



Evaluation of graphic messages to promote human papillomavirus vaccination among young adults: A statewide cross-sectional survey

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ABSTRACT

Young adults in the United States 18–26 years of age are eligible for human papillomavirus (HPV) vaccination, yet they rarely attend preventive healthcare visits. In contrast, they have a high prevalence of social media use, which could be leveraged to provide healthcare recommendations. Since graphics attract users, the study's primary objective was to determine the most appealing graphic to promote HPV vaccination to young adults. A cross-sectional survey was conducted at the Minnesota State Fair. Participants 18–26 years of age completed a 36-item survey including information on demographics, HPV vaccination status, eHealth literacy, and assessed the appeal of 8 Instagram graphic mock-ups promoting HPV vaccination to prevent cancer. The graphics represented 4 categories: 1) infographics; 2) disease photos; 3) young adult cancer patient photos; 4) humorous graphics. A total of 1037 eligible young adults participated in the study. Median age was 22 years. A majority were women (63%), white (82%), educated (79% post-secondary education or greater), or privately insured (85%). Although 61% reported receiving at least one dose of HPV vaccine, only 48% reported receiving all three recommended doses. Participants were slightly more drawn to posts with humorous graphics or infographics than disease or patient photos (pairwise *p*-values < 0.0001). There were small but statistically significant differences in response to graphics by gender, race, HPV vaccination status, and eHealth literacy.

In conclusion, graphic types tested in this study showed only small differences in response, suggesting that factors other than graphic type need to be explored to improve appeal of HPV vaccine promotional messaging.

1. Introduction

The human papillomavirus (HPV) is responsible for 31,500 new cancer cases in the United States each year (National Cancer Institute, 2015; Viens et al., 2016). HPV causes virtually all cervical and anal cancers, 70% of oropharyngeal cancers, 65% of vaginal cancers, 50% of vulvar cancers, and 35% of penile cancers (National Cancer Institute, 2015; Viens et al., 2016). The incidence of HPV-related cancers has been rising, primarily due to the increasing numbers of HPV-related oropharyngeal cancer (Centers for Disease Control and Prevention, 2016; Viens et al., 2016). Regions with high HPV vaccination rates have shown up to 90% decreases in both the prevalence of genital warts and high-grade cervical dysplasia (Garland et al., 2016; Maver and Poljak, 2018), yet only 65% of females and 56% of males in the United States initiate the vaccine series, and even fewer have completed the 2- to 3-

shot series (Walker et al., 2017). This is well below the national Healthy People 2020 target of an 80% HPV vaccination coverage (Office of Disease Prevention and Health Promotion, 2016).

The optimal age of vaccination is 11–12 years, but the United States Advisory Committee on Immunization Practices recommends administration of HPV vaccine for males and female ages 9 to 26 years (Centers for Disease Control and Prevention, 2011). Young adults 18–26 years of age are a particularly challenging group to reach. At this age, young adults are beginning to make autonomous healthcare decisions, yet they tend to be a healthy group and less frequently present for preventive health services compared to other age groups (Dempsey et al., 2009; Dunne et al., 2015). Therefore, the recommended strategy of increasing vaccination among adolescents by increasing and improving the quality of healthcare providers' vaccine recommendations is unlikely to be sufficient to increase population coverage of HPV

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vaccination among young adults. Other innovative strategies for reaching young adults are needed.

The vast majority (90%) of young adults report use of social media (Perrin A for Pew Research Center, 2015). In the young adult demographic in the United States, the social media application (“app”) Instagram is most often used to get news, including health news (58%), compared to sites such as Facebook (31%) or Twitter (38%) (Gottfried and Shearer for Pew Research Center, 2016). Instagram is a picture-based social media app designed specifically for smartphone use, with > 400 million daily users (Aslam S for Omnicore, 2017). Therefore, leveraging social media has excellent potential for communicating healthcare recommendations on a large scale.

Fogg's Mass Interpersonal Persuasion theory proposes that social media can combine the power of interpersonal persuasion with the reach of mass media to better persuade large numbers of people to change their attitudes and behaviors (Fogg, 2008). It does so by linking the persuasive experience with automated structure (easy tasks such as clicking “like” or forwarding make the persuasive action more likely), social distribution (sharing between “friends” make the persuasive action more credible), rapid cycle (the momentum of rapid message sharing engages users who may not otherwise have engaged), huge social reach, and publicly measured impact (high numbers of “likes,” comments, and shares generate message interest). Social media users spend very little time looking at each post, and graphics grab attention faster than text (Kahle et al., 2016); therefore, optimizing the social media graphics is essential to increasing the reach and potential impact of social media messaging. Communication studies have shown that not only do public service announcements or motivational messages evoke a variety of emotional responses, but that the emotional response can either inhibit or enhance persuasion (Nabi, 2010; Yan et al., 2012). Thus, understanding the effects of messages and graphics is critical to health promotion efforts.

The objective of this study was to determine the most appealing HPV vaccine promotion social media graphic for young adults 18–26 years of age in a large Minnesota-based convenience sample. The secondary objective was to determine differences in responses to social media graphics by demographic characteristics.

2. Methods

2.1. Data

The study was approved by the University of Minnesota's Institutional Review Board. This study was a cross-sectional survey of young adults 18–26 years of age who attended the Minnesota State Fair. The Minnesota State Fair attracts two-million people annually, and provides an opportunity to study a broad range of individuals from across the state. Participants were recruited at the University of Minnesota Driven to Discover building over four 7-h shifts between August 25 and September 4, 2017. State fair attendees were eligible to participate in the study if they were between 18 and 26 years of age (per self-report), able to read and write in English, and able to provide consent. The survey was administered via electronic tablet and the data were collected and managed using Research Electronic Data Capture (REDCap) (Harris et al., 2009). Participants received a University of Minnesota drawstring backpack on completion of the survey. All participants provided informed consent prior to initiating the anonymous survey. The patients whose photos were used for the study provided their permission for use.

2.2. Measures

The survey consisted of 36 multiple choice questions covering the following topics: 1) current HPV vaccination status (vaccinated, unvaccinated, I don't know), number of vaccine doses received (1, 2, 3, at least 1 but I'm not sure how many), reasons for not vaccinating (check

Table 1
Demographics (N = 1037).

Variable	n	(%) ^a
Median age: 22 years		
Sex:		
Male	374	(36.1)
Female	648	(62.5)
Transgender, Gender-queer, Gender-fluid, Gender identity unsure	32	(3.1)
Ethnicity ^b :		
Asian/Pacific Islander	118	(11.4)
Black/African/African American	48	(4.6)
Hispanic/Latino	51	(4.9)
Native American/Alaskan Native	29	(2.8)
White/Caucasian	847	(81.7)
Other	27	(2.6)
Highest level of education:		
Middle school/junior high	18	(1.7)
High school/GED	178	(17.2)
College/technical school	726	(70.1)
Graduate school	94	(9.1)
Total combined household income:		
≤ \$25,000	196	(18.9)
\$26,000–50,000	214	(20.6)
\$51,000–75,000	194	(18.7)
\$76,000–100,000	135	(13.0)
> \$100,000	160	(16.3)
Current health insurance status:		
Uninsured	35	(3.4)
Covered by parent/guardian's insurance	590	(56.9)
Covered by spouse/partner's insurance	29	(2.8)
Private insurance through work/school	239	(23.1)
Self-purchased private insurance	19	(1.8)
Government insurance (e.g. Medicaid)	61	(5.9)
Unknown	26	(2.5)
Sexual identity:		
Straight/heterosexual	866	(83.5)
Gay/homosexual	50	(4.8)
Bisexual	44	(4.2)
Something else	27	(2.6)
Not sure	18	(1.7)
Vaccination status (1 + dose):		
Vaccinated	637	(61.4)
Unvaccinated	211	(20.4)
Unsure	189	(18.2)
History of sexually transmitted infection	72	(7.0)
History of genital warts	15	(1.5)
History of cancer	12	(1.2)
Mean eHealth literacy (strongly disagree = 1, strongly agree = 5)	Mean	(SD)
I know how to use the health information I find online	4.0	(0.8)
I have the skills I need to evaluate the health resources I find online	4.0	(0.9)
I can tell high quality from low quality health resources online	4.0	(0.9)
I feel confident using information online to make health decisions	3.7	(1.0)
Summary score (sum of 4 items above)	15.8	(3.0)

^a Sum of results may not equal 100% due to respondents who checked “prefer not to answer.”

^b Respondents instructed to “check all that apply”.

all that apply: I never heard of the vaccine, I don't know enough about it yet, I am too old, it costs too much, it might be unsafe, I don't like shots, I thought the vaccine was only for females, my parents don't want me to get the vaccine, I don't know where to get the vaccine, I haven't been to a doctor recently, my doctor didn't recommend the vaccine, I'm not sexually active, I only have sex with one partner who does not have HPV, I've already had a lot of sexual partners, I already have HPV, other, no particular reason); 2) social media app(s) used and app used most often (Facebook, Instagram, Pinterest, Snapchat, Twitter, other, I do not use social media); 3) eHealth literacy: sum of 4 validated questions (Table 1) assessing an individual's ability to navigate the internet and evaluate online health information in regard to personal

relevance, credibility, and accuracy with response options of “very unlikely” (1) to “very likely” (5) (van der Vaart et al., 2011) and responses dichotomized for analyses, with those at or above the mean score (16 out of 20) categorized as having “high” eHealth literacy; 4) demographic data: age, biologic sex (male, female, prefer not to answer), gender (“Do you consider yourself transgender, gender-queer, gender-fluid, or unsure about your gender identity?” yes, no, prefer not to answer), race (check all that apply: Asian/Pacific Islander, Black/African/African American, Native American/Alaskan Native, White, Other), ethnicity (check all that apply: Hispanic/Latino(a), Hmong, Somali, None, prefer not to answer), sexual orientation (bisexual, gay/homosexual, straight/homosexual, something else, not sure, prefer not to answer), highest level of education (middle school/junior high, high school/GED, college/technical school, graduate school, prefer not to answer), household income (\leq \$25,000, \$26,000–\$50,000, \$51,000–\$75,000, \$76,000–\$100,000, > \$100,000, prefer not to answer), zip code of residence; 5) health information: history of sexually transmitted infection(s) (yes, no, I don't know, prefer not to answer), history of cancer (yes, no, I don't know, prefer not to answer); 6) previous exposure to (yes, no, I don't remember) and impact of social media messaging about HPV vaccine (“How would you describe the information you saw?” check all that apply: helpful, applied to me/geared toward my age group, in support of the vaccine, against the vaccine, interesting, boring, accurate, trustworthy, eye-catching, balanced, easy to read, easy to understand, confusing, other, none of the above).

Graphic advertising appeal of: 1) infographics; 2) disease photos; 3) young adult cancer patient photos; and 4) humorous graphics was tested using 8 Instagram mock-ups, two from each category (Fig. 1). The 4 categories were chosen based on popularity of graphics, not necessarily related to healthcare, on social media (humorous graphics), current social media and other print media advertising from health organizations such as the Centers for Disease Control and Prevention (infographics; patient photos; humorous graphics), and review of the literature regarding other health campaigns such as smoking cessation campaigns (disease photos; patient photos). The graphics and messages

for each category were conceived of, created, and voted on by an advisory panel composed of 8 University of Minnesota undergraduate and medical students, and a graphic designer transformed the graphics and messages into an Instagram-style mock-up. Each mock-up had Instagram-style text encouraging HPV vaccination to prevent cancer (e.g. “This summer remember to protect your corndog #HPVvaccine #PreventCancer” with a photo of a corndog). All participants viewed all 8 images presented in the same order. For each image a survey questions asked, “If this message showed up in your Instagram feed how likely is it that you would stop to read it?” Response options ranged from “very unlikely” (1) to “very likely” (5).

2.3. Analyses

Survey responses were summarized using descriptive statistics. Use of social media and access to health care information items were compared by demographic variables using Chi-squared tests. To test the response to a graphic theme (i.e. humorous graphics, infographics, disease photos, patient photos) rather than individual graphics, the average rating of the two images for each category was calculated for each participant and pairwise comparisons between each of the four categories were conducted using paired *t*-tests. Means \pm standard deviations (SD) are presented. In addition, responses to each of the four categories were summarized by demographic variables including gender, age (18–22, 23–26), race (white, other), education (high school graduate or less vs. at least some college/technical school), and eHealth literacy (below/above median score) were compared across groups using two-sided two-sample *t*-tests assuming unequal variance. Fully adjusted multivariable linear regression models including all of these demographic variables were also conducted. P-values were adjusted for multiple comparisons using a Bonferroni correction as appropriate. Statistical analyses were performed using SAS 9.4 (Cary, NC) and p-values < 0.05 were considered statistically significant.

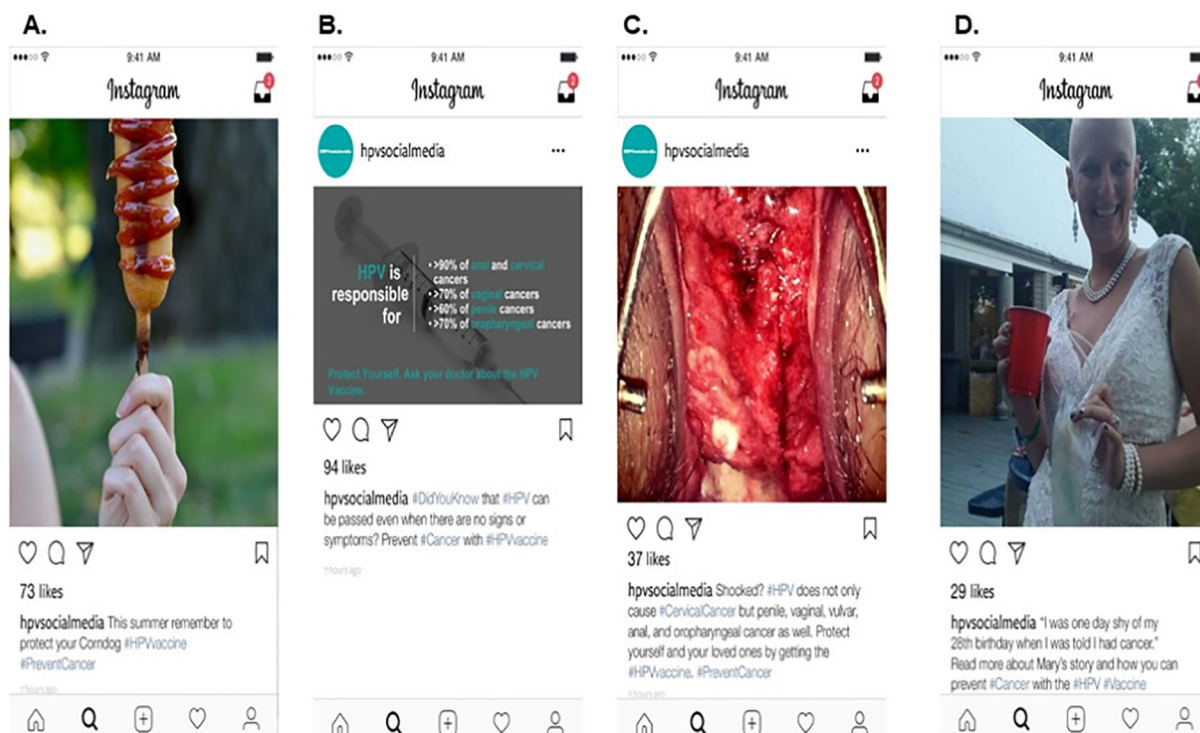


Fig. 1. Examples of graphics tested: A) Humorous graphic; B) Infographic; C) Disease photo; D) Patient photo.

3. Results

3.1. Participant characteristics

A total of 1114 Minnesota state fair attendees participated in the study. After excluding participants outside of the target age range, there were 1037 eligible participants who formed the population for this study.

Baseline demographics for the study participants are detailed in Table 1. Two-thirds (63%) of the participants were women, and 3% reported being transgender, gender queer, gender fluid or unsure of their gender. Median age was 22 years, with 55% age 18–22 years, and 45% age 23–26 years. A majority of participants (82%) were white. Most participants were well-educated, with 820 (79%) reporting at least some post-secondary education (college, technical school) or greater. A majority of participants (85%) had private insurance, with the most (57% of the entire sample) insured through a parent or guardian. A majority of participants perceived themselves to be eHealth literate, with a mean score of 15.8 ± 3.0 out of a maximum score of 20.

3.2. Social media use

Reported social media use is detailed in Table 2. Most participants reported using more than one social media app. When asked which site participants used most often, Facebook ranked highest (40%), followed

Table 2
Social media use.

	All		18–22 y/o		23–26 y/o	
	n	(%)	n	(%)	n	(%)
Social media apps used^a						
Facebook	905	(87.3)				
Twitter	419	(40.4)				
Instagram	722	(69.6)				
Snapchat	811	(78.2)				
Pinterest	418	(40.3)				
Other	98	(9.5)				
I do not use social media	34	(3.3)				
Social media app used most frequently^b						
Facebook	398	(40.0)	149	(27.2)	249	(55.6)
Twitter	69	(6.9)	41	(7.5)	23	(6.3)
Instagram	183	(18.4)	113	(20.7)	70	(15.6)
Snapchat	309	(31.1)	228	(41.7)	81	(18.1)
Pinterest	12	(1.2)	5	(0.9)	7	(1.6)
Other	24	(2.4)	11	(2.0)	13	(2.9)
Previously seen information about HPV vaccination on social media?						
Yes	188	(18.1)	88	(15.4)	100	(21.5)
No	676	(65.2)	383	(67.1)	293	(62.9)
I do not remember	173	(16.7)	100	(17.5)	73	(15.7)
Views of social media HPV vaccine information previously seen^a						
Helpful	80	(42.5)				
Applied to me/geared toward my age group	43	(22.9)				
In support of the vaccine	86	(45.7)				
Against the vaccine	10	(5.3)				
Interesting	46	(24.5)				
Boring	16	(8.5)				
Accurate	28	(14.9)				
Trustworthy	16	(8.5)				
Eye-catching	42	(22.3)				
Easy to read	46	(24.5)				
Easy to understand	35	(18.6)				
Confusing	7	(3.7)				

^a Respondents asked to check all that apply.

^b Differences in app use by age statistically significant ($p < 0.0001$).

by SnapChat (31%) and then Instagram (18%). The most frequently used app varied by age, with SnapChat ranking highest among 18–22 year-olds (42%) and Facebook ranking highest among 23–26 year-olds (56%). There were no differences in reported frequency of use by race or gender. Only 18% of respondents reported seeing information about HPV vaccine on social media. Among this subgroup, 23% felt it was geared toward the young adult age group. While 43% found the information helpful, only 22% rated it as eye-catching, and 24% found it interesting. Only 19% found it easy to understand. Almost half (46%) recalled seeing social media messaging in support of the vaccine, and 5% recalled messaging against the vaccine.

3.3. Response to graphics

When asked how likely they would be to stop and read the study-generated Instagram messages, ratings for the individual images ranged from 2.6 ± 1.1 (patient photo) to 3.4 ± 1.1 (humorous graphic). Respondents rated the humorous graphics (pair mean rating 3.3 ± 1.0) and infographics (3.2 ± 1.1) statistically significantly higher than the disease graphics (2.9 ± 1.3) and patient photos (3.0 ± 1.0 ; $p < 0.001$ for pairwise comparisons). Nonetheless, the mean likelihood ratings on a 5-point Likert scale for the four graphic types were clustered around the “neutral” response option (Fig. 2).

In the multivariable model, differences in statistically significant message ratings by category were observed by gender, race, HPV vaccination status, and eHealth literacy (Table 3). Females rated the patient photos (mean difference 0.28, 95% CI: 0.14–0.41) higher than males. Non-white respondents rated infographics higher than white respondents (0.21, 95% CI: 0.04–0.38). When controlling for factors typically associated with HPV vaccination status including gender, age and race, HPV-vaccinated respondents rated humorous graphics higher than those who were not vaccinated or who were unsure of their vaccination status (0.17, 95% CI 0.02–0.31). Those with higher eHealth literacy reported higher ratings of the humorous graphics (0.15, 95% CI: 0.02–0.28), disease photos (0.21, 95% CI: 0.03–0.39) and infographics (0.21, 95% CI: 0.03–0.39) compared to those with low health literacy. No differences were observed by age (dichotomized based on the median age of the study participants) or education level.

4. Discussion

HPV vaccination is a frequent topic on social media (Keim-Malpass et al., 2017; Teoh et al., 2018), and an ecologic study has shown a correlation between regional HPV vaccine message sentiment and vaccination rates (Dunn et al., 2017). Furthermore, randomized controlled trials in which adolescents were randomized to “like” a study Facebook page, and thus receive future messages from the study group in their social media feed have shown that participants enjoyed receiving facts via social media, and that interest in the messages was

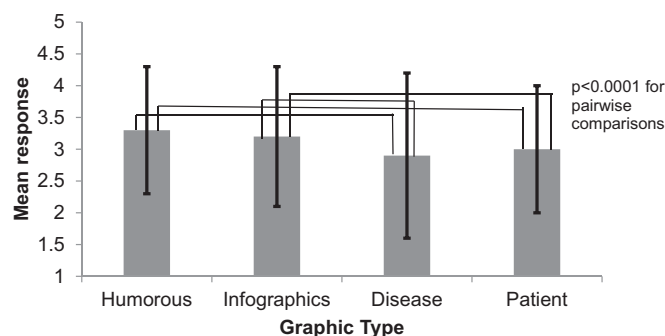


Fig. 2. Mean response to images. Each response is the mean of 2 photos within each category. Images were rated on a 5-point Likert scale, with 1 = very unlikely to read and 5 = very likely to read.

Table 3
Multivariable models of response to graphics.

Variable	Gender (female vs. male)		Age group (18–22 vs. 23–26 years)		Race (non-White vs. White)		Education (< College vs. College +)		eHealth literacy (16+ vs < 16)		HPV vaccination status (yes vs. no/unsure)	
	Mean difference (95% CI)	p-Value	Mean difference (95% CI)	p-Value	Mean difference (95% CI)	p-Value	Mean difference (95% CI)	p-Value	Mean difference (95% CI)	p-Value	Mean difference (95% CI)	p-Value
Humorous	0.11 (0.03, 0.25)	0.14	0.05 (−0.09, 0.19)	0.50	−0.02 (−0.16, 0.15)	0.94	−0.07 (−0.25, 0.11)	0.44	0.15 (0.02, 0.28)	0.03	0.17 (0.02, 0.31)	0.02
Infographic	−0.02 (−0.18, 0.14)	0.81	0.05 (−0.10, 0.20)	0.53	0.21 (−0.04, 0.38)	0.01	−0.19 (−0.39, 0.01)	0.06	0.30 (0.16, 0.45)	< 0.0001	0.05 (−0.10, 0.21)	0.49
Disease	0.04 (−0.16, 0.24)	0.68	−0.16 (−0.35, 0.03)	0.10	−0.17 (−0.37, 0.04)	0.12	0.14 (−0.11, 0.38)	0.28	0.21 (0.03, 0.39)	0.02	0.01 (−0.18, 0.21)	0.91
Patients	0.28 (0.14, 0.42)	0.0001	−0.02 (−0.16, 0.12)	0.75	0.01 (−0.15, 0.16)	0.94	0.02 (−0.16, 0.20)	0.83	0.11 (−0.02, 0.25)	0.09	−0.01 (−0.15, 0.13)	0.91

associated with improved knowledge about the vaccine, increased discussion with friends about the vaccine, and increased intention to seek vaccination (Ortiz et al., 2017; Ortiz et al., 2016). Social media users scroll through messages quickly, and graphics catch the eye more quickly than text (Kahle et al., 2016), leading to greater engagement with social media posts compared to posts composed of text only (Strekalova and Krieger, 2017; Theiss et al., 2016). However, the reasons for the popularity of certain messages remains unclear. In this pilot study, we sought to determine what type of graphic promoting HPV vaccination is most appealing to young adults.

Communications research has shown that elicited emotions can impact the extent to which individuals engage with and share information, and can also enhance or impede the persuasive effect (Nabi, 2010; Peters et al., 2009). In this study we attempted to elicit fear or disgust using disease photos, sadness using patient photos, and happiness using humorous photos. We also tested the effect of infographics since such graphics are often used by professional health organizations advocating for HPV vaccination (e.g., the Centers for Disease Control and Prevention). Our study showed statistically significant differences in response to the different graphic categories. However, small effects suggest that our findings are unlikely to have significance for clinical or public health practice. Mean responses hovered near the “neutral” response on the Likert-type scale, and it is unclear if the graphics truly had no difference in appeal or if the participants were under-engaged given that these were simulated images tested at a busy state fair rather than real-time social media messages. It is also possible that our graphics did not elicit the intended emotional responses. In contrast to the results of our study, other social media research found that photos eliciting a strong response (“awe-inspiring”) were associated with the highest social media engagement regardless of newsworthiness (Kahle et al., 2016).

Consistent with research suggesting that responses differ by the media consumer's background (Ramanadhan et al., 2017), in the present study, we found that gender, race, HPV vaccination status and eHealth literacy showed small but statistically significant effects on graphic response. Additionally, we did not assess effects of vaccine framing in the present study, but it is possible that message framing may have a greater effect on message appeal and persuasion than graphic type. Our study presented HPV vaccination as an intervention to prevent cancer, aligning with the current recommendations from the Centers for Disease Control and Prevention which are based on research with parents of younger adolescents (Prevention, 2017). However, optimal message framing among adolescent and young adults is equivocal, with multiple studies suggesting that framing HPV vaccination as an intervention to prevent genital warts may be a more effective for young adults (Krieger and Sarge, 2013; Reiter et al., 2017; Yang and Pittman, 2017).

We used Instagram mock-ups to evaluate social media graphics since nationally Instagram is the most-used social media app among

young adults age 18–29 years (Pew Research Center: Jeffrey Gottfried, 2016). However, Facebook was both the most popular and most frequently used app among study participants. Thus, the generalizability of findings from our Minnesota population to young adults in other areas of the United States is unclear and multimodal messaging may be needed to adequately reach a heterogeneous young adult population.

The primary strengths of our study include the large number of participants and short time frame for data collection. While the majority of participants were female, there were still a substantial number of male participants (n = 374). The study was conducted during a 2 week time period so variations in responses are unlikely to be due to external factors such as new reports of HPV vaccination statistics or new HPV vaccine advertisements, giving us confidence in our findings. We also tested response to two graphics in each category, allowing for better assessment of the appeal of a type of graphic rather than an individual graphic; result validation will require a larger study with multiple images from each category randomly presented. Limitations of the study include a convenience sample drawn from Minnesota state fair attendees, limiting study generalizability, and self-reported data. However, other research finds that young adults reliably report their HPV vaccination status (Rolnick et al., 2013). While representative of Minnesota, the study population was also predominantly white, educated, insured, and vaccinated against HPV. Results from our research suggest differences in graphic response by vaccination status independent of gender, age or race, and additional research is needed to determine the most attractive graphics to the unvaccinated young adult population that is the target audience for this messaging. Based on the effect of graphics in other healthcare campaigns, it is possible that the type of graphic does have an impact on message appeal, but that the graphics tested were suboptimal. The graphics for this study were designed by a highly-educated group of students within the target population age, and future studies may benefit by development and testing of graphics using focus groups composed of a more varied group of individuals. The format of this study dictated that graphics were presented to all participants in the same order, and it is possible that responses to later images were primed by previous images; results may be different when graphics are tested in real-time social media among other social media messages. Lastly, additional research is needed to evaluate whether the role of social media is limited to increasing knowledge of the topic or whether it has the potential to increase HPV vaccine uptake, as a recently published study showed that although adolescent study participants were highly engaged with Facebook messages as measured by clicks, “likes,” comments and shares, only 2 of 155,100 adolescents reached sought vaccination through a program in which barriers such as payment and parental consent were removed (Mohanty et al., 2018).

5. Conclusion

While the advertising appeal of humorous graphics, infographics, patient photos and disease photos were not tested in real-time social media, the results of this cross-sectional study suggest that factors other than optimal graphics, such as vaccine framing, may be more important in maximizing message appeal. Future social media health campaigns need to be tailored to appeal to adolescents and young adults from a variety of backgrounds, with a variety of graphics, messaging, topics, and utilization of a mixture of social media apps.

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Conflicts of interest

None.

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