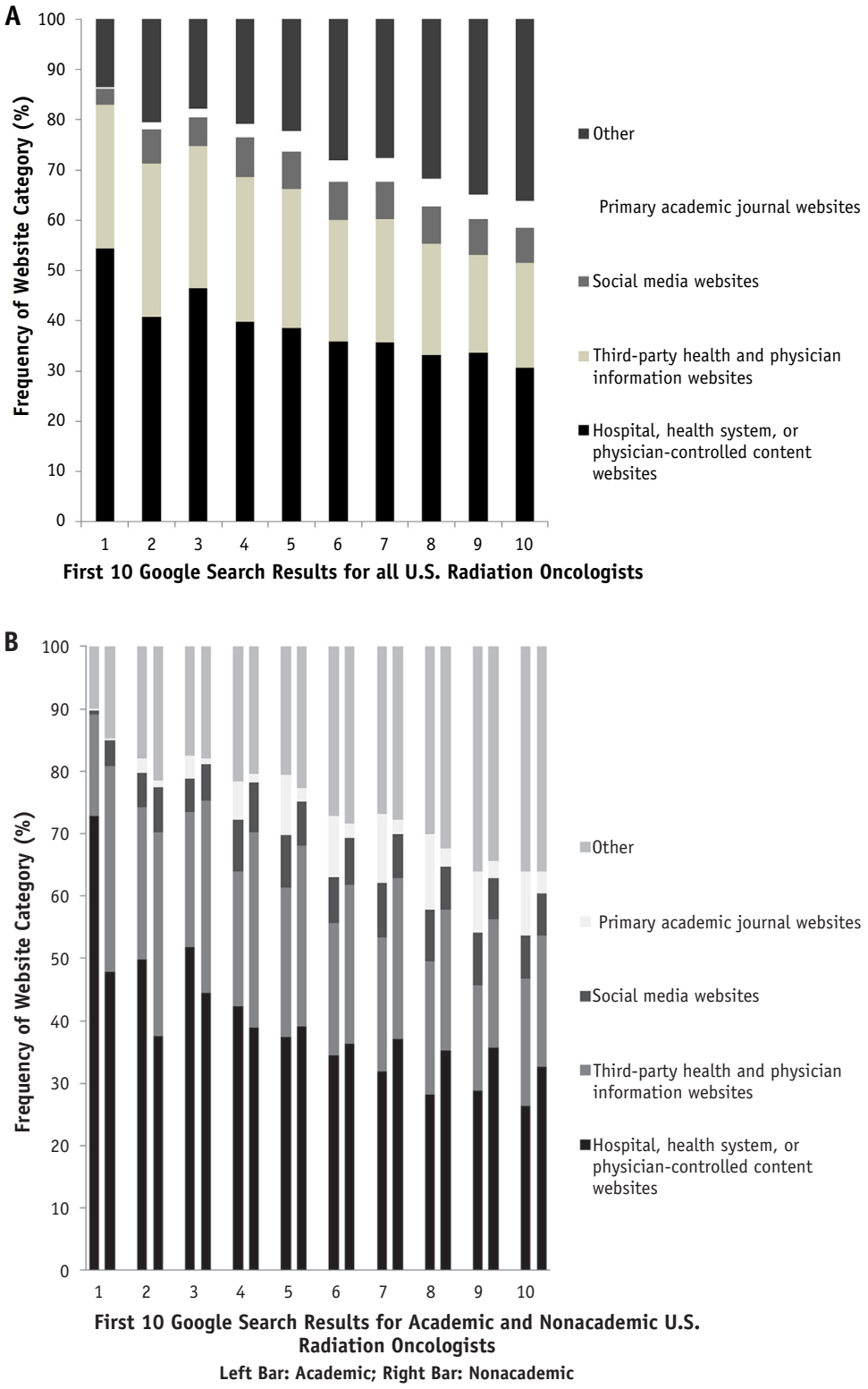

Fig. 2. (A) Website types categorized by position within top 10 Google search results for U.S. radiation oncologists. (B) Website types categorized by position within top 10 Google search results for academic and nonacademic U.S. radiation oncologists.

Figure 3 depicts the frequency of website types in the top 10 search results for U.S. radiation oncologists when categorized according to medical school graduation year. For radiation oncologists who graduated in or before 1964, other websites were the most frequently encountered search result, followed by physician- or institution-controlled websites and third-party websites. For radiation oncologists who graduated after 1964, physician- or institution-

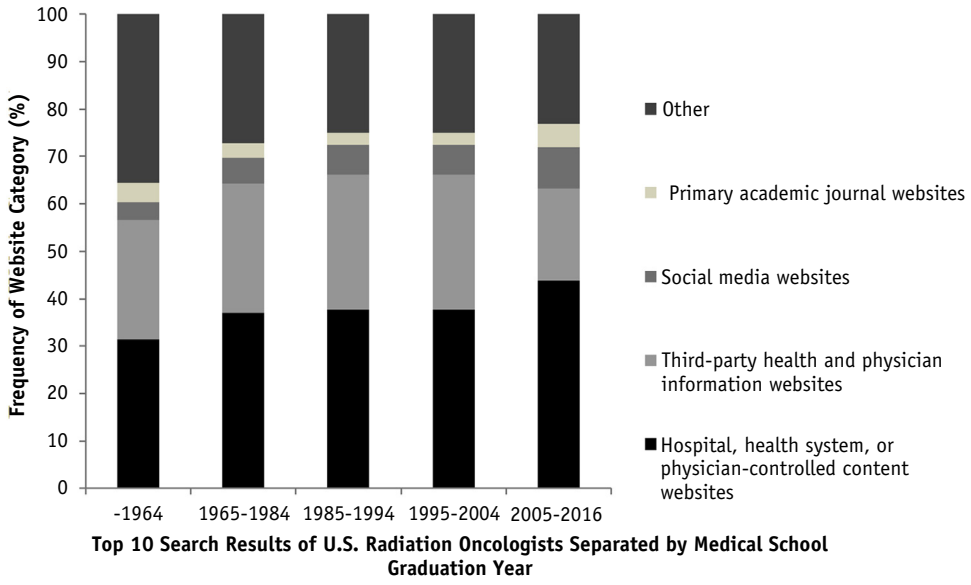

Fig. 3. Frequency of website types in top 10 search results of U.S. radiation oncologists separated by medical school graduation year.

controlled websites formed the majority of top 10 search results; this was followed by third-party and other websites for graduates between 1965 and 2004 and by other and third-party websites for graduates between 2005 and 2016. Not surprisingly, as the graduation year increased, a steady increase in the proportion of social media websites amongst the top 10 search results was seen; social media websites made up 3.8% of search results for graduates before 1964 and 8.6% of search results for graduates after 2004.

Discussion

This study evaluated the online presence of U.S. radiation oncologists through a customized Google search tool and analysis of a federal dataset representing over 90% of all U.S. physicians. We found that most radiation oncologists generally lacked self-controlled digital footprints with their first page of Google searches predominated by third-party and other websites (combined 50.6% in total radiation oncologists, 47.9% in academics, 53.8% in nonacademics), with hospital-, health system-, or physician-controlled websites making up 39.3% of all webpages. Radiologists have also been observed to lack self-controlled online content within the first page of Google search results (8), whereas academic urologists have been shown to assert control of this content (15). Our study's findings are of particular interest and significance in the current digital era, where patients are increasingly likely to turn to the Internet to search for health information and inquire about health care providers (16). To our knowledge, this is the first study assessing the digital identities of U.S. radiation oncologists in the scientific literature.

Publicly accessible third-party physician information websites were the top 3 most common domains as seen in Table 3, with the top 3 domains—healthgrades.com, health.usnews.com, and vitals.com—consisting of a combined total of 9435 search hits. Healthgrades.com in particular was seen in the search results of 63.4% of all radiation oncologists. Over the past decade, there has been a burgeoning number of websites like webmd.com where volunteered patient reviews drive physician ratings (17-19). These commercial sites are often marketed aggressively and appear on the top of web searches (20). Patients can be influenced by these websites with possible low numbers of patient ratings and may not be exposed to many potentially valuable quality metrics provided through hospital data (21).

Given these findings, it is particularly crucial for radiation oncologists to consider the impact of third-party physician rating websites in their clinical environments and practices. Previous research has found that physicians reported higher levels of agreement about the accuracy of health system patient experience surveys, such as Press-Ganey studies used internally by hospitals. But this is contradictory to patients reporting higher levels of trust with independent third-party websites (22). Patients' trust in these third-party websites may occur despite a low number, especially for a subspecialized field like radiation oncology, which may lead to biased reviews. One study showed that 65.4% of patient survey participants consulted a particular physician because of ratings shown on physician rating websites, and 52.2% of those participants did not choose to visit a particular physician based on the ratings shown on rating websites (23).

Radiation oncologists may derive much benefit from maintaining positive online identities and reviews. It is evident that radiation oncology is a specialty dependent on referrals; thus, radiation oncologists should recognize the implications of having a positive rating on these third-party websites, given the high levels of patient trust with such reviews. Although these reviews are still low in number, as

evidenced by a 2010 study that searched 300 physicians across 33 physician rating websites and found only 66 written reviews regarding such physicians (24), it may be important for physicians and hospital administrators to take initiatives to increase the number of patient reviews. In addition, it is likely that patients will increasingly use these rating websites; previous studies have noted that health care systems around the world are beginning to emphasize patient self-care, and patients will increasingly turn to digital resources to seek health information and online physician reviews before an office visit (1-3, 25, 26). If radiation oncologists were to maintain a controllable digital presence to not only increase their visibility but to also curate and present validated health information for patients' use, they may be able to strengthen patients' trust in them and foster deeper patient−physician relationships.

Social media can serve as a platform for increasing physicians' visibility and image and allow providers to interact directly with patients (27, 28). In addition, social media allow physicians to directly control their biographies, which may otherwise not be fully controllable through official hospital or health care system websites. In this study, the low overall social media presence was striking; a mere 770 (6.8%) websites of 11,374 total search results and 1959 (6.7%) websites of 29,392 total search results were identified as social media websites in searches for academic and nonacademic radiation oncologists, respectively (Fig. 2B). Even more striking was the finding that of 1159 total search results in the first search position for academic radiation oncologists, only 7 websites (0.6%) were social media websites. However, it was expected that nonacademic radiation oncologists would maintain a low social media presence, inasmuch as similar findings have been reported in the fields of urology (15) and radiology (8). When adjusting for allopathic or osteopathic medical school graduation date, we found an expected steady increase in the proportion of social media websites within the top 10 search results as graduation years became more recent. In particular, social media websites made up only 3.8% of top 10 search results for graduates before 1964 as compared with 8.6% of top 10 search results for graduates after 2004 (Fig. 3).

Radiation oncologists may be wary of maintaining personal social media profiles because of concerns about blurring boundaries, privacy concerns, or increased risk of malpractice. Academic radiation oncologists may also find administrative difficulties when trying to modify their biographies on official hospital websites. However, social media are useful for physicians in controlling what patients can learn about them. Literature has suggested that social media may allow physicians to establish themselves as worthy sources for medical information while also serving as a communications portal for patients and physicians to communicate and share health information (29, 30). It has been suggested that social media platforms may play a role in improving patient education, collaboration, recruitment, and professional images for physicians, which ultimately could lead to an improved delivery of patient-centered care (31). As such, we urge radiation oncologists to strongly consider the benefits of maintaining an online social media presence.

Maintaining controllable social media platforms may also serve to benefit the field of radiation oncology as a whole. As a particular example, 1 study has described patient perspective of radiation oncology as a "mere deliverer of radiation therapy" and suggested that radiation oncologists strive to improve the notion that they are medical professionals actively involved in a health care team throughout a patient's treatment process (32). Improving their online identities through social media platforms may be a viable option for radiation oncologists to paint a more complete picture of the field.

Strategies to improve online presence

This study has presented a baseline of the current digital footprints of radiation oncologists, and radiation oncologists can take various steps to improve their online presence. First, they can go to physician rating sites (vitals.com, healthgrades.com, yelp.com, rateMDs.com) and edit their contact information for accuracy. Second, they can create a profile on a professional social networking site that reflects their curriculum vitae, such as Linkedin.com or Doximity .com. Both of these websites are often very visible on the first page of Google and were the fourth and fifth most common domains in this study (Table 3). Radiation oncologists can also create their own personal webpages or blogs to emphasize their personal and clinical research interests; by developing and sharing patient education materials, they may build more meaningful relationships with patients (33-35). Private practice radiation oncologists and group practices can use "Google My Business" at https://www.google.com/business, which allows users to feed and manage practice information on Google Search and Google Maps for free. It will also give practices prominent right column visibility on Google. Bibault and colleagues (36) have expanded on other tips to expand oncologists' social media presence. The overarching goal is to have better control over search engine rankings, giving each radiation oncologist a larger online presence. Physicians should exercise caution and vigilance when developing their online profiles, and they should refrain from using their professional social media accounts for nonclinical purposes. Physicians can consult policy guidelines from the American College of Physicians and the Federation of State Medical Boards (37).

Limitations

Our study has important limitations. As noted in other studies using administrative claims data, the study population was limited by physicians' specialty self-designation in CMS (8, 38, 39). The search string used did not include radiation oncologists' middle names and used search terms "[degree] + radiation + oncologist + [city] + [state],"

which may not reflect the information-seeking behavior of patients. We may have retrieved websites unrelated to physicians who have very common names. Physicians affiliated with an academic organization may not be academic in the scope of their day-to-day practice if they work at community-based sites. To obtain and access search results in a programmatic manner, this study used the Custom Search Engine (CSE) offered by Google; CSE is the only method available to legally and efficiently obtain results at scale through the Google search engine. However, several technical limitations prevent CSE from perfectly replicating a manual Google search. As such, the list and order of search results obtained and examined in this study may not perfectly replicate that obtained by an individual consumer or patient.

Google is known to constantly modify the order and the contents of search results based on various individual searches to return the "best" search results and increase user engagement, called "Individual User Targeting." Through this process, Google algorithmically modifies an individual's Google search query and returns search results that are reflective of that person's search history and patterns. As such, the search results that are used and analyzed in this study may not be fully reflective of individual users' search results returned when searching for U.S. radiation oncologists. Similarly, CSE does not modify search results according to location; therefore, practice locations were incorporated into the search term for the purposes of this study. It is known that the Google search algorithm incorporates the location of an individual user when returning search results; thus, the search results of this study may have been weighted differently than a typical search run by an individual.

Also of note is that error handling during a CSE search is known to be inferior to that of a manual search. Unlike a manual search, CSE searches do not suggest alternative, similar search terms to address spelling errors; therefore, fewer search results were returned for physicians with misspelled names on the CMS database. The websites tracked in this study were affected by search engine optimization algorithms, which can increase traffic to third party or social media sites and affect patients' perceptions of a physician's practice (40). In addition, although Google does not publicly publish the algorithms used in CSE searches, this underlying search algorithm may differ from the algorithm that would handle a manual, personalized Google search. It appears that CSE searches return a mixed set of search results that would otherwise be separately categorized during a manual Google search. For example, the top search results for separate search categories (news, video, Google Scholar) for a given search term may be returned as a combined, overall top 10 results through a CSE search, whereas these results would be classified separately according to the particular search category used by an individual.

This study evaluated the online presence of radiation oncologists through analysis of the top Google search results for all radiation oncologists included in the study population. As a result, a large number of website results were returned during the search (n = 40,764). Due to the sheer volume of returned results, it was infeasible to conduct a qualitative analysis of each and every website. However, we believe that this study is an encompassing investigation of the digital identities of U.S. radiation oncologists.

Another limitation that warrants mention is that large medical organizations have the resources to manipulate online visibility. There are opportunities for organizations and businesses to position their search results at the top of search results through paid links; as such, smaller private practices and individual physicians may find it financially challenging to exert full control of their online visibilities.

Future directions

Future studies could evaluate differences in online presences of primary care specialties and more subspecialized specialties, or between clinical specialties and ancillary specialties, such as pathology and radiology. Because of the inherent differences in patient populations, dependencies on referral for such fields, and patient contact, we speculate that there are significant differences among distributions of website categories among these different groups. Given the high number of third-party websites seen in this study, hospital administrators may also find it useful to more aggressively increase the digital presence of Press-Ganey surveys that detail patient satisfaction with regard to providers. There also may be differences in the online presence of radiation oncologists among different countries, and future studies could readily compare and contrast their findings with the American cohort presented in this study.

In conclusion, our study demonstrated that most radiation oncologists lack self-controlled online content within the first page of Google search results. Given the increasing tendencies for patients to turn to the Internet to seek health information and search for physicians before appointments, and the high prevalence of third-party websites among search results, radiation oncologists would benefit from increasing their online presence. Strategies to improve online visibility were discussed, and future research is warranted on improving the online presence of U.S. radiation oncologists.

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