

Creditable Health Information? An Analysis of Human Papillomavirus Vaccine Messages on YouTube

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Authors' contributions

This work was carried out in collaboration among all authors. Author ACCC designed the study, trained team members, performed analysis and wrote the manuscript. Author ER co-designed the study and contributed to the writing. Other authors assisted in coding, provided valuable inputs and contributed to writing. All authors read and approved the final manuscript.

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ABSTRACT

Aims: Human papillomavirus (HPV) infection is the most common sexually transmitted infection globally. Vaccination is effective in preventing HPV-associated cancers and is recommended for children at ages 11-12; however, the vaccination rate is suboptimal. Credible information about HPV vaccine in social media will help the public make effective healthcare decisions. This study analyzed YouTube videos about HPV vaccine.

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Study Design: Descriptive study.

Place and Duration of Study: Videos in English posted on YouTube during 2006-2020.

Methodology: We used purposive sampling to select and conduct a quantitative content analysis of 151 YouTube videos that met the criteria. An instrument including video characteristics and theoretical constructs of the Health Belief Model was used to code the videos. Three researchers independently coded the data; another three verified the accuracy. The team discussed discrepancies until reaching a consensus. We conducted descriptive and inferential statistics.

Results: The major source of videos were medical centers/hospitals (26%), government (22%), media (20%), and consumers (15%). About 80% of the videos were positive in tone. Information covered included vaccine knowledge (85.4%), benefits (81.5%), severity if infected (79.5%), susceptibility (60.9%), and barriers (37.7%). The primary vaccination barriers were lack of knowledge of HPV and vaccine (12.6%), worries about adverse events/safety of vaccine (14.6%) and its side effects (9.3%). Videos in neutral tone had the highest number of views, likes and dislikes. Negative tone was mostly found in videos made by consumers and media while positive tone was found in videos made by governmental agencies and medical center/hospital.

Conclusion: Despite YouTube being a popular avenue to disseminate health information and influence care, the HPV-related information on YouTube is mixed. Anecdotal health information without scientific support can mislead individuals' decision in vaccination. Educational videos with comprehensive and accurate HPV information addressing barriers are imperative to promote vaccination and prevent HPV-related cancers.

Keywords: Cancer prevention; HPV; vaccination; videos; YouTube.

1. INTRODUCTION

Human papillomavirus (HPV) infection is the most common sexually transmitted infection in the U.S. and globally [1,2]. It is a significant public health issue as about 80 million Americans are infected with HPV, and this number is projected to increase by 14 million new cases each year [1].

HPV is a small DNA virus and more than 200 different types of HPV have been identified currently. HPV infects epithelial tissue in both males and females; the low-risk types (e.g., type 6 or 11) are found to be associated with benign or low-grade cervical cell abnormalities, respiratory track papillomas, and genital warts while high-risk types (e.g., types 16, 18) are directly linked to cancers [3]. For females, HPV has been found in almost all cases of cervical cancer and some cancers of the vulva, vagina, anus and oropharynx. For males, HPV causes genital warts and head/neck, penile, anal, and oropharynx cancer [1,4]. Healthcare costs related to HPV prevention and treatment are substantial, estimated at about \$8.0 billion (2010 U.S. dollars) annually [5]. The high morbidity, mortality, and economic burden attributed to cancer-causing HPV calls for researchers and practitioners to address this public health concern through vigorous prevention efforts, including HPV vaccination among children at age 11 or 12 [1].

To promote early protection against HPV-related infections and cancers, Healthy People 2030 set a goal of 80% HPV vaccination completion rate for children by age 15 [6]. Before the COVID-19 pandemic, HPV vaccination rates for youth 13-17 years were substantially below the goal of 80% -- 53.7 % for females and 48.7% for males [7]. The vaccination rates among young adults aged 18-26 are even lower (35.3% in women, 9% in men) [8]. Since the suboptimal HPV vaccination rates have worsened during the COVID-19 pandemic [9], it is critical to bring HPV vaccination back on track for cancer prevention.

Social media is an important source of health information. Social media outlets, such as YouTube, have been used as a popular platform to disseminate health information and a potential avenue for healthcare providers to influence care [10-12]. As of September 1, 2021, there are 31.9 million YouTube subscribers and 2,475,566,340 views in the U.S [13]. Given the wide accessibility and nature of this online community, YouTube videos have a high potential to reach a large population rapidly.

The mixture of science-based evidence and hearsay in YouTube, however, may cause confusion for its viewers. Keelan and colleagues analyzed 153 HPV-related videos in YouTube and found that negative videos had more views and higher ratings [14]. Similarly, Ache and Wallace found 25.3% of these videos portrayed

HPV vaccine negatively, and negative videos were more likely to have more views [15]. Briones et al. conducted a similar analysis of 172 YouTube videos focusing on the HPV vaccine [16]. They reported that the majority of these videos were from non-healthcare providers and negative in tone. Ekram and colleagues analyzed 35 YouTube videos collected in 2014 and suggested that most videos were negative in tone toward the vaccine, and anti-vaccine videos were more likely to report incorrect information and/or omit the correct information [17].

Pervasive and misleading health information online might lead to users' poor vaccination decisions and consequently lower the vaccination rate [18]. YouTube users who have not learned about HPV and its vaccine from reliable sources and those who are hesitant to receive the vaccine could particularly be affected by misinformation. It could also be challenging to combat the misinformation due to confirmation bias in people who were more inclined to ignore information which contradicted their past ideas or beliefs [19]. Thus, the videos with a negative tone could be preferred by individuals who already hold negative attitudes or intentions towards HPV vaccine, and thus they tend to support and further distribute the negative messages.

Exploring potential challenges and gaps in the use of YouTube in vaccine education might shed light upon the optimal utility of the online platform and regulation of its content to improve public health and well-being. Given the safety and effectiveness of HPV vaccine and the popularity of using YouTube videos as an outlet for health information, it is critical to understand how YouTube videos share knowledge towards HPV infections and its vaccine. Despite the above-mentioned research that has provided useful insights about public views on HPV vaccination disseminated on YouTube, limited research has systematically reviewed and evaluated YouTube videos that specially target HPV vaccine to understand how it is currently portrayed [14-17]. Credible information about HPV and the vaccine for consumers, in particular youth and their parents and caregivers, will help them make effective healthcare decisions. Thus, we conducted a quantitative content analysis [20] to systematically evaluate the YouTube videos related to HPV vaccine to understand how this cancer prevention vaccine has been portrayed on YouTube, one of the most popular social media platforms.

2. METHODOLOGY

2.1 Design

We conducted a descriptive study to examine characteristics of YouTube videos related to HPV vaccine (sources, tones, viewers responses), content included in the videos based on constructs of the Health Belief Model [21], and relationships among these aspects of the videos.

2.1.1 Theoretical framework

We used the Health Belief Model (HBM) as a Framework for Coding. HBM has been widely adopted in studies on health behavior change, including vaccination [22]. The key constructs embedded in the framework, including perceived benefits, perceived barriers, perceived susceptibility, perceived severity, self-efficacy and cues to action, can be measured to help to identify the likelihood of individuals engaging in certain health behaviors [21]. In the context of HPV vaccination, influential factors such as people's perceived value of receiving the HPV vaccine and completing the vaccine series, obstacles or barriers to the vaccination, likelihood of contracting HPV virus, impact of HPV-related infections, personal confidence in his or her ability to get vaccinated, as well as additional facilitators of the HPV vaccination are all essential factors to consider that could possibly influence the vaccine acceptance and uptake.

2.2 Procedures

We received approval from the University Institutional Review Board (IRB) as an exempt study. Ethical considerations were implemented throughout the process of analyzing publicly available videos in YouTube.

2.2.1 Search terms

We searched YouTube (www.youtube.com) to locate videos related to the HPV vaccine using the following terms: *HPV*, *HPV vaccine*, *HPV vaccination*, *HPV immunization*, *human papillomavirus vaccine*, *human papillomavirus immunization*, and *Gardasil 9*. Guided by previous research [14-16], we retained the first 50 videos for each search term. We removed duplicated videos and those presented in a language other than English.

2.2.2 Timeframe

We selected videos posted in YouTube during 2006 - 2020 for this systematic evaluation. We chose to start with videos posted in 2006 because the U.S. Food and Drug Administration (FDA) approved the 1st HPV vaccine Gardasil to prevent cancers and diseases caused by four HPV types 6, 11, 16, 18 in 2006 [23].

2.2.3 Coding scheme

The coding scheme included the characteristics of the videos: title, date of posting, length, number of videos posted by the same user, number of subscribers, original vs. repost, number of views, number of likes, number of dislikes, and description excerpt. We coded the videos for the type of source (e.g., consumer, government, medical center/hospital, media) and the tone of the message (i.e., neutral, negative, positive, ambiguous). We also coded the videos based on the HBM as it provides a theoretical framework for the key factors associated with HPV vaccination. These factors included perceived benefits, perceived barriers, perceived susceptibility, perceived severity, and self-efficacy.

2.2.4 Coding

The team received a coding training using sample videos. Three investigators independently conducted the evaluation using a coding schema, including the definition and operationalization of each category. Another three investigators reviewed the coding sheets. The team discussed discrepancies in coding until reaching the consensus.

2.2.5 Analysis

We conducted data analysis using SPSS 27.0 [24] to compute frequencies of the key characteristics of the videos (e.g., number of views, likes, and dislikes, source, tone, and presence or absence of information related to HBM constructs). Chi-square analysis was conducted to examine the relationships between source and content, tone and content, and tone and source. We also conducted ANOVA tests to examine the relationship between the number of views, likes, dislikes and source, and the relationship between the number of views, likes, dislikes, and tone.

3. RESULTS

3.1 Sources

Results from the systematic review show that 151 videos were posted by the following sources: (a) medical centers/hospitals: 26.0%; (b) government sources (e.g., CDC): 22.0%; (c) media (e.g., TV, CBS, FOX news, Podcast): 20.0%; (d) consumers/personal stories: 14.7%; (e) professional/advocacy organizations (e.g., National Cervical Cancer Coalition, research institutes): 10.0%; (f) pharmaceutical/for profit companies: 4.0%; and (g) others (e.g., provider's private blog/channel: 3.3%.

3.2 Tone

We categorized "tone" expressed in the videos as positive (approving of HPV vaccines), negative (disapproving of HPV vaccines), neutral (neither approve nor disapprove vaccination), and ambivalent (mentioning both positive and negative sides but did not make a recommendation). In our analysis, 80% were positive in tone, 10% were negative in tone, 8% were neutral, and 2% were ambivalent (Fig. 1). Compared to prior research [14-17], we had found higher proportion of positive tone in these videos.

3.3 Views

Among all videos, we found that those with neutral tone had the highest number of views (Mean = 937505), followed by positive tone (Mean = 103149), negative tone (Mean = 41590) and ambivalent tone (Mean = 23819). Other researchers [14,17] have found videos of negative tones and positive tones were having more views.

3.4 Number of Likes

In our analysis, videos with neutral tone had the highest number of likes (Mean = 3632), followed by negative tone (Mean = 761), ambivalent tone (Mean = 420) and positive tone (Mean = 177). Findings in prior research [14,15] suggested a higher number of likes in videos that had a negative tone.

3.5 Number of Dislikes

Among the 151 videos, those with neutral tone also had the highest number of dislikes (Mean = 428), followed by positive tone (Mean = 42),

negative tone (Mean = 32), and ambivalent tone (Mean = 20). Differently, Ekram et al. [17] suggested that videos with negative tone (i.e. anti-vaccine) had more number of dislikes compared to those with positive tone. Briones et al. [16] did not find significant relationship between tone and number of dislikes.

3.6 Health Beliefs Model Constructs

The Health Beliefs Model constructs were presented in Fig. 2. Most videos covered vaccine knowledge (85.4%), benefits of vaccination (81.5%), susceptibility of getting HPV infection (60.9%), severity if infected (79.5%) and barriers of vaccination (37.7%). The top three barriers to vaccination mentioned in the videos were lack of knowledge of HPV and the vaccine (12.6%), worries about adverse events/safety of vaccine (14.6%), and its side effects (9.3%). Other barriers were associated with concerns of individuals (perceived no/low risks for infection, fear of shots), concerns of parents (vaccination might encourage early sexual activity of children), concerns about providers and authorities (lack of recommendation and communication, inconsistent recommendation), vaccines (not effective or affordable). Similarly, another study [14] used the HBM model in the

analysis of 172 YouTube videos reported the following information covered in the video: benefits of HPV vaccination (70.3%), susceptibility to HPV infection (48.8%), and severity of the infection (53.4%). They also found physical risks/side effects (53.5%) and psychological risks (36%) were reported as vaccination barriers.

3.7 Conspiracy Theories and Arguments

Conspiracy theories and arguments for civil liberties were presented in four videos. Conspiracy theories pertain to ways in which the government and/or pharmaceutical companies try to cover up problems and risks related to the HPV vaccine [17,25]. Arguments regarding civil liberties presented ways in which vaccinations are unethical or illegal to mandate [25].

3.8 Relationships between Key Variables

We conducted ANOVA tests to examine relationships between key variables. Tests were conducted to address the relations between: (a) source and number of views, source and number of likes, and source and number of dislikes, (b) tone and number of views, tone and number of likes, and tone and number of dislikes.

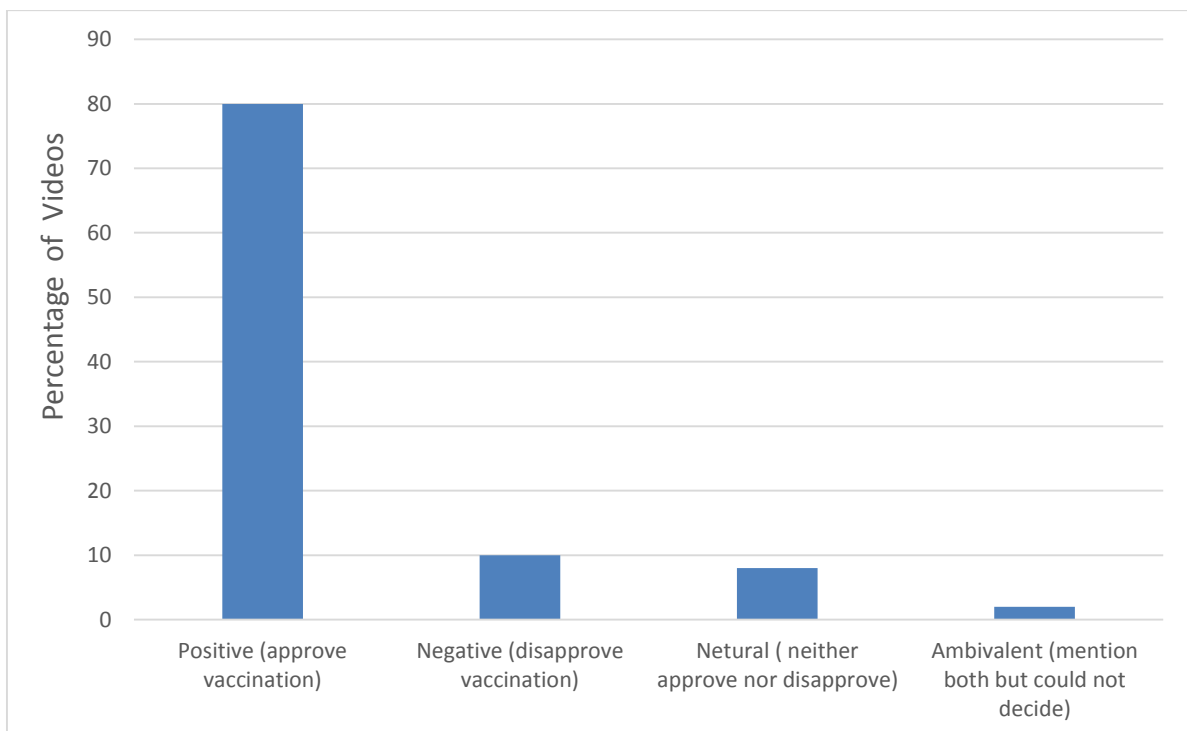


Fig. 1. Tone of videos (N = 151)

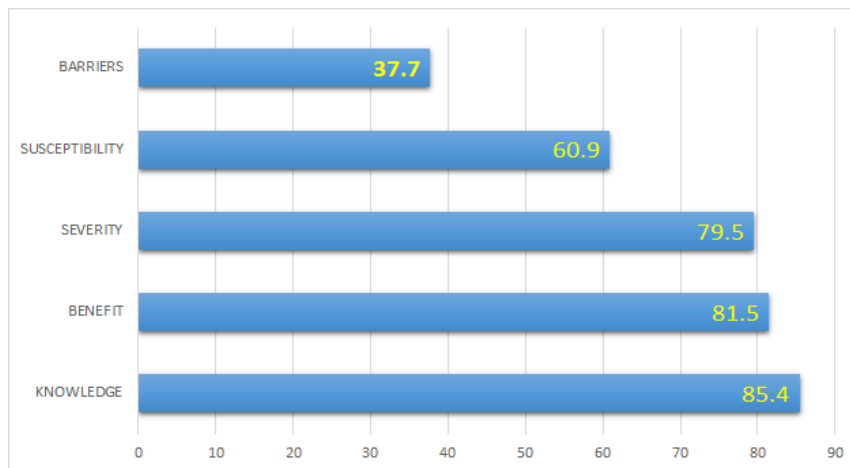


Fig. 2. HBM constructs addressed in HPV YouTube videos

The relationship between source and number of views; source and number of likes; source and number of dislikes. No significant results were found in these relationships.

The relationship between the tone and number of views. The overall F for tone and number of views was significant ($F = 3.21, P = .03$). Multiple comparisons tests revealed that neutral tone videos had a significantly higher number of views than positive tone videos.

The relationship between the tone and number of likes. The overall F for tone and number of likes was also significant ($F = 3.54, P = .02$). Multiple comparisons tests suggested that neutral tone videos had a significantly higher number of likes than positive tone videos.

The relationship between the tone and number of dislikes. The overall F for tone and number of dislikes was also significant ($F = 2.93, P = .04$). Multiple comparisons tests indicated that neutral tone videos had a significantly higher number of dislikes than positive tone videos.

The relationship between the tone and source. The result of Chi-square test was significant, suggesting the tone of the video varies by the source of the video ($\chi^2 = 38.79, P = .000$). Specifically, negative tone was mostly found in videos made by consumers ($n = 7$) and media ($n = 6$) compared to other sources. Positive tone was commonly found in videos made by governmental agencies ($n = 40$), medical center/hospital ($n = 38$), and media ($n = 18$) compared to videos produced by consumers or media.

4. DISCUSSION

We systematically evaluated characteristics (sources, tones, viewers responses, HBM constructs) of 151 YouTube videos related to HPV vaccine posted between 2006 and 2020 and examined the relationships among these aspects of the videos. Our findings show that most videos are positive in tone, different from prior research (e.g., [16,17]). One possible reason of the inconsistent findings between this study and prior research is the longer length of time of videos (between 2006 and 2020) reviewed in our study. The U.S. FDA has approved three HPV vaccines: Gardasil (against HPV types 6, 11, 16, 18), Cervarix (against HPV types 16, 18), and Gardasil 9 (against types 6, 11, 16, 18, 31, 33, 45, 52, 58) in 2006, 2009, and 2014, respectively. Currently, Gardasil 9 which provides the highest protection of HPV-related cancers is the only HPV vaccine distributed in the U.S. [26]. Scientific evidence gathered from long-term and rigorous research confirms the efficacy of HPV vaccines in preventing cancers. Thus, we have found 80% of the videos are positive in tone. Another possible explanation for the positive tone (approving of HPV vaccination) in the videos included in our study could be associated with the sources of videos. Almost half (47%) of the videos on HPV vaccines were produced by medical centers, hospitals, and government agencies that communicate vaccine efficacy and safety. There was only 11% of videos attributed by these sources in Briones et al. [16].

Regarding tone in videos and its popularity, prior research has shown that videos' tonality had no bearing on videos' popularity. For instance, the

number of “likes” and “dislikes” were almost equally ranked for videos that supported the HPV vaccine and were against it [17]. Furthermore, videos with a negative tone (disapproving of HPV vaccines) usually received higher ratings, more views, and more likes [14,16]. Our findings suggest, in contrast, that videos with neutral tone had a significantly higher number of views and likes than those with positive tone. This could represent a tendency in favor of unbiased opinions regarding the vaccine that viewers had questions about. The needs for balanced and detailed vaccine information in supporting informed decision-making among vaccine information explorers and those who are hesitant to take the vaccine were highlighted across studies [27,28]. Videos with honest vaccine messages addressing both benefits and risks are important to inform decision making by the public about vaccination.

Quality of the health messages delivered by the videos on YouTube and viewers’ trust towards the information source are additional considerations when using the videos for public education purpose. Videos from non-creditable sources or those consisting of ambivalent messages may confuse people and make it more difficult for them to make an informed decision about vaccination. Health professionals and government agencies can increase the credibility and trustworthiness of video content, and encouraging contributions by professionals and government agencies in communicating the health messages [11]. Viewers with pre-existing distrust of the government or healthcare systems could misinterpret the content and be proactive in spreading vaccine rumors and further fuel the anti-vaccine sentiment [17]. A lack of trust in the information source was likely to shape negative attitudes toward HPV vaccine regardless of knowledge [29]. Thus, identifying factors that promote vaccine trust and tailoring video content to effectively respond to different concerns the public have about the vaccine may maximize the effect of education and help the public make informative decisions in vaccination.

5. LIMITATIONS

While this study contributes to the understanding of characteristics of HPV vaccine related videos assessable on YouTube, it is not without limitations. First, the inclusion of only English videos limits the generalizability of study findings. Second, although this systematic evaluation included videos posted during 2006-2020, some

videos can still be missed as new videos are constantly being added to YouTube. Third, this study focused on one social media platform, YouTube, which represents a fraction of the content that exists on the internet. Future research including videos with languages other than English and published in other popular social media platforms (e.g., Tiktok, Instagram, Facebook) is warranted to provide more comprehensive information.

6. CONCLUSION

As seen in the current vaccination debate about vaccinations including HPV and COVID-19, social media channels have great influence for good or ill in shaping opinions about health, disease, and health care. The information about HPV and its vaccine shared on the YouTube platform, however, is mixed. It is incumbent on health professionals to provide timely and accurate content to creators of YouTube videos about health affairs, or to provide such videos themselves. Health professionals who are not fluent with creating appealing videos can partner with social media experts and content creators to post videos that will attract viewers and generate likes. Paying attention to tone as well as content is a significant factor, as we demonstrated that viewers want a neutral tone along with accurate information to not feel coerced into a personal decision. Viewers want to make independent decisions and well-crafted videos from health professionals can meet this need. Providing accurate and sensitive information about vaccinations against communicable diseases is too important to be left to those with anti-vaccination bias who use the videos to promote their spread of misinformation.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

This study evaluated publicly available YouTube videos. Consent is not required.

ETHICAL APPROVAL

This research was approved as an exempt study (IRB ID: STUDY00014247). All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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