


# Development and Evaluation of a Social Media Health Intervention to Improve Adolescents' Knowledge About and Vaccination Against the Human Papillomavirus

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## Abstract

This study describes the formative research, execution, and evaluation of a social media health intervention to improve adolescents' knowledge about and vaccination against human papillomavirus (HPV). Based on the results from formative focus groups with adolescents (N = 38) to determine intervention feasibility, parameters, and message preferences, we developed and conducted a pretest/posttest evaluation of a 3-month social media health intervention for adolescents who had not completed the HPV vaccine series (N = 108). Results revealed that adolescents who fully engaged with the intervention improved in their knowledge compared with a control group, and many were also likely to have interpersonal discussions with others about what they learned. Adolescents are generally interested in receiving information about HPV and the vaccine, along with other relevant health information, through social media channels if messages are considered interesting, their privacy is protected, and the source is credible.

## Keywords

HPV vaccine, social media intervention, adolescent, youth, monitoring and evaluation research

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## Introduction

The human papillomavirus (HPV) remains the most common sexually transmitted infection in the United States despite vaccine availability to prevent many of the infection's strains in both young women and men.<sup>1</sup> The Advisory Committee on Immunization Practices of the Centers for Disease Control and Prevention recommends that HPV vaccination occur at ages 11 or 12, prior to average age of sexual debut, but encourages all eligible nonvaccinated individuals under the age of 26 to vaccinate.<sup>1</sup> HPV vaccine uptake, however, continues to lag well behind those of other adolescent vaccines; only 49.5% of females and 37.5% of males, aged 13 to 17 years, were up-to-date with the HPV vaccination series, as of 2016.<sup>2</sup> Nearly all sexually active men and women will contract the virus at some point in their lives, especially if not vaccinated, and the infection can lead to genital warts and various cancers.<sup>1</sup>

Many young people are not vaccinated because of a lack of awareness and/or misconceptions about the virus and vaccine among themselves<sup>3-6</sup> and/or their parents.<sup>7-10</sup> Much of the formative research on HPV vaccine uptake, to date, explores how parents perceive and decide whether to vaccinate their children,<sup>11,12</sup> but there is evidence that adolescents can also play a role in the decision-making process.<sup>13,14</sup> In one study with eligible parents in North Carolina, just over half reported that their adolescent daughters were at least moderately involved in the decision to get vaccinated; 11.6% identified their daughters

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as the primary decision maker.<sup>14</sup> Almost half (48.4%) of California high school students surveyed said that they participated in the decision.<sup>15</sup> Greater knowledge and positive attitudes about the vaccine are positively associated with higher vaccination rates.<sup>16</sup>

A health care provider's recommendation is another major predictor of whether a young person will get vaccinated,<sup>17-19</sup> but not all health care providers are routinely providing information about or strongly recommending the vaccine to their adolescent patients. In some cases, providers indicated that they felt a lack of importance about recommending the vaccine, felt uncomfortable talking with parents and patients who they thought would not value vaccination, and/or felt they did not have the time to discuss the vaccine during the patient's visit.<sup>20-22</sup>

While time is often limited in face-to-face visits, clinicians can continue the conversation with their adolescent patients outside of the clinic by meeting them in online spaces. A survey of teens aged 12 to 17 years in the United States conducted by the Pew Research Center found that almost a third use the Internet to get health information, and almost a fifth reported using the Internet to gather information about topics they have a hard time discussing with others, such as sexual health topics.<sup>23</sup> Social media channels (e.g., Facebook, Twitter) may be useful platforms in which to provide health information to this audience, as the vast majority of adolescents aged 13 to 17 years in the United States (71%) regularly use more than one social media platform, with Facebook being the most common and frequently used.<sup>23</sup> Also, nearly three quarters of adolescents have access to a Smartphone with Internet access, and 92% of adolescents said they go online every day.<sup>23</sup>

Many health care practitioners already advocate for the use of social media by clinicians to communicate with their patients, and use of these channels shows promise in getting patients more involved in their health care and more likely to complete vaccination series and treatments.<sup>24-27</sup> Previously tested education interventions that included online messaging components (i.e., website, blogs) with young adults resulted in positive attitude change and knowledge gain after exposure.<sup>28,29</sup> A systematic review of health education interventions using social media and texting to distribute sexual health information to adolescents and young adults, for example, found preliminary evidence that receiving information in this fashion can increase knowledge regarding the prevention of sexually transmitted diseases (STDs).<sup>30</sup> The use of social marketing tactics and/or behavioral theories for STD prevention and control has also shown promise to change prevention and testing behaviors.<sup>31</sup> Very little research to date, however, has systematically

examined how to best use these channels and tactics to communicate with adolescents about HPV vaccination.

The purpose of the current study was, therefore, to determine whether the strategic distribution of information about HPV and the HPV vaccine via an adolescents' (ages 13-18) social media platform (i.e., Facebook) is a feasible and effective way to improve adolescents' knowledge about the virus, vaccine, and vaccination rates. Additionally, since adolescents who are interested in vaccination must visit a health care provider for the vaccine and will likely need to discuss vaccination with a parent or guardian beforehand, the current study also assessed whether receiving information about the virus and vaccine could lead to interpersonal discussions with others (most notably, parents and health care providers) as a precursor to vaccination. Thus, the following hypotheses were proposed:

**Hypothesis 1:** Adolescents who receive information about HPV and the HPV vaccine via a social media health intervention will improve in their (a) knowledge about the virus and vaccine and (b) HPV vaccination rates from pretest to posttest compared with adolescents who do not.

**Hypothesis 2:** Adolescents who receive information about HPV and the HPV vaccine via a social media health intervention and have interpersonal discussions with others about the information they received will increase in their (a) knowledge about the virus and vaccine and (b) HPV vaccination rates from pretest to posttest compared with adolescents who do not.

## Intervention Development

The social media health intervention was developed using traditional social marketing processes, including planning, formative research, pretesting, implementation, and evaluation,<sup>32</sup> based on the success of this approach in previous STD prevention and control campaigns.<sup>31</sup> The health belief model (HBM)<sup>33</sup> was employed as a guiding theory for intervention development based on findings in the formative research and the overarching goal to improve adolescents' knowledge about HPV and HPV vaccination. The following is an overview of each of these processes with key methodological focus on evaluation of the final intervention. All efforts were conducted with adolescents in the Southeastern region of the United States, and the institutional review boards of the researchers' respective universities approved all aspects of the project. Funding for the development and execution of the intervention was provided by the predominant US HPV vaccine provider, Merck & Co, though all efforts were conducted without any input from the company.

Formative research for the current study was conducted by soliciting initial feedback from a total of 38 adolescents in four mixed-gender, mixed-racial and ethnic focus groups to learn about their HPV and HPV vaccine awareness and perceptions and their preferred messaging strategies for receiving health information. The groups ranged in size from seven to 12 participants, lasted approximately 60 to 90 minutes each, and included a total of 13 females and 25 males ( $n = 38$ ) between the ages of 11 and 21 (mean  $[M] = 15.86$ ) in 2 Southeastern cities in the United States. One of the study investigators, a white female in her early 30s, and a staff member, a black male in his mid-30s, jointly moderated all the focus groups using semi-structured moderator guides.

All participants reported regular access to the Internet. All but five participants reported owning or having regular access to a cell phone that allowed for access to the Internet and used it for texting, surfing the Internet, and accessing their social media accounts. The most common social media used by participants were Facebook, Twitter, and Instagram, with all participants indicating they had and regularly used a Facebook account.

Participants were recruited from and participated in the groups at a community teen center or a pediatric and adolescent clinic. Potential participants were informed about the study through recruitment posters and fliers placed in the respective locations (i.e., in the waiting room of the clinic and main area of the teen center). All focus group participants were compensated with US\$25 gift cards each time they participated. Those who participated in any of the focus groups were not eligible to participate in the final intervention.

As previously noted, many adolescents and parents/guardians hold misconceptions about or a lack of awareness of the virus and vaccine. Components of the HBM were used in the development of the focus group moderator guide to ensure full assessment of the adolescents' current knowledge and understanding of the virus and vaccine (i.e., perceived benefits, barriers, severity, susceptibility) to then determine how to best present the most relevant information for the final intervention (i.e., cues to action).<sup>33</sup>

Each group began with discussion about the participants' use and purpose for using social media. Prompts were then given to assess from whom they trusted receiving health information (with a focus on HPV), their willingness to receive health information through social media, and from what sources and why. Preferences, concerns, and barriers to receiving health information via social media were also discussed. They were also asked whether they had heard of HPV before, and if so, what they had heard, revealing an overall lack

of knowledge about the virus or vaccine or general misunderstanding of how the virus is transmitted, who is vulnerable, and how to protect against transmission. The moderators then provided a brief overview of basic information about the virus and vaccine (i.e., who is vulnerable, how vaccination can help protect against HPV, etc) and asked the participants how they might communicate this information to others their age. Example questions included "What do you think about using social media to get information about your health?" and "What do you think is the best way to present information about the HPV vaccine through social media? Through text messaging? And who should the information come from?"

Participants in each of the initial groups indicated that they would be willing and interested in receiving information about HPV vaccination from their health care provider through their social media channels, so long as it was communicated in an entertaining and interesting way that also protected their privacy (i.e., was not sent directly to their accounts for others to see but instead was information presented alongside other messages they received through the respective social media channel). They also voiced interest in learning about a variety of health topics, not just HPV and the HPV vaccine, originating from sources they found most credible (e.g., health care provider, governmental agency such as the Centers for Disease Control and Prevention, a well-known and respected public figure).

Many agreed that they may notice paid promotion (e.g., banner advertisements, promoted social media posts), especially if it included a celebrity endorsement, but they would be skeptical of the message and not perceive it as trustworthy. An analysis of all of the responses revealed that adolescents would accept relevant messages about HPV and the vaccine from sources that generally met the following criteria: the source should be (1) well known or someone they know personally, (2) credible, (3) liked, and (4) relevant to the message.

Using a participatory action research framework, participants in the initial focus groups were then asked if they would be willing to participate in later focus groups (herein known as youth advisory board meetings) to help in the refinement of the message strategies for the final intervention. A participatory action research framework enables participants to guide the interpretation and focus of a research study to ensure actions taken are reflective of the participants' needs and interests.<sup>34</sup> Sixteen participants volunteered and participated in two additional groups to help the researchers develop and refine the final messages for the social media intervention.

In the first youth advisory board meeting, the most common responses identified in the initial four groups were then summarized back to the advisory board members. They were then asked to provide feedback about whether they agreed with these responses and to explain why they thought these responses were given. The structure of the group was semi-structured to ensure all questions were addressed but also allowing for participants to guide the conversation. In the second advisory board meeting, participants were again asked briefly for clarification on some of the most common responses given and asked to generate specific messages and strategies to promote the HPV vaccine via social media. A list of more than 50 interesting health facts were pretested with the youth advisory board members for use in the final intervention.

The final social media health intervention was then developed based on the feedback that adolescents would be willing to receive health information via social media if the source was considered credible and relevant, the information provided was considered interesting (and not just about one health topic), and that their privacy online was protected. Based on these findings, a private Facebook page was created called “About Your Health,” listed as a source of relevant health information for adolescents and maintained by local (i.e., the state in which the participants lived) health care providers. To ensure protection of privacy, which was articulated by adolescents as simply appearing in their news feed and not on their personal page, a new health fact was posted by the Facebook page (and would therefore appear in news feed of those who eventually participated in the intervention) every four to five days (i.e., twice a week).

A total of 24 health facts were posted to the Facebook page throughout a three-month period and included relevant images and links to credible websites for more information about each topic. Since participants requested that the information provided not only be about one health topic, only 11 of the 24 facts were specifically about HPV and/or the HPV vaccine.

Each fact addressed a modifying factor proposed by the HBM and most relevant to the information focus group participants were interested in learning, such as virus susceptibility (e.g., “Anyone can get HPV if they engage in sexual contact with someone else”), virus severity (e.g., “HPV can eventually lead to genital warts and cancer in both girls and boys”), vaccine benefits (e.g., “It is best for teens to receive the HPV vaccine before they engage in sexual contact, but the vaccine may still prevent HPV at any time”), vaccine barriers (e.g., “The HPV vaccine is constantly being checked for safety by public health organizations”), and self-efficacy (e.g., “There is no cure for HPV, but you can help

prevent it by getting the HPV vaccine”). The HPV-related facts (i.e., call to action) were created based on the formative research feedback and the guiding presumptions of the HBM that indicate individuals will take a health-related action (i.e., vaccination), if they perceive the action as worthwhile to avoid a health condition (i.e., perceived susceptibility and severity of transmitting HPV) and beneficial (i.e., perceived benefits and barriers of getting vaccinated).<sup>33</sup>

Examples of the other 12 health facts provided included “Eating breakfast regularly will help keep weight off because it gets your metabolism going” and “Every cigarette smoked cuts approximately 5 minutes of life on average, which is roughly the time it takes to smoke one cigarette.” These additional health facts unrelated to HPV were included based on feedback from the formative focus group research. Adolescent participants said they did not want to receive health information via their social media feeds about only one type of health topic, especially when the topic is of a taboo and sensitive topic (i.e., sexual health). They preferred receiving a variety of health information, and therefore, additional health facts were included to avoid oversaturation of one topic (i.e., HPV).

## Methods

### Participants

One hundred and eight adolescents (60.2% female) with an average age of 15.6 years (SD = 1.68) at the time of study completion participated in the final intervention. Over half indicated their race as exclusively white/Caucasian (n = 58, 53.7%); one of these participants also indicated their ethnicity as Hispanic/Latino(a). Over a quarter indicated their race as exclusively black/African American (n = 27, 25.0%). Ten participants (9.2%) identified exclusively as Hispanic/Latino, and the remaining 13 participants indicated they were of mixed race (e.g., black/African American and white/Caucasian; n = 8), Asian or Pacific Islander (n = 4), or Native American (n = 1). Most of the participants (78.7%) reported that they had not yet had sex. More than half (57.4%) indicated they used Facebook at least once a day or more than once a day in the past week (M = 3.35, SD = 1.49, on a scale from 1 to 5, such that 1 = not at all, and 5 = more than once a day).

Prior to study enrollment, the majority of participants (n = 73, 67.6%) had not yet received any shots of the HPV vaccine. Fourteen participants (13.0%) had received 1 shot, and 21 (19.4%) had received 2 shots. Females were just as likely (32.3%) as males (32.6%) to have initiated the vaccine series prior to study enrollment,

$\chi^2(1, N = 108) = .001, P = .98$ , and age differences were not found between those who had and had not initiated,  $t(106) = .656, P = .51$ .

Eighty-two participants were randomly assigned to the intervention group, and 26 were assigned to the control group. A greater number of participants were randomly assigned to the intervention group to allow for additional statistical testing among the participants who received the intervention based on participation levels. Some participants may engage more or less with the intervention as instructed and therefore could be broken down further as unique groups within the intervention group to determine if level of participation in the intervention may influence proposed outcomes. Chi-square and independent sample  $t$  test analyses did not reveal significant differences between the two groups by gender (female, male), age, race (white, nonwhite), whether have had sex (yes, no), Facebook use in the past week (1-5), or vaccine initiation (yes, no),  $P > .05$ .

### Design and Procedures

Potential participants (and their parents/guardians) were approached about the study during a participating clinic visit (e.g., in the waiting room lobby of doctor's office), at a local health fair, or by phone (i.e., from the clinics' patient list or the state's immunization registry). Participants were eligible to participate if they were within the designated age range, had not participated in any of the initial focus groups, had not initiated or completed the HPV vaccine series, had a personal Facebook account that they accessed at least three times a week, and did not have previous history of severe hypersensitivity to a previous dose of HPV vaccine or severe hypersensitivity to yeast.

All interested participants gave informed written (or verbal, when relevant) consent, and the same was obtained from parents/guardians for all participants under the age of 18. Participants provided the study personnel with their email address to be sent the online survey questionnaires as part of the study. They were also asked to provide their cell phone number if they were willing to receive up to six text message reminders about completing the questionnaires over the course of the study.

Two hundred and nineteen adolescents (and their parents/guardians) agreed and consented to be part of the study and were emailed an online pretest questionnaire within a week of enrollment and providing consent. The questionnaire included questions about basic demographic information, social media use, and their knowledge about HPV and the HPV vaccine. One hundred and forty-eight adolescents (67.6%) completed the pretest questionnaire.

At the end of the questionnaire, participants were then randomly provided with either a message that indicated they would receive another email to complete a second survey questionnaire (i.e., posttest questionnaire) in three months (i.e., control group) or were asked to "Like" the study's Facebook page and select the option to receive a notification every time a new message was posted to the page (i.e., intervention group).

Participants assigned to the intervention group were also provided instructions on how to keep any personal information from their account private from others, if they chose to do so, and told they would receive another online survey questionnaire (i.e., posttest questionnaire) by email in three months. Participants received a US\$10 Amazon gift card delivered to their email within three to five business days after completing each questionnaire.

Three months after participants completed the online pretest survey questionnaire, they were then emailed a link to the online posttest questionnaire. The questionnaire included the same questions as in the pretest, but participants in the intervention group were also asked at the end of the questionnaire whether they had interpersonal discussions about what they learned and whether they received a notification every time a new fact was posted and what facts they could recall from the Facebook posts. One hundred and eight adolescents completed the final posttest questionnaire as instructed and were included in the final dataset.

### Measures

**Virus and Vaccine Knowledge.** In the pretest and posttest questionnaires, participants were asked to answer eight relevant questions about HPV and the HPV vaccine to assess their level of knowledge gain over the course of the intervention period. Questions included whether (1) a person can get HPV from having sex, (2) a person can have HPV and not know about it, (3) a lot of people get HPV, (4) HPV can cause cancer in females, (5) HPV can cause cancer in males, (6) HPV can cause genital warts in females, (7) HPV can cause genital warts in males, and (8) both boys and girls can get the HPV vaccine. Each answer was coded as 1 for "yes" or 0 for "no" or "don't know," for a possible knowledge score of 0 to 8. Participants overall had a pretest score of 3.74 (SD = 2.33,  $\alpha = .77$ ) and a posttest score of 4.50 (SD = 2.60,  $\alpha = .82$ ). Simple linear regression analyses did not reveal any significant differences by age or Facebook use for pretest and posttest knowledge scores, and independent samples  $t$  tests did not reveal any significant differences by gender, race, vaccine initiation, and whether had sex.

**Vaccination Completion Rates.** Study personnel developed and maintained a secure database of the adolescent patients to track their HPV vaccination rates by using information from the (state) Immunization Registry. The HPV vaccine immunization status of all participants were monitored for the duration of the study and six months after study participation. Final rates were calculated prestudy and poststudy participation as percentages based on the number of vaccine shots received out of a possible total of three (to complete the series), for a final score of 0 to 3. Participants overall had a pretest vaccination score of .52 (SD = .80) and a posttest vaccination score of .94 (SD = 1.142). Simple linear regression analyses did not reveal any significant differences by participant age or Facebook use for pretest and posttest vaccination scores, and independent samples *t* tests did not reveal any significant differences by race, gender, and whether had sex.

**Interpersonal Discussion.** In the posttest questionnaire, participants who received the intervention were asked whether they had discussed HPV or the HPV vaccine with someone else (yes, no) after “seeing the facts on the Facebook page,” and asked to indicate with whom they had these discussions. Almost half (45.4%) of participants who received the intervention said that they had discussions with others. The most common person the participants said they talked with was their mom (or female guardian; 27.8%), followed by a doctor or nurse (15.7%).

**Intervention Recall and Fidelity Check.** Participants in the intervention group were asked at the end of the posttest questionnaire to indicate whether they received a notification from Facebook every time a new fact was posted (yes, no, or sometimes). They were then also provided with all 24 facts in random order (12 about HPV and/or the HPV vaccine) that were posted to the study’s Facebook page and asked to indicate which of the facts they recalled from the intervention.

Almost half of participants in the intervention group indicated they received a notification from the Facebook page every time a new fact was posted ( $n = 40$ , 48.8%), 17 (30.5%) indicated they “sometimes” received a notification, and 25 (20.7%) reported they did not receive notifications.

An ANOVA (analysis of variance) analysis revealed that participants who reported receiving a notification every time a new fact was posted recalled an average of 9.20 facts about HPV and the HPV vaccine out of 11 total (SD = 1.91); participants who “sometimes” received a notification recalled an average of 6.18 facts (SD = 4.57), and participants who did not receive a notification

recalled an average of 3.32 facts (SD = 4.22),  $F(2, 79) = 23.58$ ,  $P < .001$ . A post hoc Bonferroni test revealed significant differences between each of the three groups for recall of facts,  $P < .05$ .

All subsequent analyses testing the effects of the intervention, therefore, examined the control group against the intervention group as a whole, as well as examining the control group and the three distinct notification groups within the intervention group, as they indicate varied levels of engagement with and exposure to the intervention. Chi-square analyses did not reveal any significant differences between the three notification groups and control group by gender, race, vaccine initiation, and whether they had sex; ANOVA analyses also did not reveal any differences for age or Facebook use,  $P > .05$ .

## Intervention Results

Hypothesis 1 proposed that adolescent participants who received the social media intervention would improve in their (a) knowledge about the virus and vaccine and (b) HPV vaccination rates compared with those who did not receive the intervention. A one-way repeated measures multivariate ANOVA (MANOVA) was conducted with pretest and posttest knowledge and vaccination scores as the dependent variables and the group variables (control, intervention) as the between-subjects factor. There was a significant between-subjects effect of group, Wilks’  $\Lambda = .93$ ,  $F(2, 104) = 4.00$ ,  $P < .05$ , and a significant within-subjects effect of time (pre to post), Wilks’  $\Lambda = .78$ ,  $F(2, 104) = 14.52$ ,  $P < .001$ , but only a marginally significant within-subjects effect of time by group, Wilks’  $\Lambda = .95$ ,  $F(2, 104) = 2.52$ ,  $P = .09$ .

An additional one-way repeated measures MANOVA was then conducted to compare the control group and the three notification groups (i.e., group variable broken into four unique groups) to determine whether the level of participation in the intervention was a more relevant predictor of the outcome variables. There was again a significant between-subjects effect of group, Wilks’  $\Lambda = .84$ ,  $F(6, 204) = 3.19$ ,  $P < .05$ , and a significant within-subjects effect of time (pre to post), Wilks’  $\Lambda = .66$ ,  $F(2, 102) = 26.23$ ,  $P < .001$ , but only a marginally significant within-subjects effect of time by group, Wilks’  $\Lambda = .90$ ,  $F(6, 204) = 1.94$ ,  $P = .08$ .

On further reflection, univariate tests revealed a significant within-subjects pretest to posttest difference between the four groups for knowledge gain,  $F(3, 103) = 2.76$ ,  $P < .05$ , but not for vaccination rates,  $F(3, 103) = 1.10$ ,  $P = .35$ . A post hoc analysis of the four groups indicated that for those participants in the intervention group who reported receiving a notification every time a new fact was posted to the Facebook page, they were

significantly more likely than any other group to increase in their HPV and vaccine knowledge,  $P < .05$ . To confirm this finding, a new group variable was created with dummy coding, such that 1 = always received a notification and 0 = all other groups (including control group). A one-way repeated measures MANOVA was then conducted, with the new group variable as the between-subjects factor and the pretest and posttest scores of knowledge and vaccination as the dependent variables. There was a significant between-subjects effect of group, Wilks'  $\Lambda = .86$ ,  $F(2, 104) = 8.35$ ,  $P < .001$ , a significant within-subjects effect of time, Wilks'  $\Lambda = .63$ ,  $F(2, 104) = 30.20$ ,  $P < .001$ , and a significant within-subjects effect of time by group, Wilks'  $\Lambda = .93$ ,  $F(2, 104) = 3.65$ ,  $P < .05$ .

Univariate tests indicated that significance of time by group was for knowledge gain,  $F(1, 105) = 7.18$ ,  $P < .01$ , though an increase in vaccine rates remained insignificant,  $F(1, 105) = .12$ ,  $P = .73$ . Participants in the intervention who reported always receiving a notification increased in their knowledge score from a 4.45 (SD = 2.31) to 5.88 (SD = 2.04), whereas participants from the other groups (as one group) only increased from a knowledge score of 3.31 (SD = 2.25) to 3.68 (SD = 2.50). Hypothesis 1 was thus not supported; however, the level of participation in the intervention may have played a role in positive knowledge gain.

Hypothesis 2 proposed that for participants who received the intervention, those who reported discussing the virus and/or vaccine with someone else as a result of the intervention would be more likely to improve in their (a) knowledge about the virus and vaccine and (b) HPV vaccination rates than those who did not discuss the information with anyone else. A one-way repeated measures MANOVA was conducted with pretest and posttest knowledge and vaccination scores as dependent variables, and the discussion variable (yes, no) as the between-subjects factor.

There was a significant between-subjects effect of discussion, Wilks'  $\Lambda = .32$ ,  $F(2, 79) = 3.30$ ,  $P < .05$ , and a significant effect of time, Wilks'  $\Lambda = .60$ ,  $F(2, 79) = 26.12$ ,  $P < .001$ , but not a significant within-subjects effect of time by discussion, Wilks'  $\Lambda = .99$ ,  $F(2, 79) = .27$ ,  $P = .76$ . Participants who discussed what they learned from the intervention with others had significantly higher knowledge scores at both pretest (M = 4.51, SD = 2.29) and posttest (M = 5.33, SD = 2.44) than those who did not (pretest: M = 3.12, SD = 2.23; posttest: M = 4.27, SD = 2.44),  $F(1, 80) = 58.84$ ,  $P < .05$ , but they did not differ in their rates of increased knowledge,  $F(1, 80) = .48$ ,  $P = .49$ , from pretest to posttest or in their vaccination rates,  $F(1, 80) = .05$ ,  $P = .82$ . Hypothesis 2 was thus not supported.

## Discussion

The purpose of the current study was to determine whether providing relevant health information from a credible health source via a commonly used social media platform (i.e., Facebook) could be a feasible and effective way to improve adolescents' knowledge about HPV and the HPV vaccine and increase HPV vaccination rates. A social marketing approach guided the current study, by gathering insight via formative research that ultimately lead to the intervention development and execution. The HBM was used as the guiding theoretical model for intervention development, such that messages were created based on the key components of the model (e.g., perceived susceptibility, etc) in an effort to improve adolescents' knowledge about the virus and vaccine and ultimately lead them to enact the proposed behavior (i.e., vaccination).

Formative research findings revealed that adolescents are generally interested in receiving information about HPV and the vaccine, along with other relevant health information, through social media channels, as long as the messages are interesting, their privacy is protected, and the source is considered credible. A three-month social media health intervention evaluation incorporating these findings indicated that adolescents who fully engaged with the intervention as instructed improved in their knowledge about HPV and HPV vaccination when compared with a control group and those less engaged with the intervention. In some cases, engaging in the intervention also lead to interpersonal discussions with others (e.g., parents, doctors) about what they learned. A significant increase in HPV vaccination, however, did not occur as a result of the intervention. These findings suggest that the strategic approach of providing informative health facts via a commonly used media channel (i.e., Facebook) has the potential to be an educational strategy for improving adolescents' HPV knowledge but may not be enough on its own to move adolescents toward behavior change (i.e., HPV vaccination).

Some adolescents are willing to, and interested in, receiving information about HPV and the vaccine, along with other health information, through social media, but the adolescent must fully engage (e.g., receive notifications) and receive all relevant content for significant knowledge gain to occur. Therefore, providing health information via social media channels may only be a strategy helpful to a specific group of adolescents, namely, adolescents who are motivated to improve their sexual health and receive health information via their social media feeds.

Notably, participants who had interpersonal discussions as a result of the intervention were much higher on knowledge gain in general than other adolescents in the study. This finding may suggest that there are unique motivational factors of adolescents willing to engage with social media health interventions, such that adolescents who already have a base level of knowledge or interest about a topic may be more willing to engage and share that information with others. Future research should attempt to uncover these motivational differences to determine the type of adolescent most receptive and ultimately focus on providing messages specific to those adolescents to lead to significant behavior change. These adolescents may have different perceptions of susceptibility, severity, and so on about the virus and vaccine that were not addressed in the current study, and therefore, once those facts are crafted into more relevant messages for this audience, the outcome of behavior change may be more feasible, at least for some adolescents. Future research should also attempt to discern what, if any, differential effects are present for knowledge gain among the various HBM constructs (e.g., does knowledge gained about benefits support vaccination more so than knowledge gained about susceptibility) and perhaps test the theory more holistically instead of just using it as a guiding framework for the design of the intervention.

Despite the lack of successful behavior change found as a result of this intervention, the interest of some adolescents to engage in social media health interventions reveals potential opportunities for health care providers to engage with at least some of their adolescent patients. Receiving a physician recommendation to get vaccinated remains a key predictor of vaccine uptake, and providers do not always have the time or ability to fully educate their patients in the clinic. They can use social media as a place to further inform adolescents about the decision to get vaccinated.

For health care practitioners to successfully incorporate this study's findings, it is important to note that communicating with the adolescent patient via social media is more complicated than simply crafting and sending/posting an engaging message, as witnessed firsthand in the current study. The adolescent must first opt in to receive such messages. To appear on an adolescent's social media "news feed" (using Facebook as an example), for example, the adolescent must first "Like" (Facebook) the account and actively engage with the information being posted. While the health care provider could purchase a paid promotion on a social media platform to ensure delivery, the participants strongly advocated against this strategy, saying they would not

take a paid advertisement/promotion seriously, seeing it as untrustworthy. Therefore, health care providers must understand the motivations and interests of their adolescent patients to ensure they are creating a platform worthy of appearing in their adolescent patients' news feeds.

Additionally, some content (i.e., sensitive health information) will not be suitable for distribution via personal channels. As HPV is a sexually transmitted infection, open discussion of the vaccine in public spaces could lead to potential stigmatization. The adolescents in the focus groups made it clear that they did not want their friends or family making assumptions about their sexual health after seeing sexual health information posted in their "public" individual spaces (e.g., main social media page). Messages about HPV and the vaccine, therefore, must be provided in places where adolescents can access the information without being directly connected to the message, such as appearing organically in their social media news feeds.

Adolescents in this study provided specific positive feedback about communicating with their health care providers via digital platforms, but developing and maintaining these digital relationships can be time-consuming, and many health care providers may not have the time, given their already busy work schedules. Enlisting help from youth staff members or an advisory board of adolescent patients could be a potential strategy to handle development workload and ensure that messages are perceived as interesting, relevant, and worthwhile to adolescents. While the HBM was a useful theoretical framework to guide the message development of the current intervention, social cognitive theory may also be an additional theory to consider,<sup>35</sup> such that messages should also focus on relevant social interactions and behavior modeling (e.g., seeing someone like them getting vaccinated or talking to their doctor).

Future research should explore additional strategies to further engage adolescents with social media health interventions such as the one used in this study, because significant and positive knowledge change did occur among those who engaged with the intervention as proposed. To improve on this study, future research should try to understand what makes some adolescent participants fully engage while others do not. Based on the data available, demographic differences (e.g., gender, age, etc) between the groups were not found, and therefore, individual motivations for engagement should be explored. Monetary incentives were the same for all participants, so individual attitudes about interventions such the one used in this study and perhaps a more nuanced examination of how these individuals use Facebook could provide greater insight into why



engagement was higher among some participants and not others.

### Author Contributions

RRO: Contributed to conception and design; contributed to acquisition; drafted manuscript; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

AS: Contributed to conception and design; contributed to interpretation; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

JC: Contributed to conception and design; contributed to interpretation; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

TCB: Contributed to conception and design; contributed to acquisition; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

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