REVIEW

A systematic literature review to examine the potential for social media to impact HPV vaccine uptake and awareness, knowledge, and attitudes about HPV and HPV vaccination

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ABSTRACT

This article summarizes the findings from a systematic literature review to examine how social media may impact HPV vaccine uptake and HPV and HPV vaccine related awareness, knowledge, and attitudes. Study inclusion criteria was original data collection of at least one data point about social media and HPV and/or HPV vaccination, such that the study provided insight into how social media content may influence HPV and HPV vaccine related knowledge, attitudes, and/or behaviors. A total of 44 relevant articles were identified using the following databases: PubMed, PsycINFO, Communication Source, Sociological Abstracts, Business Source Elite, and the Educational Resources Information Center (ERIC). Most studies analyzed the valence, type, and frequency of social media content about HPV vaccination, and some found associations between potential exposure to negative, anti-vaccine content and lower vaccination rates. Some studies that included primary human subject data collection found that engagement with HPV related social media content was associated with improved awareness and knowledge but not with increased vaccine uptake. The literature overall is lacking in systematic and rigorous research examining the effects of social media on HPV related knowledge, attitudes, and behaviors and needs further examination as social media increasingly becomes a source of health information.

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Introduction

This article provides a comprehensive review of relevant academic literature to determine the implications of what we know thus far about how relevant social media content and use may impact awareness, knowledge, and attitudes about human papillomavirus (HPV), the most common sexually transmitted infection, and the respective vaccines available to help protect against transmission, as well as HPV vaccine uptake. Since 2006, many countries have implemented programs to promote HPV vaccination, but HPV vaccine uptake remains low in comparison to other widely-available childhood and adolescent vaccines.¹ Systematic reviews of studies on the efficacy and herd effects of HPV vaccination offer strong promise for its ability to reduce incidence of HPV infections and cancers, such as anogenital warts and cervical cancer.^{2,3} Social media, defined for the purposes of this manuscript as channels and tools that allow for individuals to interact with each other and share opinions and content in digital and online spaces, is increasingly becoming a source of health information for individuals all over the world.^{4–7} We therefore wanted to understand how the content available on and the use of social media for information about HPV and HPV vaccination may influence HPV vaccine uptake.

Social media democratizes the ability for both lay consumers and qualified health professionals to share their experiences and opinions about health issues with a wide variety of

audiences, whether the information they share is medically accurate or not. All it takes for either party is to sign up for a social media account on any given social media platform, such as Facebook, Twitter, and YouTube, connect with other members on the platform and begin sharing, posting, and commenting on topics for those in their online social networks to receive in their respective news feeds. In many cases, if a user leaves their content publicly accessible, an individual does not need to be officially connected to a user's social media account to view or share their content or add comments. The ability for individuals to spread medically inaccurate, biased information about health issues such as HPV and HPV vaccination on social media is of great concern, as it may hinder the ability for herd immunity against HPV and greater health inequities among certain populations, because some may choose not to get vaccinated based upon misinformation.⁸

According to the World Health Organization, most countries recommend HPV vaccination occur between the ages of 9 and 14, with the primary target group being young adolescent girls, though vaccination for adolescent boys and young adults who have yet to vaccinate is also often recommended. In the United States, for example, the HPV vaccination is recommended routinely for boys and girls at age 11–12. As the HPV vaccine is ideally an adolescent vaccine, relevant stakeholders can therefore include adolescents, their parents

and/or primary caregivers, and relevant healthcare providers. Social media is a place where these stakeholders can receive and share health information from and with others. Healthcare professionals can and do share health information with their patients and the public using social media,^{9,10} and many parents, adolescents, and young adults use social media as a source of health information.^{4,5,11–13} Reliable and valid worldwide statistics of social media use are difficult to find, but the Pew Research Center surveyed adults in many developed countries in 2016 and found that at least half of adults from the majority of these countries were regularly visiting social media sites.¹⁴ Based upon another Pew Research Center survey in 2018, the majority of adolescents in the United States use social media, with YouTube, Instagram, Snapchat, and Facebook reigning as the most popular platforms.¹⁵

The purpose of this literature review was therefore to aggregate, analyze, and summarize all relevant findings reported in scholarly publications that would allow us to provide an assessment of what the research thus far reveals about how social media (both its content and use by consumers) may impact awareness, knowledge, and attitudes about HPV and HPV vaccination and HPV vaccine uptake.

Article selection criteria and methodology

This review included analysis of relevant English language articles published in peer reviewed, scholarly journals before December 31, 2018. We identified and searched six subject-specific electronic databases relevant to our topics of interest: PubMed, PsycINFO, Communication Source, Sociological Abstracts, Business Source Elite, and the Educational Resources Information Center (ERIC). We used a variety of search terms about HPV and social media, including specific popular social media platforms (e.g., Facebook, Twitter, Instagram). See Table 1 for the search terms used.

Social media was defined, for the purposes of this study, based upon the definition given by the Chartered Institute of Public Relations, such that social media is “internet and mobile-based channels and tools that allow users to interact with each other and share opinions and content. As the name implies, social media involves the building of communities or networks and encouraging participation and engagement” (p. 3).¹⁶ While technologies like text message and email allow for users to share content with each other, from a health communication perspective, these communication tools are most often used by health professionals as a one-way communication system, such as sending text reminders to patients about their appointments or other health information.^{17,18} We instead wanted to focus on communication tools and

platforms that primarily allow for interactivity and engagement between users to determine the potential impact of digital and online social interaction on HPV knowledge and vaccination and thus studies exclusively about text messages or email were not included in this review. Websites, blogs, and online news stories were also generally excluded unless they included analysis of interactive features, such as users commenting on or responding to respective and relevant content in public or member comment sections.

We first read the abstracts of each of the peer-reviewed articles that appeared in the respective database searches to determine whether the study might be relevant. If it was determined to have potential for inclusion, the article was annotated by title, publication year, first author name, and abstract into a spreadsheet for further review. Any duplicate articles that appeared in additional database searches were noted but not fully annotated again.

We then reviewed the full text of a sample of each of these articles to assess the study’s relevance by annotating each study’s population, method, key variables and data points of interest, and relevant takeaways about the potential relationship between social media and HPV related knowledge, attitudes, and/or behaviors. After discussing the sample and comparing annotations, two of the authors independently annotated and evaluated the full text of each of the remaining articles based upon the inclusion criteria. The authors then collaboratively discussed and determined which articles would be included in the final review.

For an academic study to be included in this review, the study must have included original data collection with measurement of at least one data point about HPV and/or the HPV vaccine and social media content and/or use (as defined above), such that the results or implications of the study were relevant to the purpose of this review to examine the potential relationship between social media content and use and HPV and HPV vaccine awareness, knowledge, and/or attitudes and/or HPV vaccine uptake. One study, for example, that did not meet this criteria examined the impact of a technology-based, social-media-facilitated weight gain prevention intervention for college students.¹⁹ The experimental group received a behavioral weight gain prevention intervention over nine weeks, and the control group was assigned to receive a HPV awareness intervention over the same time period. However, given that the purpose of the manuscript was about weight gain prevention, the only results reported were the relevant weight gain measures and not about HPV awareness.

Articles that included some mention of social media but did not report any information about the (at the very least, potential) connection to its impact or relevance to HPV and HPV vaccine awareness, knowledge, attitudes, or behaviors were therefore not included. One study that was excluded, for example, evaluated the impact of the use of automated reminders to increase on-time completion of the three-dose HPV vaccine series, of which private Facebook messages were an option.²⁰ Less than 1% of participants chose Facebook as their reminder communication channel and therefore these few participants were excluded from the study.

Studies that used social media as a channel for participant recruitment for HPV and/or HPV vaccine studies but did not

Table 1. Search terms.

Key Concepts	Search terms
Social media	“Social media” OR “social network*” OR Facebook OR Twitter OR YouTube OR Instagram OR Vine OR Reddit OR WeChat OR Pinterest OR Snapchat OR Tumblr OR “message board” OR “discussion board” OR forum* OR (online AND comment*)
AND	
HPV and HPV vaccine	HPV OR “human papillomavirus” OR “human papilloma virus” OR Gardasil OR Cervarix

include social media measurement in the actual study ($n = 17$) were also not included in this review, as these studies discussed their recruitment strategies separate from relevant findings (e.g., HPV vaccine knowledge, awareness, and intentions). These studies also did not typically include any mention of HPV in their recruitment language. Some of these recruitment studies however did arguably provide some evidence that social media may serve as a potential channel to reach certain relevant, potentially harder-to-reach populations, such as lesbian, gay, bisexual, and transgendered individuals²¹⁻²³

After aggregating and organizing the articles by method and social media platform, we then analyzed the key takeaways and relevant data points from each of the studies, as relevant to addressing our objective of examining the potential relationship between social media content and use and its potential impact on HPV and HPV vaccine awareness, knowledge, and attitudes and HPV vaccine uptake. We then determined the most relevant key themes for the development of implications for health care professionals and communicators by comparing and contrasting the relevant findings and implications from each study. This systematic review and its protocol were not prospectively registered or published elsewhere previously.

Results

Final articles selected and analyzed

A total of 325 articles were returned from the database searches, with 145 citations from PubMed, 107 citations from Sociological Abstracts, 47 citations from PsycINFO, 11 citations from Communication Source, 13 citations from Business Source Elite, and 3 citations from ERIC. Twenty-four articles were duplicates and therefore removed, leaving

a total of 301 non-duplicate citations that were screened by title and abstract for inclusion consideration. Seventy-nine articles were retrieved from this initial screening, and a total of 44 articles remained after full text screening. See Figure 1 for the PRISMA diagram of the complete selection process.

The majority of the final articles selected were analyses of social media content and/or user engagement about HPV and HPV vaccination on specific platforms ($n = 29$), including Twitter ($n = 14$), YouTube ($n = 6$), Facebook ($n = 3$), Google+ ($n = 1$), MySpace ($n = 1$), Instagram ($n = 1$), and other online social spaces, such as comment sections and discussion boards ($n = 5$). See Table 2 for a summary of these articles. The remaining 15 articles included primary human subject data collection such as interviews, surveys, experiments, and focus groups. Eight of these articles provided results from campaigns, interventions, or experiments that measured or implemented social media in some fashion in an attempt to improve HPV vaccine awareness, knowledge, attitudes, and/or uptake. See Table 3 for a summary of these articles.

The frequency and type of content about HPV and HPV vaccination available on social media and how exposure to that content may influence knowledge and attitudes about HPV vaccination was the focus of most of the studies. The most common social media platforms analyzed were YouTube and Twitter, most likely because of easier accessibility to data on these platforms than others, such as Facebook and Instagram. Various reports suggest that content creators on YouTube and Twitter are more likely to leave their accounts and content publicly available for anyone to view; whereas, users on Facebook and Instagram are more likely to have at least some of their content private, only accessible to those they allocate access,⁶⁸⁻⁷¹ which makes data collection more restrictive for research purposes.

Figure 1. PRISMA diagram.

Table 2. Summary of content analysis articles included in review.

Article (First Author Name)	Relevant Content Source	Primary Content Topic	Relevant Data Collected*
Keelan (2007) ²⁴	YouTube	Vaccination and immunization	All videos as of February 20, 2007
Ache (2008) ²⁵	YouTube	HPV vaccination	All videos as of February 8, 2008
Briones (2012) ²⁶	YouTube	HPV vaccination	All videos as of November 1, 2010
Basch (2017) ²⁷	YouTube	Anal cancer	All videos with at least 1,000 views as of June 29, 2016
Basch (2016) ²⁸	YouTube	HPV	Most viewed "consumer" and "professional" videos from 2007 and June 2014
Ekram (2018) ²⁹	YouTube	HPV vaccination	Most viewed videos and top 100 comments from June 22, 2014 and December 19, 2014
Coloma (2015) ³⁰	Facebook, Twitter, Google+	HPV and fertility	All posts as of September 25, 2014
Suragh (2018) ³¹	Facebook	Immunization adverse effects	Top 20 posts from 2007 to 2016 about each topic: hysteria, fainting, and mystery illness after vaccination
Hale (2014) ³²	Facebook	Health conditions	All Facebook pages of 20 most searched for health conditions (HPV as #17) on Google as of July 24, 2012
Dunn (2015) ³³	Twitter	HPV vaccination	All tweets from October 1, 2013 to April 1, 2014
Zhou (2015) ³⁴	Twitter	HPV vaccination	All tweets from October 1, 2013 to March 31, 2014
Mahoney (2015) ³⁵	Twitter	HPV vaccination	First 100 tweets that included news articles from April 1, 2011 to October 31, 2011
Bahk (2016) ³⁶	Twitter	Vaccination	All tweets from August 2013 to July 2014
Massey (2016) ³⁷	Twitter	HPV vaccination	All tweets from August 1, 2014 to July 31, 2015
Surian (2016) ³⁸	Twitter	HPV vaccination	All tweets from October 1, 2013 to October 29, 2015
Du (2017) ³⁹	Twitter	HPV vaccination	All tweets from November 2, 2015 to March 28, 2016
Dunn (2017) ⁴⁰	Twitter	HPV vaccination	All tweets from October 1, 2013 to October 30, 2015
Keim-Malpass (2017) ⁴¹	Twitter	HPV vaccination	All tweet over two-week period in June 2015
Shapiro (2017) ⁴²	Twitter	HPV vaccination	All tweets from Australia, Canada, and the UK from January 2014 to April 2016
Lama (2018) ⁴³	Twitter	HPV	All tweets posted by users in the USA from November 11, 2014 to August 8, 2016
Massey (2018) ⁴⁴	Twitter	HPV vaccination	All tweets from August 1, 2014 to July 31, 2015
Teoh (2018) ⁴⁵	Twitter	Cervical cancer	Top tweets in January 2016
Keelan (2010) ⁴⁶	MySpace	HPV vaccination	All posts from November 2005 to May 2008
Basch (2018) ⁴⁷	Instagram	HPV	Most recent 50 posts on September 7, September 21, and October 4 of 2018
Battles (2010) ⁴⁸	Online message board	HPV vaccination	All posts in May, September, and November 2007
Pias-Peleterio (2013) ⁴⁹	Online forums	HPV vaccination	All blogs or forums found from Spanish-language Google search on September 20, 2012
Penta (2014) ⁵⁰	Online discussion forums	HPV vaccination	All comments from Romanian forums with at least 5 user comments from 2007 to 2012
Feinberg (2015) ⁵¹	Online comment sections	HPV and HPV vaccination	All comments on English and French online news articles about HPV and/or HPV vaccination on Canadian news websites in 2012
Lee (2012) ⁵²	Q&A section	HPV	All questions submitted publicly or privately from March 2004 to July 2011 to a Korean website about HPV

*All content was English language and based upon all publicly available information available at the time of data collection unless specified otherwise.

The following is a summary of the key relevant findings from each of the studies included in this review, organized by their relevant theme and contribution to addressing the purpose of this review. All statements about the state of the social media platforms discussed in this manuscript are based upon the information available at the time of writing.

Portrayals of HPV and HPV vaccination on social media

Content valence

The analyses of the valence of HPV and HPV vaccination content on social media identified a wide range of positive, neutral, and negative posts, some encouraging (e.g., pro-vaccine) and some discouraging (e.g., anti-vaccine). It should be noted however that the determination and classification of content valence was independent to each study.

On YouTube, all available videos about the HPV vaccine that were positive in tone, as classified and identified by each individual study, ranged from 56% ($n = 20$) in February 2007²⁴ to 74.7% ($n = 109$) in February 2008²⁵ to 33% ($n = 56$) in November 2010.²⁶ Between June and December 2014, one study of the top 35 most viewed YouTube videos about the

HPV vaccine indicated that 57% were anti-vaccine; 31% were pro-vaccine; and 11% were neutral.²⁹

On Twitter, 25.1% ($n = 20,994$) of the analyzed tweets about the HPV vaccine from October 2013 to April 2014 were classified as negative,³³ with similar findings (25.3% negative, $n = 48,940$) in another analysis from August 2014 to July 2015.³⁷ Over a two-week period in June 2015, another study found that the 1,794 tweets analyzed about HPV and HPV vaccine were polarizing, with 50.8% positive, 43.5% negative, and 5.8% neutral.⁴¹

A study of MySpace posts about HPV vaccination between November 2005 and May 2008 found that 52% ($n = 157$) were classified as positive, 43% ($n = 129$) as negative, and 6% ($n = 17$) as ambivalent.⁴⁶ In an analysis of the comment sections of news articles about HPV or the HPV vaccine on Canadian news websites in 2012, 630 (52.6%) individuals expressed positive responses about HPV vaccination, while 404 (33.7%) were negative, 34 (2.8%) were mixed, and 130 (10.8%) were neutral.⁵¹ A study of 50 of the most recent Instagram posts available on September 7, September 21, and October 4 of 2018 that used the hashtag #HPV (for a total of 150 posts) found that 45% mentioned the HPV vaccine, and the majority of those posts were identified as being pro-vaccine (79.2%).⁴⁷

Table 3. Summary of primary human subjects research articles included in review.

Article (First Author Name)	Primary Method/Design	Participant Sample	Relevant Outcome Measures
Britt (2014) ⁵³	Survey	Undergraduate students in midwestern USA	HPV vaccine attitudes and intentions; social media use attitudes
Zhang (2015) ⁵⁴	Focus groups	Female college students in Hawaii, USA	Perceptions about how information about HPV should be shared on Facebook
Yoo (2018) ⁵⁵	Survey	Female Twitter followers of cervical cancer prevention campaign	HPV vaccine attitudes and intentions; social media perceptions and behaviors
Dilley (2018) ⁵⁶	Survey and interviews	Health care providers and parents in Alabama	Perceptions of barriers and potential facilitators to improve HPV vaccine uptake (including social media)
Kim (2018) ⁵⁷	Survey	Undergraduate students in Korea	Beliefs, acceptance, and information sources of HPV vaccine (including social media)
Widman (2018) ⁵⁸	Survey and interviews	Health care providers and parents in western region of New York state, USA	Experiences, perceptions of barriers, and potential facilitators to improve HPV vaccine uptake (including social media)
Margolis (2018) ⁵⁹	Survey	Parents in USA	Frequency and source (including social media) of having heard stories about HPV vaccine harm or HPV disease prevention; HPV vaccine initiation, delay, and refusal
Lai (2015) ⁶⁰	Facebook intervention	Senior high school students in Taipei, Taiwan	HPV and HPV vaccine knowledge, attitudes, and intentions
Delany-Moretlwe (2018) ⁶¹	Campaign evaluation	Grade 4 girls in South Africa and Department of Health staff	Media coverage of campaign and HPV vaccination and its potential impact on vaccine uptake (including social media)
Lyson (2018) ⁶²	Social media intervention	Adult females in USA	Knowledge, awareness, and prevention behaviors related to HPV and cervical cancer
Mohanty (2018) ⁶³	Facebook campaign	Adolescents in Philadelphia, PA, USA	Campaign engagement and HPV vaccine uptake
Ortiz (2018) ⁶⁴	Facebook intervention	Adolescents in USA who had not completed the HPV vaccine series	HPV awareness, knowledge, and vaccine uptake
Piedimonte (2018) ⁶⁵	Campaign evaluation (included use of Facebook and Instagram)	College students at universities in Canada	HPV and HPV vaccine knowledge and perceptions and HPV vaccine uptake
Sundstrom (2018) ⁶⁶	Campaign evaluation (included use of Facebook, Twitter, and Vine)	College students at a college in South Carolina, USA	HPV and HPV vaccine knowledge and perceptions and HPV vaccine uptake
Lee (2017) ⁶⁷	Experiment (testing effect of messages on Facebook vs. online news site)	College students at a southwestern university, USA	HPV and HPV vaccine attitudes, perceptions, and intentions

Negative vs. positive content

The most common type of content that appeared in negative social media posts were inaccurate claims; information about conspiracy theories involving distrust in the pharmaceutical companies, government, and doctors; concerns about side effects and safety of the vaccine; issues with individual civil liberties regarding possible vaccine mandates; and lack of vaccine efficacy.^{24,26,29,37,40,46,51,50} Positive and pro-vaccine social media postings were more likely to include information about prevention, protection, and evidence of safety and efficacy.^{37,40,51}

Pro-vaccine content however did not always include all relevant health information. In an analysis of the top 35 videos about HPV vaccination between June and December 2014, information about the efficacy and safety of the vaccine was excluded in the majority of the videos.²⁹ The most common topics included in tweets about the HPV vaccine written by health professionals between August 2014 and July 2015 were about prevention and protection (35.5%, $n = 302$) with significantly less tweets about side effects (10.7%, $n = 91$) and risk or prevalence (10.3%, $n = 88$).⁴⁴ In an analysis of the top 35 videos about HPV from 2007 to June 2014 created by a nonprofit or health organization featuring one or more professionals with clinical credentials, the most common information included was HPV's association with cancer (97.1%), HPV screening (77.1%), how the virus is transmitted (65.7%), and prevention of HPV infection (60.0%).²⁸ Only 19 videos (54.3%) included any discussion

of HPV vaccination, and five of these were discouraging against vaccination; nine were neutral. An analysis of the top tweets made during Cervical Cancer Awareness Month in January 2016 found that 70.3% were focused on HPV screening and/or vaccination, and only 3.8% included information that was inaccurate (i.e., not fact based).⁴⁵

Pro-vaccine content was more likely to include evidence-based arguments and provide links to peer-reviewed publications and government health sites,^{46,50} though users in general, regardless of content valence, were more likely to share links to sources such as news sites and other user-generated content than from health organizations or scientific journals.^{30,35} When a Google web search was conducted for information about the HPV vaccine, the most frequent type of site to appear was a blog or forum, which often lacked complete information and adequate scientific credibility.⁴⁹ An analysis of public posts as of September 2014 about the potential association between HPV vaccination and infertility on Facebook, Google+, and Twitter found that most of the posts referenced news sites and blogs at substantially higher rates than scientific journals or health professional references.³⁰

(In)accuracy of content

Reliable and accurate information was therefore often mixed in with inaccurate, conspiratorial, unrepresentative, and/or incomplete information. One study that analyzed YouTube videos about anal cancer as of July 2016, for example, found that only 24.6% and 8.8% included any mention of HPV or the

HPV vaccine, respectively.²⁷ An analysis of tweets about the HPV vaccine from November 2014 to August 2016 posted by U.S. users found disproportionate gender and racial representation in the images used in the tweets, such that women and white individuals were overrepresented compared to actual disease burden.⁴³ The study of a selection of 150 HPV related Instagram posts in 2018 found that photos used in the posts were more likely to feature women (29%) than men (9%).⁴⁷

In one study, Facebook and Google were searched for clusters of reports about adverse effects experienced following immunization, and the HPV vaccine was the most common vaccine implicated (48.7%).³¹ Additionally, HPV was the 17th most searched for health condition on Google as of July 24, 2012, but among relevant support, marketing, and information/awareness pages on Facebook, pages for HPV were largely represented by marketing/promotion pages and did not include any patient or general support pages,³² even though some of the most frequent questions submitted publicly or privately to a HPV website from 2004 to 2011 were about wanting to know the treatment options for HPV infection.⁵²

Content creators and influencers

While some original content was created by nonprofit organizations, health professionals, or other related organizations, much of the content about HPV and the HPV vaccine was created by an “average” or “lay” consumer or the news media.²⁴⁻²⁶ The content created by individual social media users were often the most polarized in their valence, while the news media content were typically positive.

Over a two-week period in June 2015, 74.2% of the 1,794 tweets about HPV and HPV vaccine analyzed were written by a “lay consumer,” and they were almost equally likely to be positive (44.7%) and negative (49.3%).⁴¹ The majority of the content produced by the news media (77.0%), however, were positive. Out of a total of 146 YouTube videos about HPV vaccination analyzed as of February 2008, 70.6% were created by individual YouTube members and 33.9% were from local or national television news coverage. Most (61%) of the individual members’ content and news coverage (92%) were positive.²⁵

Mainstream news coverage about HPV vaccination, including media scandals, political debates, and the release of new scientific evidence, often influenced the valence and frequency of social media content.^{36,39,40,44} On December 4, 2013, for example, U.S. television talk show host Katie Couric had two mothers as guests on her show who claimed their daughters were seriously harmed, one died, as a result of getting the HPV vaccination. Couric was criticized by many for not pushing back against the women’s claims, given the scientific evidence for the vaccine’s safety. A week after the show aired, she issued an apology, saying she should have focused more on the safety and efficacy of the vaccine. An analysis of relevant mainstream articles from August 2013 to July 2014 and tweets from December 2013 to January 2014 revealed that mainstream news coverage toward the HPV vaccine was overwhelmingly positive (95.8%), as well as the tweets (77.5%) the day before (when previews aired) to ten days after the airing.³⁶ However, the predominant valence about the HPV vaccine on Twitter before the airing was negative and returned to negative by December 15 (average of 74.9%), despite the fact that

mainstream news articles remained generally positive (75.5%) well after the event. Two other studies found similar findings, such that news events and mainstream media coverage of HPV and HPV vaccination can lead to temporary spikes in positive social media postings, but the anti-vaccine content often persisted longer.^{39,44}

In 2007, U.S. Texas state Governor Rick Perry signed an executive order requiring that all sixth-grade girls in the state of Texas receive the HPV vaccine, though the order was later overturned by the state legislature before the mandate went into effect. Many criticized Perry for the mandate, including then Minnesota Congresswoman Michele Bachman who claimed the order was a violation of civil liberties and then claimed on a U.S. television talk show that she knew of a woman who said her daughter suffered from “mental retardation” as a result of the HPV vaccine. In one study, the first 100 news articles about HPV vaccination that appeared on Twitter after the event were analyzed, from August 1 to October 31, 2011.³⁵ The articles were most often positive in tone (54.0%) (with 29% classified as neutral and 17% as negative) and included information about disease protection (75%), side effects (66%), and vaccine eligibility for females (66%). The U.S. Centers for Disease Control and Prevention was the most common source referenced (52%), followed by medical doctors (49%) and political/governmental officials (46%).

Potential impact of social media content on public opinion and HPV vaccine coverage

Both individual social media users and news media coverage can therefore drive the social media conversations about HPV and HPV vaccination, in both positive and negative ways. The types of conversations users have on social media about HPV vaccination may concentrate within certain homogenous communities and further reinforce positive, medically-accurate information or perpetuate misinformation and conspiracy theories.^{38,40} An analysis of tweets about HPV vaccination from August 2014 to July 2015 found that there were 14% more positive tweets (39%) than negative (25.3%). However, while Twitter users posting positive tweets about HPV vaccination had almost twice as many average followers (8,022) as users posting negative tweets (4,772), positive and negative tweets had equivalent average number of retweets per tweet (9.7 vs. 9.1, respectively).³⁷ Negative tweets were therefore just as likely to be retweeted as positive tweets. In a study of a selection of 150 HPV related Instagram posts about HPV vaccination in 2018, anti-vaccine posts received significantly more likes than pro-vaccine posts.⁴⁷

An analysis of tweets about HPV vaccination from October 2013 to October 2015 identified communities in which certain topics and post valence were more likely to appear.³⁸ Communities of users who were most likely to post about their experiences with HPV vaccination were also more likely to tweet about evidence and advocacy for the vaccine. Users who posted about harms and conspiracies about the vaccine, however, belonged to different communities and had the most tweets per user, while those who posted about their experiences had the least. Another analysis of tweets from this same time period found a strong

correlation between regional HPV vaccine coverage in the United States and greater likelihood of exposure to certain topics on Twitter, such that states where residents were more likely to be exposed to tweets about safety concerns and conspiracy theories on Twitter had lower vaccine coverage.⁴⁰ States with higher vaccine coverage were more closely associated with exposure to content that included topics covered in mainstream news media. Therefore, while positive tweets often reached larger audiences, negative tweets that may include biased, inaccurate information permeated within concentrated communities to potentially affirm or influence negative beliefs about HPV vaccination.

Analyses of tweets from October 2013 to April 2014 found that user connections on social media (i.e., who they follow on Twitter) were a powerful predictor of the type of content in which a user was likely to post themselves.^{33,34} About a third (29.5%) of users that tweeted about HPV vaccination during this time period were exposed to a majority of negative tweets, and the likelihood of a user posting a negative tweet after exposure to a majority of negative tweets was 37.8% compared to 10.9% of users who were primarily exposed to both positive or neutral tweets.³³ It was therefore suggested that there is a “core of users that may be influential in vaccine information communities and that their followers tend to express similar opinions as a consequence of homophily or contagion” (p.764).³⁴ An additional analysis of tweets from January 2014 to April 2016 found that users who expressed their concerns about the vaccine’s safety were more likely to be connected on Twitter to other users who also expressed their concerns than those who had not.⁴²

Concern for impact of negative information on social media

A handful of the studies identified concerns parents and healthcare providers had about the spread of misinformation, conspiracy theories, and general negative information about the HPV vaccine and its potential impact on vaccine refusal. One study found in a survey with 1,263 parents of adolescents in the United States who had not yet completed the HPV vaccine series that about a third (34%) indicated they heard stories of people who were harmed after receiving the vaccine, including long-lasting side effects, temporary serious harm, mild side effects, and death, while about a quarter (26%) heard stories about people who got diseases the vaccine could have prevented.⁵⁹ The parents reported that the harm stories were more likely to come from social media (30%) than stories about HPV vaccine preventable diseases (11%). Parents who only recalled hearing harm stories were at lower odds of vaccine initiation compared to parents who heard both types of stories or no stories at all and were more likely to have delayed or refused vaccination for their child.

Results from qualitative interviews with health care providers and parents in the U.S. state of Alabama indicated that some felt that social media could be used as a potential channel for reaching parents of adolescent children with accurate, useful information in part to “combat the misinformation and negativity about the HPV vaccine that exists

online” (p.129).⁵⁶ Similar results were found with interviews and surveys with parents and clinicians in western New York, such that they felt parents needed more and better education about the vaccine to counter the spread of misinformation on social media.⁵⁸

An evaluation of a national school-based HPV vaccination campaign for young girls in South Africa in April 2014 found that, while the campaign was able to get 86.6% of age-eligible girls vaccinated, campaign staff reported that misinformation and negative rumors spread via social media during the campaign may have hindered their ability to gain higher vaccination rates because of its perceived negative impact on parental consent by campaign staff.⁶¹ They recommended carefully monitoring social media messaging during campaigns in the future to monitor its influence and be prepared to combat misinformation with a designated media response plan.

Social media use for information and discussion about HPV and HPV vaccination

Some studies revealed that individuals often turned to social media to answer their questions or engage in discussions about HPV infection and HPV vaccination. An analysis of three online discussion boards about HPV vaccination in 2007 revealed that adolescent members shared their decision-making process with each other on whether to get vaccinated or not, with most indicating they planned to get it or were in the process of doing so.⁴⁸ In a survey with Korean college students, 30% reported that they used social media as a source of information about HPV, in part because they felt too uncomfortable or embarrassed to talk with others about the topic.⁵⁷ In another study, when female adolescents at a senior high school in Taipei, Taiwan were broken into two discussion groups (one in person, the other conducted via a Facebook group) after receiving a classroom lecture about HPV vaccination, the students in the Facebook discussion group significantly improved in vaccine knowledge, attitudes, and intentions compared to the in-person discussion students.⁶⁰ It was suggested in the article that the effectiveness of the Facebook group was in part because the adolescents felt more comfortable discussing the potentially-sensitive topic in an online setting.

Results from two surveys provided correlational associations between receiving information about HPV and HPV vaccination via social media and positive beliefs about the vaccine and desire to search for more information.^{53,55} In focus groups with adolescents in North Carolina, they indicated that they would be generally interested in receiving information about HPV and the HPV vaccine via social media, as long as the messages were interesting and credible.⁶⁴ College students in Hawaii also indicated in focus groups that they felt that social media (i.e., Facebook) could be a good platform to share accurate and useful information about HPV and the HPV vaccine but that they would not feel comfortable sharing information with their friends until they felt more knowledgeable about the topics and could personalize the message themselves to make it relevant to their friends.⁵⁴

Using social media to reach audiences with HPV vaccination information

A handful of campaigns and interventions used social media with varying degrees of success as a distribution channel to improve awareness, knowledge, and vaccine uptake. One study distributed Twitter messages multiple times per day over the course of five days to adult women, and while awareness did increase, knowledge and vaccine intentions did not.⁶² Results from a three-month Facebook intervention with adolescents who received messages about HPV and HPV vaccination via their news feeds indicated that those who fully engaged in the intervention improved in their knowledge about HPV and the HPV vaccine compared to a control group, but, again, vaccine uptake did not increase.⁶⁴ Many of the adolescents in the intervention group did however report that they had interpersonal discussions with others about what they learned.

Two campaigns on college campuses used social media as one of their message distribution strategies to spread information about HPV and HPV vaccination and found success in audience engagement and small increases in vaccine uptake, but vaccination could not be directly attributed to the social media messages alone.^{65,66} Additionally, the Philadelphia Department of Public Health launched a Facebook campaign to target local adolescents and found that messages focused on HPV disease risk and local resources were the most successful in engaging their audience, but they did not see an increase in vaccine uptake as a result.⁶³ An online experiment with college students did find however that participants who viewed a Facebook message about the negative consequences of not getting vaccinated were significantly more likely to intend to get vaccinated than those who saw the same message via an online newspaper.⁶⁷

Discussion

The results from this review indicate that social media can serve as a source of information and discussion for many about HPV and HPV vaccination, but the information in which individuals may be exposed may not always be complete, accurate, or favorable. Negative social media content most often included concerns about the safety and efficacy of the vaccine and were less likely to link to credible, scientific sources. Parents and healthcare professionals voiced concerns about the spread of misinformation on social media about HPV vaccination and its potential negative impact on HPV vaccine uptake.

Exposure to negative social media content was associated with greater HPV vaccine refusal,⁵⁹ lower HPV vaccination coverage,⁴⁰ and a greater likelihood to share negative content with others on social media.³³ Positive content and content that corresponded with mainstream news coverage showed some associations with greater HPV vaccination coverage, and mainstream news coverage about HPV vaccinations appeared to drive temporary positive social media conversations. However, while positive content often reached larger audiences, negative content was just as likely (and sometimes more so) to be shared by social media users, often within more concentrated communities.

Anti-vaccine content often included concerns about the vaccine's safety, potential side effects, and lack of efficacy, but positive and pro-vaccine content focused primarily on the benefits of the vaccine to prevent and protect and rarely on the vaccine's safety and efficacy. If health professionals and communicators want to reach those against vaccination because of safety and efficacy concerns, social media content targeting these audiences likely needs to include more information addressing these topics. Anti-vaccine content was also less likely to include links or references to credible, scientific sources than were pro-vaccine content, and thus, to reach and connect with the primary audiences of negative and anti-vaccine content, health professionals and communicators may need to be cautious in using government and health organizations as information sources. These audiences may be less likely to trust these organizations, especially if they have received and supported information about conspiracy theories involving the government and pharmaceutical companies.^{72,73}

Health professionals and communicators may therefore benefit from identifying key social media influencers in which individuals who are most concerned about the vaccine's safety and efficacy are connected. Results from some of the studies indicated that to whom an individual is connected on social media could influence the type of HPV vaccine content they receive and share, which may ultimately influence vaccine acceptance, especially for those primarily exposed to negative content. Identifying common connections between users who often receive and share negative content and determining the most influential users of those connections could provide health professionals and communicators with valuable information about how they might counter common negative messages with strategic positive messaging of their own. For example, health communicators could identify other social media influencers like those who are influential in these negative vaccine communities and employ them to share accurate and relevant content about the vaccine's safety and efficacy to counter the negative content.

While positive content often spiked on social media around breaking mainstream news coverage, the increase in positive postings was short-lived. Health professionals and communicators can take advantage of relevant news events to engage social media users in positive conversations about HPV vaccination, but they must remember to keep the conversation going long after the news coverage dies down. Analyzing the news sources, blogs, and websites most often included and endorsed during these news events, for both positive and negative content, could also provide rich insights into the specific sources that different communities (both pro- and anti-vaccine users) find most useful and credible. Relevant healthcare stakeholders suggested at the proceedings of the U.S. National Vaccination Roundtable meetings in 2016 that cultivating parent champions on social media to distribute positive messages and stories about vaccination may serve as a promising strategy to counter negative content.⁷⁴

Results from many of the studies in this review indicated that many are willing and interested in receiving accurate and helpful information about HPV and HPV vaccination via social media. This may be particularly relevant for those who feel more comfortable receiving sexual health

information and talking about these topics in online spaces instead of in-person,⁷⁵ likely in part because of the vaccine's association with a sexually transmitted infection. They are therefore able to have more autonomy and privacy about how they receive information and participate in discussions on social media than in-person group discussions.

Some of the few interventions and campaigns that have been conducted provided evidence that adolescents and young adults will engage with content about HPV and HPV vaccination on social media and can improve in their awareness and knowledge as a result. The likelihood that engagement with this content will lead to an increase in vaccination is however less clear, especially because none of the interventions or campaigns targeted or engaged parents of adolescents, who are also potential key stakeholders in the vaccination decision-making process.

Several factors limit our ability to make conclusive claims or implications about the impact of social media on HPV vaccine uptake. Most of the studies in this review focused on analysis of content only and therefore claims about audience effects cannot be made. A handful of content analysis studies evaluated the time order connections between content postings, mainstream news coverage, and immunization records, but the relationships could still only be assessed at the correlational level. Also, while social media is used by many individuals around the world, active users on any given social media platform at any given time are not representative of the actual population, and much of social media content is private and inaccessible to researchers. In 2018, for example, while most U.S. adults and adolescents reported using Facebook (68% and 51%) and YouTube (73% and 85%), only about a quarter (24%) and a third (32%) reported using Twitter.^{15,76} U.S. adolescents also reported frequently using Instagram (72%) and Snapchat (69%), with U.S. adults reporting lesser usage (35% and 27%), but academic literature about the use of these platforms for information about HPV vaccination was not found, most likely because these platforms only recently gained popularity and content is often private. Public social media content is therefore only a snapshot of some active users' public postings on some platforms at a specific time.

Most of the studies that included human subject data collection were also based upon nonrepresentative samples and correlations or qualitative observations. Only one study surveyed participants from a probability-based sample of U.S. households.⁵⁹ Only one experimental or intervention study included the use of a true control comparison group,⁶⁴ and only three included a pre- and post-test assessment of the outcome measures.^{60,62,64} While these studies focused on a variety of audiences (e.g., parents, college students, adolescents), campaigns and interventions were only conducted with adolescents and young adults and therefore implications about social media use to reach parents is only based upon their self-reported responses to surveys and interviews and not on any systematic interventions.

Conclusion

Results from the studies in this review provide foundational evidence for the potential for social media to have significant

impact on some individuals' awareness, knowledge, attitudes, and behaviors related to HPV and HPV vaccination, in both positive and negative ways, but this area of research is still largely understudied. Previous systematic reviews of interventions using social media and/or other digital media to improve vaccine uptake came to similar conclusions.^{77,78} Future research should continue to analyze the frequency and type of social media content that social media users are creating and sharing about HPV and HPV vaccination so that health professionals and communicators are aware of the content to which the public is potentially exposed. Additionally, rigorous and systematic interventions and experiments with primary key stakeholders, most notably parents, are lacking and therefore need investigation. While preliminary evidence indicates that social media is a potentially fruitful platform in which to reach adolescents and young adults with information about HPV and HPV vaccination, investigation on the use of social media to reach parents and other primary caregivers is absent and in need of examination.

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No potential conflict of interest were disclosed.

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