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Original article

Search Engine Ranking, Quality, and Content of Web Pages That Are Critical Versus Noncritical of Human Papillomavirus Vaccine

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A B S T R A C T

Purpose: Online information can influence attitudes toward vaccination. The aim of the present study was to provide a systematic evaluation of the search engine ranking, quality, and content of Web pages that are critical versus noncritical of human papillomavirus (HPV) vaccination.
Methods: We identified HPV vaccine–related Web pages with the Google search engine by entering 20 terms. We then assessed each Web page for critical versus noncritical bias and for the following quality indicators: authorship disclosure, source disclosure, attribution of at least one reference, currency, exclusion of testimonial accounts, and readability level less than ninth grade. We also determined Web page comprehensiveness in terms of mention of 14 HPV vaccine–relevant topics.
Results: Twenty searches yielded 116 unique Web pages. HPV vaccine–critical Web pages comprised roughly a third of the top, top 5– and top 10–ranking Web pages. The prevalence of HPV vaccine–critical Web pages was higher for queries that included term modifiers in addition to root terms. Compared with noncritical Web pages, Web pages critical of HPV vaccine overall had a lower quality score than those with a noncritical bias ($p < .01$) and covered fewer important HPV-related topics ($p < .001$). Critical Web pages required viewers to have higher reading skills, were less likely to include an author byline, and were more likely to include testimonial accounts. They also were more likely to raise unsubstantiated concerns about vaccination.
Conclusions: Web pages critical of HPV vaccine may be frequently returned and highly ranked by search engine queries despite being of lower quality and less comprehensive than noncritical Web pages.

IMPLICATIONS AND CONTRIBUTION

Studies support the influence of exposure to online content on personal vaccination attitudes. This study finds that Web pages critical of human papillomavirus vaccine may be frequently returned and highly ranked by search engine queries despite being of lower quality and less comprehensive than noncritical Web pages.

Human papillomavirus (HPV) infection is the leading cause of cervical cancer which causes more deaths than any other cancer among American women [1]. In addition, HPV infection is implicated in other anogenital and oropharyngeal cancers and genitals warts in males and females [1]. Despite overwhelming evidence supporting the safety and efficacy of HPV vaccine (HPV2

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[Cervarix, GlaxoSmithKline, London], HPV4/HPV9 [Gardasil, Merck, Whitehouse Station, NJ]), [1] overall coverage rates in the United States with the three recommended doses of HPV vaccine remain low—37.6% for girls and 13.9% for boys [2].

In recent systematic reviews, lower likelihood of HPV vaccine uptake was associated with lower vaccine-related knowledge and less positive vaccine attitudes [3,4]. A growing body of research points to an association between exposure to online information critical of vaccination and personal antivaccine beliefs [5–7]. This relationship is noteworthy because many Americans report consulting the Internet for HPV vaccine information [8,9]. In a 2010 study of eight vaccine-critical Web sites, all expressed concerns about vaccine safety and linked vaccination to severe, long-term side effects or death [10]. There have been three recent studies of HPV vaccine information online; all of which found content to be suboptimal [11–13]. Tozzi et al [13] compared Italian and English language HPV vaccine–related Web pages and found English Web pages to be of higher quality. This study identified Web pages using only neutral-toned search engine queries and did not evaluate Web pages for their bias (i.e., whether they were critical of HPV vaccine or not). Two studies that did assess Web page bias found that a minority (7.9% [11] and 14.4% [12]) were critical of HPV vaccine, but both of these also conducted only neutral-toned queries, thereby potentially overlooking vaccine-critical pages. Evidence from Google Trends [14], which identifies the most commonly searched related terms as a percentage of all searches, suggests that critical toned queries may be common; for instance, one of the most popular search terms related to "HPV vaccine" is "HPV side effects" [15]. To gain further appreciation of the Internet's potential influence on attitudes, especially among parents who are uncertain about HPV vaccine, it would be helpful to know how often vaccine-critical Web pages appear among the top results in HPV vaccine–related search engine queries and how Web pages that are critical of HPV vaccine differ from those that are not. The aim of the present study was to provide a systematic evaluation of the search engine ranking, quality, and content of Web pages that are critical versus noncritical of HPV vaccination.

Methods

This study did not use human subjects and was exempt from institutional board review.

Search engine queries

Because eight in 10 Americans begin health-related Internet inquires using a search engine [16] and because there is a high degree of overlap in results returned by the most commonly used search engines [17], we chose to identify Web pages for study inclusion with a set of queries entered into a single search engine. We identified Web pages using Google on the basis of this particular search engine's popularity (preferred by 83% of users [18] and used in 41% of all searches [19]).

Previous studies of online HPV content have used six to seven neutral-toned search terms for search engine queries [11–13]. We began with a set of similar neutral-toned root terms: *HPV vaccine*, *cervical cancer vaccine*, *Human papillomavirus vaccine*, *Gardasil*, and *Cervarix*. To identify additional Web pages that could be more commonly encountered by users with concerns about HPV vaccine, we also sought term modifiers that could convey vaccination hesitancy. For potential modifiers, we performed an ad hoc canvassing of three online parenting forums for user suggestions and searched Google Trends for popular relevant terms [15]. We selected the following modifiers: *risks* (e.g., *HPV vaccine risks*), *pros and cons*, *dangers*, *safety*, and *side effects*. In total, we conducted 20 search queries (Table 1).

Table 1
Terms entered into search engine to identify HPV vaccine–related Web pages

Search term
HPV vaccine
HPV vaccine dangers
HPV vaccine pros and cons
HPV vaccine risks
HPV vaccine safety
HPV vaccine side effects
Cervarix
Cervarix dangers
Cervarix pros and cons
Cervarix risks
Cervarix safety
Cervarix side effects
Gardasil
Gardasil dangers
Gardasil pros and cons
Gardasil risks
Gardasil safety
Gardasil side effects
Cervical cancer vaccine
Human papillomavirus vaccine

HPV = human papillomavirus.

To ensure prior Internet browsing history did not influence search results, all Web browser windows were closed, and a new Google Chrome incognito window opened for each new query. All queries were conducted, and the content of returned Web pages saved on August 8 and 9, 2013.

Web page inclusion and ranking

A recent survey found that 97% of participants only view the first 10 Web pages returned by search engines, and very few view Web pages listed after the first page [20]. Therefore, for each of the 20 queries, we included only the first 10 Web pages returned or Web pages listed on the first page—whichever was fewer. Sponsored Web pages, pharmaceutical manufacturer Web pages, paid advertisements, news feed articles, and non-English language Web pages were excluded, as were Web pages only accessible via sponsored links, restricted access, video-only, or suspicious according to antivirus software.

Because Web pages closer to the top of search results are more likely to be viewed than those further down [18], we recorded Web page rank (the order in which a page was returned by a search). If a Web page was returned by more than one search, all rankings were recorded.

Web page data extraction

Double-data extraction of all Web page information was independently performed by two members of the research team. Advertisements, sidebar content, and open comments sections that appeared on Web pages were excluded from extraction. Data were entered into a Research Electronic Data Capture (REDCap) form created for this project [21]. In instances of discrepancies between the two independent extractors, a third-blinded extraction was conducted to arrive at a majority decision. Overall, inter-rater