Brief report

Greater freedom of speech on Web 2.0 correlates with dominance of views linking vaccines to autism

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ABSTRACT

Introduction: It is suspected that Web 2.0 web sites, with a lot of user-generated content, often support viewpoints that link autism to vaccines.
Methods: We assessed the prevalence of the views supporting a link between vaccines and autism online by comparing YouTube, Google and Wikipedia with PubMed. Freedom of speech is highest on YouTube and progressively decreases for the others.
Results: Support for a link between vaccines and autism is most prominent on YouTube, followed by Google search results. It is far lower on Wikipedia and PubMed. Anti-vaccine activists use scientific arguments, certified physicians and official-sounding titles to gain credibility, while also leaning on celebrity endorsement and personalized stories.
Conclusions: Online communities with greater freedom of speech lead to a dominance of anti-vaccine voices. Moderation of content by editors can offer balance between free expression and factual accuracy. Health communicators and medical institutions need to step up their activity on the Internet.

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1. Introduction

Autism is a neurodevelopmental disorder characterized by impaired social interaction, communication, and repetitive or stereotyped behaviors [1] that appears to be increasing in prevalence [2,3]. Increasing public awareness has coincided with concern about autism being triggered by childhood vaccinations, particularly the MMR vaccine against Measles, Mumps and Rubella [4]. This was initiated by the publication of a study, which has since been retracted, in the journal The Lancet [5]. This has led to a decline in childhood vaccination rates and the resurgence of vaccine-preventable diseases [6].

The vaccine-autism controversy has been significantly enabled by the rise of the Internet. Fear of vaccine-induced illnesses, especially autism from the MMR vaccine, is the foremost concern expressed on anti-vaccine websites [7]. Anti-vaccine voices seem

louder on Web 2.0 [8], but this has never been quantified. Web 2.0 refers to websites that feature a lot of user-generated content, even from non-credentialed sources [9]. Regarding the potential of Web 2.0 to improve health communication, one author stated that "the promise of open access in Web 2.0—freed of publishing barriers and multinational interests—is especially compelling", and noted the "opposing tensions of openness exemplified by Web 2.0 and the monolithic lack of openness in old forms of media" [9].

Although this increased openness is often beneficial to the purpose of health communication, we believe this has also diluted the voice of science in the public arena. In recent years, increasing attention has been devoted to the question of how to maintain a balance between facts and free speech on the Internet [10]. Therefore, we decided to obtain data on how the distribution of viewpoints on vaccines vis-à-vis autism varied on different Internet platforms. Primarily, we were interested in how viewpoints varied with the degree of "freedom of speech" offered. Secondarily, we assessed what techniques were employed to convince the public against the academic consensus. We compared viewpoints on YouTube, Google and Wikipedia, which are sources for the general public allowing significant user participation, with PubMed, which is primarily a resource for scientists and physicians.

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2. Materials and methods

2.1. Definitions of terms

We defined freedom of speech as being composed of two parameters:

(a) The ability of lay persons to add material to the website.
(b) The likelihood that this addition would be allowed to stay on the site, and be seen by future users.

The ability of lay persons to add material is constrained to various extents by individual websites. By "material", we refer to videos on YouTube, websites on Google search, edits and references on Wikipedia, and articles on PubMed. We did not include comments on YouTube videos or Google sites as part of our metric to define freedom of speech.

On YouTube, anyone can upload videos [11]. Similarly, any user of the Internet can make a website that gets indexed by Google's search algorithm. Wikipedia too allows lay users to make edits to most articles [12]. PubMed, however, allows only indexed scientific publications to be present in its search results [13].

When it comes to the likelihood that material added by lay persons would stay on the site to be seen by future users, the mechanisms employed by the site to index and display its contents are of crucial importance. The default setting on YouTube is to search by "relevance" which assesses the number of views, average view time, descriptions of the video, the title, and so on, but does not privilege institutional or scientific authority. This allows any user's addition to rise to the top of the search results, as long as a lot of people engage with it [14]. Google's search algorithm, on the other hand, promotes pages that have been linked to by several other pages, in the belief that these highly linked pages are likely to be important [15,16]. Institutional and mass media websites are often the beneficiaries of this bias toward highly interlinked pages. New additions and fringe viewpoints, although present, are often lower in the list of search results. Wikipedia has a requirement that those who make changes to articles provide references in support of their viewpoints [12]. It has editors who remove additions to articles that are not backed up by what the community determines to be reliable sources.

Therefore, for our purposes, freedom of speech varies in the following order – YouTube > Google > Wikipedia > PubMed.

2.2. Rationale for choice of targets

Although previous studies on vaccine information have assessed the material on anti-vaccine blogs and websites [7,17–19], there have not been any such studies specifically on the vaccine-autism topic. It is likely someone who is concerned about vaccination leading to autism would search for the terms "vaccines" and "autism" together, instead of something more generic like "vaccine". Indeed, one study in 2007 found that most videos on YouTube on the subject of "Vaccination" were pro-vaccine [17]. Also, YouTube, Google and Wikipedia, each of which receive more than 75 million unique visitors a month, play a large role in shaping public opinion, especially on science-related issues [20]. The differences in how content is generated on each of these websites made them good targets for our study.

2.3. Search protocols

2.3.1. YouTube

We searched YouTube between November 20 and 27, 2013, for the term "vaccines autism". We assessed the top 175 videos in the order returned by the search query using default search settings. We divided them into pro-vaccine (proclaiming vaccine safety, in keeping with current clinical guidelines) and anti-vaccine (arguing for a link between vaccines and autism, against the academic consensus). Other criteria we assessed were length, age in days, number of likes and dislikes, number of comments, presence of links to scientific articles, MD or DO speakers, celebrities and personalized stories, and whether the title was suggestive of a conspiracy to suppress such views.

2.3.2. Wikipedia

We searched Wikipedia on December 13, 2013, for the term "vaccines autism". Four relevant articles were found – "MMR vaccine controversy", "Vaccine controversies" (the subsection dealing with autism), "MMR vaccine" (the subsection dealing with autism) and "Controversies in autism" (the subsection dealing with vaccines). References on these Wikipedia articles were tallied as pro or anti-vaccine.

2.3.3. Google and PubMed

We assessed the top 100 results that resulted from a Google search for "vaccines autism" on February 20, 2014, and coded them as pro- or anti-vaccine based on their stance on whether vaccines caused autism. We also assessed whether these websites were part of "mainstream media" or not, which we defined as websites run by well-recognized TV channels, newspapers and magazines. On PubMed, we analyzed the top 100 abstracts returned by a search for "vaccines autism" on January 20, 2014. Articles which did not have the abstract or full text available online were excluded if the title was not indicative of their leanings.

2.3.4. Analysis

Analysis was performed using SPSS Version 21 (IBM) and Graphpad QuickCalcs (http://www.graphpad.com/quickcalcs/index.cfm). We compared the proportion of pro- and anti-vaccine views across the platforms using a Chi-square test. Descriptive statistics were performed on contents of the YouTube videos. Quantitative parameters with non-normal distributions were compared by Mann–Whitney U test, with median and interquartile range calculated. Fisher's exact test was used to compare proportions (since some cells had $n < 5$). Calculations were performed on data gathered by one author (AV). Cohen's kappa statistic for inter-observer reliability was calculated by comparing data gathered by author AV with data gathered by author NK. Kappa interpretation was performed per criteria laid out by Landis and Koch [21]. Kappa was calculated only for those questions where it was thought that decisions were subjective, in whole or in part.

3. Results

3.1. Distribution of pro- and anti-vaccine stances

On YouTube, of the top 175 videos, 39 (22.3%) were pro-vaccine, 130 (74.3%) were anti-vaccine, and 6 (3%) were ambivalent or neutral (Cohen's kappa = 0.804, 95% CI 0.702–0.906, $p < 0.0005$). Among the top 100 web results on Google search, 59 (59%) were pro-vaccine, 41 (41%) were anti-vaccine (Cohen's kappa = 0.817, 95% CI 0.703–0.931, $p < 0.0005$). On Wikipedia, 24 out of 150 references in "MMR vaccine controversy", 4 out of 42 in "Vaccine controversies", 1 out of 12 in "MMR vaccine", and 4 out of 25 in "Controversies in autism" were critical of vaccines. The overall proportion of anti-vaccine references was therefore 33/229 (14.4%), and the remaining were pro-vaccine (Cohen's kappa = 0.749, 95% CI 0.633–0.865, $p < 0.0005$). 17 of the top 100 results (17%) on PubMed Search for "vaccines autism" supported a link between vaccines and autism, whereas 82 (82%) did not, and one was a neutral overview