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Effects of a Narrative HPV Vaccination Intervention Aimed at Reaching College Women: A Randomized Controlled Trial

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Abstract This longitudinal study reports on the development and evaluation of a narrative intervention aimed at increasing human papillomavirus (HPV) vaccination among college women. The prevention of HPV is a public health priority due to its pervasiveness and relationship to cervical cancer, the second leading cause of cancer deaths among women worldwide. Pilot work utilizing culture-centric narrative theory guided development of the intervention content. Exemplification theory led to hypotheses comparing communication sources of the narrative messages (peer only, medical expert only, or a combination of the two source types) in a four-arm randomized controlled trial (N=404; 18–26 year olds). The combined peer-expert narrative intervention nearly doubled vaccination compared to controls (22% vs. 12%). The pragmatic goal of increasing HPV vaccination and the theoretical predictions about message source were supported. As predicted, the inclusion of peer and medical expert sources plays a critical role in promoting HPV vaccination among college women. Furthermore, the intervention increased HPV vaccination by increasing vaccine self-efficacy and intent. Theoretical and practical implications for designing effective HPV vaccine messages are discussed.

Keywords HPV vaccination · Culture-centric narrative communication theory · Communication source · College women

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Human papillomavirus (HPV) is a pervasive infection that has been linked to multiple disease progressions including cervical and anogenital cancers (Dunne et al. 2007; Munoz et al. 2006). Most notable is the publicized link between HPV and the potential for women to develop cervical cancer. Annually, an estimated 11,000 women in the U.S. are newly diagnosed with cervical cancer and 4,000 die from the disease (Parkin 2006). With these morbidity and mortality statistics, HPV prevalence incurs not only a clinical, but also an economic public health burden (Dunne et al. 2007). Repeat clinic visits due to chronic HPV infection, particularly among young adults, result in an estimated 3.4 billion dollars spent annually on the diagnosis and treatment of HPV infection and related cervical cancer in the U.S., making HPV the second most expensive sexually transmitted infection (STI) after HIV (Soper 2006).

College-aged women are at disproportionally higher risk for acquiring HPV with 75% of new HPV infection rates occurring among 18–26 year olds (Dunne et al. 2007). The Centers for Disease Control and Prevention's (CDC's) Advisory Committee on Immunization Practices (ACIP) recommends catch-up vaccination for 18–26 year olds (Adams et al. 2009; CDC 2010; Markowitz et al. 2007). Despite the vaccine's near 100% efficacy for the targeted forms of cancer and that young adult women are at higher risk, HPV vaccination among 18–26 year olds remains low nationally at 10–12% (Conroy et al. 2009; Dempsey et al. 2011; Jain et al. 2009). Widespread adoption of the vaccine could significantly reduce the HPV public health burden. With national low adoption rates the main prevention task that lies ahead is to increase vaccination. To this end, a narrative prevention intervention aimed at college-aged women was developed and evaluated in this study.

A Narrative Communication Prevention Model

Culture-centric narrative theory (Larkey and Hecht 2010) guided development of the intervention content. A narrative approach to designing health messages focuses on the ways people structure reality (including health decisions) by telling stories (Fisher 1987). The advantages of a narrative over an informational approach include more effectively reaching audiences who are less involved, resistant, have low knowledge about the health issue at hand, or who are in early stages of behavior adoption (Kreuter et al. 2010; Larkey and Gonzalez 2007; Zillmann and Brosius 2000). College women's prototypical HPV vaccine decision stories were used as the intervention message in this study. The prototypical narratives were used to engage and attract less involved college-aged women who might otherwise not listen.

Translating culture-centric narratives into intervention components involves first identifying prototypical stories related to the health behavior in question (Hecht and Miller-Day 2009). This relies on tapping into implicit cultural values and rendering these values explicit in the narratives used as health messages (Guttman et al. 2008). It is important to identify narratives that reflect the cultural codes that invoke personal meanings for the audience. An example of how narratives are translated into intervention components is illustrated by the school-based substance use prevention program *keepin' it REAL* (Hecht and Miller-Day 2009). This program utilizes four prototypical drug resistance narratives that adolescents commonly apply when they encounter drug offers from peers: (1) a straightforward refusal narrative [REFUSE], (2) resisting drug offers by giving an explanation [EXPLAIN], (3) avoiding situations or places where youth engage in substance use [AVOID], and (4) leaving situations or scenes when substances are offered [LEAVE] (Hecht and Krieger 2006; Hecht et al. 2003; Hecht and Miller-Day 2009). For examples of these videos, go to http://kir.psu.edu/curriculum/videos/#. A culture-centric narrative approach prioritizes the audience's conceptualization of the health issue and provides cultural codes for motivating behavior change. In the case of HPV vaccination and college women, prototypical vaccine decision narratives are hypothesized as being more persuasive compared to non-narrative (control) messages in advocating HPV vaccination.

Prototypical HPV vaccine decision narratives were identified by the author by interviewing college women and soliciting their HPV vaccine decision narratives (Hopfer and Clippard 2010). Using specialized narrative interviewing techniques, women were asked to recount how they went about making the decision to vaccinate including experiences, people or events that shaped their decision. Women who had not vaccinated were also interviewed to identify attitudinal barriers to vaccination. After coding for emergent decision themes including family, peer, and health care provider messages that college women received and coding for college women's interpretation of these messages, four prototypical vaccine decision themes were used for the intervention: susceptibility narratives, vaccine self-efficacy narratives, vaccine safety narratives, and mother-daughter narratives (Hopfer and Clippard 2010).

HPV susceptibility narratives specific to college-aged women included sharing stories of knowing someone with HPV and sharing relationship stories that raise awareness about serial monogamy being the primary transmission mode for HPV. Efficacy narratives included realizing that access to HPV vaccination is available on campus, that the appointment takes 15 min and can be integrated into busy college life schedules, that email reminders are sent for completion of all three shots, that cost barriers can be overcome, and that supportive parent messages facilitate vaccination. Vaccine safety narratives included resistance to vaccinating because of the recency of vaccine development and mistrust of the federal approval process for new drugs and vaccines. Mother daughter narratives included the importance of supportive parental messages expressed through financial (paying for the cost of the vaccine), logistical (arranging the appointment) or normative (saying that vaccination was a good thing) support. According to Bandura's social cognitive theory (2002a, b), narratives that model how efficacy barriers can be overcome are expected to increase vaccine self-efficacy, and in turn increase vaccine intent. Intent acts as precursor to vaccine adoption. The narratives themselves are not the only consideration in how they influence. The deliverer or communication source is likely to have an equally important influence on audiences (Daley, Vamos et al. 2010).

Communication Source Considerations

Exemplification theory (Zillmann 1999) is a narrative approach, which argues that the choice of communication source for an influence attempt can be a crucial determinant of the success of narrative behavior change campaigns (Zillmann and Brosius 2000). Applied to the context of designing a persuasive vaccine campaign, the theory indicates that communication source plays a critical role in college women's HPV vaccine decisions. Communication source may play an even more important role when uncertainty surrounds an advocated health behavior such as a new vaccine. Up to one-fourth (25%) of the U.S. public has significant mistrust of vaccines generally (Gellin et al. 2000; Poland et al. 2009; Rees 2010). A minority (5–10%) of the U.S. public mistrusts the HPV vaccine (Conroy et al. 2009; Daley, Crane et al. 2010; Hopfer and Clippard 2010; Licht et al. 2010; Stupiansky et al. 2010; Zimet et al. 2010). Findings from exemplification studies suggest that the

inclusion of like-aged peers is necessary for conveying social trust as influence attempt for college-aged women while inclusion of medical experts is necessary for motivating compliance (Zillmann 2002). Thus, a combined source condition was predicted to be most persuasive in promoting HPV vaccination than either source alone. Based on this theorizing, a series of hypotheses were posed.

H1: The odds of HPV vaccination for women receiving the peer-and-expert narrative intervention will be higher than women receiving non-narrative (control) messages. The combined peer-expert narrative will show the strongest effects compared to peer-only and expert-only narratives.
H2: The odds of HPV vaccination for women receiving the peer-only intervention will be higher than women receiving non-narrative (control) messages.
H3: The odds of HPV vaccination for women receiving the expert-only intervention will be higher than women receiving non-narrative (control) messages.
H4: The relationship between the intervention and HPV vaccination will be mediated by intent.
H5: The relationship between the intervention and intent will be mediated by vaccine self-efficacy.

Method

Participant Recruitment Procedure

In the fall of 2008, upon receiving IRB approval, 1,000 women between the ages 18 and 26, who had not been seen at the campus university health center were randomly sampled from the university health service's database using a random number generator. A University Health Services staff person who maintains the University Health Services database randomly sampled students by filtering the database according to the inclusion criteria, assigning a random number, then sorting by that number, and selecting the first 1,000 names. The University Health Services staff person sent each of these 1,000 women an email with a notice about the study. The email was sent from University Health Services using the subject heading: health related announcements L-UHS-Alerts. The email advertisement announced the study, solicited volunteers, and included an eligibility statement that only women who had not been vaccinated for HPV were eligible to participate. Volunteers who participated received a $6 lunch coupon upon completion of the study as compensation.

A total of 404 female students from the 1,000 randomly sampled were eligible and participated representing a 40.4% recruitment rate (2 women responded to the advertisement but did not meet eligibility criteria because they were already vaccinated). The randomly sampled population's sociodemographic characteristics were similar to the general university female population based on published and publicly available university demographics. This indicates the sample is unlikely to be biased with respect to sociodemographics. Of the 404 eligible participants who expressed interest, all received the intervention or a control, completed the survey, and responded to the 2-month post-intervention email about vaccination, representing a 100% response rate (Cook et al. 2000).

Experimental Study Procedures

Volunteers that met eligibility criteria signed up for a 30-min time to come to a computer lab, watch the brief video intervention, and complete a posttest online survey. Upon arrival to the computer lab, participants were seated at a computer and briefed by the author about the purpose and procedures of the study (i.e., participants were consented). Participants were asked to come to a lab to ensure that they receive the intervention in an uninterrupted manner, complete the survey in its entirety, and that the video played seamlessly. Student volunteers were seated at every other computer to ensure privacy when completing the survey. A pre-intervention survey was administered to collect socio-demographic, sexual activity, and HPV knowledge information. Volunteers then received the treatment (i.e., a narrative video intervention) or a control and then completed an immediate post-test online survey. The post-test survey asked participants of their intent and perceived vaccine self-efficacy.

Volunteers who received a treatment viewed one of three videos: (1) a video of vaccine decision narratives delivered by peers, (2) a video of narratives delivered by medical experts, or (3) a video of narratives delivered by a combination of peers and experts. Volunteers who received a control viewed one of three controls: (1) an informational video without narratives, (2) the campus website providing information about HPV and the vaccine, or (3) no message. Two months after receiving the intervention or control, participants were emailed asking them whether they received the first HPV vaccine shot.

Stimulus Development

The intervention content was based on prototypical HPV vaccine decision narratives collected during formative research (Hopfer and Clippard 2010). Each video included four types of vaccine decision narratives: (1) HPV susceptibility narratives (stories of a sister or friend who had been diagnosed with HPV), (2) vaccine self-efficacy narratives about overcoming barriers to vaccinate (e.g., finding time to vaccinate, cost of vaccination, availability of the vaccine on campus), (3) vaccine safety narratives (describing the rigorous process of clinical trials and FDA approval), and (4) narratives prompting college women to vaccinate regardless of their dating status (i.e., whether or not they are sexually active).

Format of the narratives included either direct testimonials (e.g., college woman telling a story that motivated her to vaccinate) or re-enactments (a re-created scenario of college women talking in a dorm room about what prompted them to vaccinate and a re-created scenario of women talking at the campus health waiting room discussing scheduling and insurance for the vaccine).

Communication source used in each video operationalized the study condition. There were three treatments: peer only, medical expert only, and combined peer-expert. Five treatment videos were produced that operationalized these three treatments: two videos were peer delivered vaccine decision narratives (the videos differed only by actresses used); two videos were peer and medical expert delivered vaccine narratives (these videos also differed only by actresses used); and one video was medical expert delivered (due to restricted filming only one version of the campus health providers was produced). Two versions of intervention videos were produced to rule out actor effects and extend generalizability (Jackson and Jacobs 1983).

The two peer-only interventions were 521 words in length and were 3.46 and 3.39 min in length. The expert-only intervention was shorter, containing only 210 words and 1.25 min in length. The combined peer-and-expert narratives were 556 words and were 4.11 and 4.15 min, respectively, in length. The informational website control condition was 546 words in length while the informational video was 1 min in length and 120 words in length. These differences in length are a methodological limitation that will be discussed in the conclusion section.

Three control conditions were used in the study. The video control condition provided a content-matched control while the website control provided a topic-matched control. The video control condition ruled out alternative explanations related to media format while the website control provided a natural environment control (i.e., information that college women would receive had they sought information online at the university health services website). The no message control was used to provide a comparison between utilizing a brief intervention and a no message exposure. All the control conditions represented a non-narrative condition lacking the personal decision narratives. After establishing that control group means were not significantly different, they were collapsed for the purpose of parsimony in analyses.

Measures

All measures were derived from existing scales and confirmatory factor analyses conducted to verify their validity in the current study sample. Four covariates relevant to HPV vaccination were included in structural equation modeling: HPV knowledge, sexual activity, daughter-parent vaccine communication, and age.[1]

HPV Knowledge was measured by the HPV knowledge scale (Brewer and Fazekas 2007) consisting of 10 true/false knowledge items, 8 items about HPV symptoms, 8 items about consequences of untreated HPV, and 8 items about risks for acquiring HPV (M=7.48, SD=1.6; α=.66). Participants were asked to mark all items that applied (only 3 of 8 symptom items were correct; 3 of 8 consequence items correct, and 5 of 8 risk items correct). Composite scores were computed by counting the proportion of correctly marked items. Higher scores indicate greater HPV knowledge.

Sexual Activity was measured by a scale developed by Sales et al. (2008). Participants indicated if they were (1) sexually active at this time, (2) not currently sexually active but have been in the past 12 months, or (3) not currently sexually active but plan to be in the future. Responses from (1) were coded as 1=sexually active and responses from (2) and (3) were collapsed and recoded as 0=not currently sexually active.

Daughter-Mother HPV Vaccine Communication was measured by a single item (Kahn et al. 2008). Participants responded with a *no*=0 or *yes*=1 to the statement "My mother and I have talked about HPV vaccination."

HPV Vaccination Intent was measured by two intent items from Brewer and Fazekas (2007): "I intend to get vaccinated for HPV" and "If the HPV vaccine were completely free, how likely would you be to get the HPV vaccine in the next year?" Scale format consisted of a 4-point response scale ranging from 1=*definitely won't* to 4=*definitely will* with higher scores indicating greater intent to vaccinate (M=6.04, SD=1.60, α=.82; r=.71).

HPV Vaccine Self-Efficacy was measured by two items: "How confident are you that you could get vaccinated completely against HPV; that is get all three shots?" and "How confident are you that you could find time to go to University Health Services for three visits to get vaccinated against HPV?" (Kahn et al. 2008). Response format was a 7-point scale with responses ranging from 1=*not at all confident* to 7=*completely confident*. Higher values indicated greater self-efficacy (M=10.95, SD=2.86, α=.70; r=.53).

HPV Vaccine Uptake Vaccination was measured using self-report (yes/no) data collected 2-months after participants received the intervention. The author emailed participants 2 months after they received the intervention asking whether they had received the first HPV vaccine shot. Participants responded by email.

[1] Age was included as a covariate in structural equation modeling posthoc and did not change results.

Data Analysis

Preliminary analyses included examining the feasibility of collapsing same exposure treatment groups that differed only by actress used in the video (same condition), testing for baseline equivalence of means across groups, confirming the factor structure of the measures, and checking missingness. Logistic regression was used to assess whether treatment increased HPV vaccination compared to control messages. The three treatment conditions were dummy coded to compare each intervention to the control group. Structural equation modeling was performed using Mplus 5.21 to test mediation hypotheses (Muthen and Muthen 2007). Full information maximum likelihood (FIML) method was used to handle missing data (Graham 2009).

Results

Participants

A total of 404 college women ranging in ages 18 to 26 (M=21, SD=1.87) participated in the randomized controlled trial. The majority of participants were Caucasian (72%), had health insurance coverage (90%), and had heard of HPV (92%). Half of the participants (50%) were sexually active (i.e., reported having engaged in penetrative intercourse in the last 30 days) and slightly more than half (53%) had spoken with their mother about the HPV vaccine (see Table 1).

Table 1 Participant sociodemographics (N=404)

Sociodemographics	% (N)
Year in College	
Junior	30 (122)
Senior	24 (95)
Sophomore	19 (77)
Graduate student	16 (63)
First Year	11 (44)
Ethnicity	
Caucasian	72 (290)
Asian-American	11 (46)
African-American	10 (40)
Latino	5 (18)
Middle Eastern	.01 (4)
Native American	.002 (1)
Health Insurance Coverage	
Yes	90 (365)
No	8 (32)
Didn't know	1 (4)
HPV Knowledge	
Have heard of HPV	92 (372)
Link between cervical cancer & HPV	97 (390)
Link between warts & HPV	62 (249)
Sexual Activity	
Active	50 (202)
Intercourse last 30 days	54 (220)
Daughter-Mother HPV Talk	53 (214)

Collapsing Same Exposure Treatment Groups

Two versions of each intervention condition video were developed to avoid the problems associated with messages as fixed effects (Jackson and Jacobs 1983). Following the recommendations of Jackson and Jacobs, comparisons were made across each version. There were no significant differences within conditions on the outcome measures. Independent sample t tests between the two peer versions, which differed only by actresses used in the video showed no significant differences across a range of outcomes: intent [t (97)=1.264, p=.21], vaccine self-efficacy [t (96)=−.643, p=.522], HPV susceptibility [t (97)=.432, p=.67], and belief about the HPV vaccine's effectiveness [t (97)=.198, p=.84]. Similarly, there were no significant differences between the two peer-expert video versions on outcomes: intent [t (99)=−.675, p=.50], vaccine self-efficacy [t (98)=.167, p=.87], HPV susceptibility [t (99)=.065, p=.95], and belief about the vaccine's effectiveness [t (99)=.345, p=.731]. Following Jackson and Jacobs' recommendations, and as a result of finding no significant differences, videos reflecting the same study condition were collapsed.

Successful Randomization

At baseline, there were no significant differences between intervention and control groups across sociodemographics or covariates (see Table 2).

Did the Intervention Increase HPV Vaccination?

Logistic regression was conducted to compare vaccination between treatment and control groups (H1-3). Among participants receiving the combined peer-expert narrative intervention, the odds of vaccinating 2 months later was twice as likely compared to controls (OR=2.07; 95% CI=1.05, 4.10; p=.036). By contrast, the peer-only narrative intervention did not significantly increase the odds of vaccinating compared to controls (OR=1.61, 95% CI=.80, 3.28, p=.185). Neither did the expert-only intervention. It showed a decrease in the odds of vaccinating compared to control messages (OR=.48, 95% CI=.13, 1.69; p=.25). These results support hypothesis 1, that the combined peer-expert intervention increased vaccination

Table 2 Successful randomization

	Peer	Peer & Expert	Expert	Control
Mean Age	21	21	21	21
Year in College	Junior	Junior	Junior	Junior
Mean HPV Knowledge	7.64	7.36	7.50	7.40
Insurance Coverage	89% (88)	92% (92)	88% (44)	93% (141)
Caucasian	70% (68)	80% (80)	82% (40)	68% (102)
Suburban	61% (60)	65% (65)	68% (34)	55% (83)
Sexually Active	57% (58)	55% (55)	58% (29)	51% (78)
D-M HPV Talk	54% (53)	61% (60)	48% (24)	51% (77)

D-M=daughter-mother. ANOVAs were computed for age and knowledge contrasts. Chi square tests were computed for the remaining categorical variables. None of these analyses produced statistically significant differences ($p>.05$), indicating that randomization was successful in equalizing the groups

compared to control messages and that the combined source intervention as predicted showed strongest effects. However, hypotheses 2 and 3 predicting that the peer-alone and expert-alone narratives result in higher vaccination compared to control messages were not supported.

Chi square analyses of vaccination frequencies were conducted to assess the magnitude of effects. Overall, 15% of the 404 participants ($n=61$) vaccinated 2 months after receiving the treatment or control. Chi square analysis showed that among women receiving the combined peer-expert intervention, vaccination was nearly double (22%) that of women receiving a control condition (12%). This difference was significant: χ^2 (3, 404)=8.6, $p<.035$ (see Table 3).

How Might the Narrative Intervention be Operating?

Structural equation modeling was conducted to investigate whether the intervention (i.e., HPV vaccine decision narratives) influences vaccination behavior by increasing vaccine self-efficacy and intent (H4 and H5). HPV knowledge, sexual activity, daughter-mother vaccine communication, and age were included in the model given that these covariates play a role in HPV vaccine decision-making (Kahn et al. 2003).

The Measurement Model

The measurement model included two latent factors: HPV vaccination intent and vaccine self-efficacy. The measurement model fit the data well: SB-χ2=15, df=10, SB-χ2/df= 1.5, CFI=.99, RMSEA=.04, and $p$close=.23. A good model fit is indicated when RMSEA≤.06 and CFI≥.95 (Hu and Bentler 1999). Satorra Bentler chi square (SB-χ2) was used to correct for non-normality. $\chi 2/df$ should be less than 3 indicating a good fit (Carmine and McIver 1981). Correlations among the latent constructs were significantly different from each other supporting their discriminant validity. Inspection of the latent factors in the CFA measurement model showed that the intent items correlated with each other strongly ($r=.71$) while they correlated weakly with efficacy ($r<.45$). Vaccine self-efficacy items correlated only moderately with each other ($r=.53$); however, they still demonstrated discriminant validity correlating to a lesser extent with other items. Interfactor scale correlations also were examined and demonstrated moderately strong correlations among factors. Less than 2% of data on each variable was missing.

The Structural Model

Structural equation modeling (SEM) using FIML was performed to answer hypotheses 4 and 5. To answer hypothesis 4, SEM results including the mediator intent showed that the combined peer-expert intervention significantly increased vaccination ($\gamma=.195$, $p<.000$) while the peer-only intervention ($\gamma=.079$, $p<.207$) and expert-only intervention ($\gamma=-.050$, $p<.444$) did not. To answer hypothesis 5 (see Fig. 1), SEM results showed that the combined peer-expert intervention significantly increased vaccination ($\gamma=.590$, $p<.000$) via vaccine self-efficacy ($\gamma=.263$, $p<.000$) and intent ($\gamma=.480$, $p<.000$), while the peer-only intervention ($\gamma=.116$, $p<.057$) and the expert-only intervention ($\gamma=-.089$, $p<.100$) did not. Direct effects (not shown in Fig. 1 for parsimony) between the intervention conditions and vaccination were not statistically significant (the peer-only to vaccination path was non-significant: $\gamma=.067$, $p=.45$; the peer-and-expert to vaccination path was non-significant: $\gamma=.086$, $p=.46$; and the expert-only to vaccination path was non-significant: $\gamma=-.122$, $p=.252$).

Table 3 Vaccine intent, self-efficacy, % HPV vaccinated ($N=404$)

Condition	Intent (*SE*)	Efficacy (*SE*)	% Vaccinated	*N*
Peer	2.92 (.83)	5.82 (1.48)	17.8 (18)	101
Peer & Provider	3.10 (.66)	5.95 (1.21)	21.8 (22)	101
Provider	2.74 (.88)	4.73 (2.05)	6.0 (3)	50
Control	2.81 (.78)	5.27 (1.72)	11.8 (18)	152

Joint indirect effects of vaccine self-efficacy and intent mediating the relationship between the intervention and vaccination were tested for whether they were significant using bias corrected confidence intervals in PRODCLIN: Lower and upper 95% confidence intervals of .19951 and .43064 did not contain zero indicating a statistically significant mediation effect (MacKinnon et al. 2007a, b). In the model, the R^2 for HPV vaccination was 40% while the R^2 for vaccine intent was 23%, and R^2 for vaccine self-efficacy was 5%. Hypotheses 4 and 5 were supported.

An equivalent model in which vaccine self-efficacy and intent each simultaneously predicted vaccination was also tested. The equivalent model's comparative fit indices (AIC, BIC) were higher than the proposed model indicating a worse fit: For the equivalent model, comparative fit indices were AIC=2652.0 and BIC=2716.0, while fit indices for the hypothesized model were AIC=2598.81 and BIC=2650.8.

Discussion

The study reports on the evaluation of a theory-based HPV vaccine narrative intervention aimed at increasing vaccination among college-aged women. Results show that the combined peer-health care provider message was an effective strategy for increasing HPV vaccination. In fact, this short, 4 minute intervention nearly doubled the rate of vaccination initiation (i.e., receiving the first of three HPV vaccine shots). As a result, the study met its practical goal of increasing HPV vaccination and its main theoretical goal of examining the role of communication source in vaccine behavior.

The study also makes a significant theoretical contribution. Three unique prevention strategies are introduced in this study that advance prevention science. First, vaccine decision narratives were used successfully as communication strategy to provide context-specific information that resonated with the intended audience of college women—an audience that might otherwise not attend to these messages. Second, results support the importance of considering communication source type in relationship to vaccination behavior. Third, analyses clarified how narrative prevention strategies impart influence on vaccine behavior change.

Communication Source Plays a Critical Role in HPV Vaccine Campaigns

The findings from this study demonstrate that communication source matters for HPV vaccination among college-aged women, supporting predictions from exemplification theory (Zillmann 2006). The results also corroborate formative research indicating that inclusion of peer messages normalizing vaccination and medical expert messages endorsing vaccination play a crucial role in motivating HPV vaccination (Hopfer and Clippard 2010). Although peer-alone and expert-alone narratives did not significantly increase HPV vaccination in this study, their effects may have been underpowered.

Peer-expert intervention effects may be explained by this intervention providing the level of reinforcement required for message acceptance. A meta-analysis of health campaigns including vaccine campaigns shows that reinforced messages have the greatest message effects (Snyder and Hamilton 2002). Combining different source types to reinforce a message boosts perceived credibility and trust (Wang 2008). Unlike dieting and exercise, which the public assumes are "good for you"; the public still has significant trust concerns with vaccines (Downs et al. 2008). Many are skeptical and weary about the safety of vaccines (Downs et al. 2008). Particularly for vaccine campaigns, including both peer and expert narratives appears to be the preferred strategy to communicate with college women.

Results of the peer-expert intervention were more effective than the control, but these same results were not found for the peer-only or expert-only video. For the expert-only intervention, this may be explained by a weaker dosage effect since this intervention was shorter in length. On the other hand, peer-expert video effects cannot solely be attributed to duration factors given that the peer-only intervention was the same length as the peer-expert video yet also did not show significant effects.

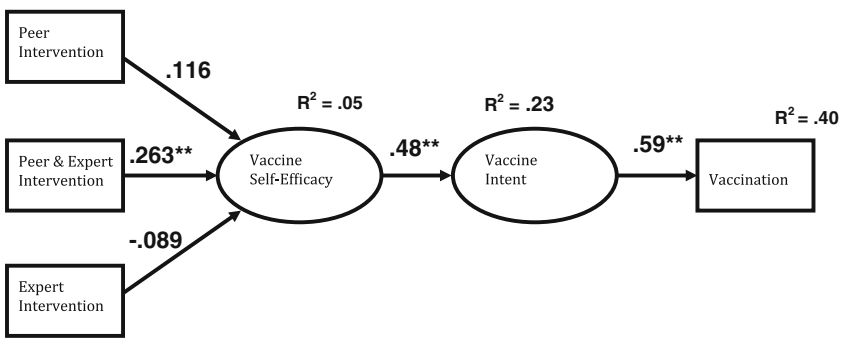

Fig. 1 Mediation model testing the effects of a narrative video intervention on HPV vaccination via vaccine self-efficacy and intent. $^{**}p=.01$

Another reason why the expert-only intervention may not have been evaluated favorably by college women is because they are less receptive to authority figure messages. The combined source intervention opened with a peer-delivered narrative and ended with a medical expert's narrative. Opening with a peer message may attract college women's attention. Ending with the medical expert narrative, which reflected a mother-daughter narrative (a mother who is a doctor encouraging her own daughter to vaccinate) possibly motivated compliance with vaccination. The findings highlight that source effects likely differ depending on the health behavior in question and developmental stage of the audience.

Vaccine Self-Efficacy Narratives Increase Vaccine Intent

Mediation analyses showed that increasing vaccine self-efficacy plays a role in increasing HPV vaccination. Prior research has shown the important role that vaccine self-efficacy plays in HPV vaccination (Kahn et al. 2008). Results indicate that HPV vaccine decision narratives increased vaccination by normalizing vaccination and modeling how to overcome vaccine barriers whether logistical or psychological. For college women these barriers often include increasing awareness and access to vaccination through on campus opportunities, making vaccination accessible through short appointments that can be worked into busy schedules, providing email reminder services to complete all three shots and providing strategies for college women to discuss vaccination with their parents. Narratives that address overcoming these vaccine efficacy barriers will more likely resonate with college women.

Practical Importance of the Study

The randomized controlled trial suggests that implementing this brief, stand-alone narrative video intervention, which combines peer and expert vaccine narratives can significantly increase HPV vaccination. Vaccination among participants receiving the peer-expert intervention was nearly double (22%) that of participants receiving the control message (12%). These significant intervention effects were observed despite the brief nature of the intervention and the fact that both treatment and control groups were exposed to strong media attention about HPV vaccination (Fan 2002; Snyder and Hamilton 2002). Additionally, increase in vaccination was shown under rigorous experimental conditions (random sampling, random assignment, two versions of each peer narrative using different actors). Having a one-time narrative intervention impact behavior change offers a low-cost prevention strategy to increase vaccination and reduce the HPV public health burden.

University student health centers can benefit from brief interventions such as the one exemplified in this study to lower sexually transmitted infections (STI) prevalence including HPV. Similar brief interventions have also shown positive effects (Downs et al. 2004; Myint-U et al. 2010). This intervention is particularly attractive for campus health centers because it does not require a counseling component, has the potential to save health care staff time by covering the basics of HPV vaccination, arouses interest in college women to follow up during clinic visits, and can correct misinformation. University health centers offer an efficient dissemination vehicle for delivering stand-alone brief interventions such as this one because they reach large numbers of young adult women in an efficient low-cost manner.

Limitations

Several limitations of the efficacy trial should be noted. First, vaccination initiation (i.e., the first shot) was measured as outcome rather than completion of all three HPV shots. Future studies will need to capture and fully account for the intervention's effectiveness in motivating women to complete all three vaccine shots and receive full immunity benefits. Second, study findings are limited to the college-aged female population at the study's university, which reflects a largely Caucasian population. Interventions aimed at reaching minority, low socioeconomic, or male populations will need to identify vaccine messages that resonate with these audiences. A third limitation of the study is that the expert-only intervention was shorter in length, which did not permit dosage effects to be ruled out as explanations for differences. Finally, women's prior HPV diagnosis history was not collected during the experimental study. Randomization in theory should balance groups of women with a prior history of HPV but future studies should include this information and adjust for it in models.

Future Research

Further research is still needed to identify narrative mechanisms of persuasion. Culture-centric narrative theory for health promotion (Larkey and Hecht 2010) hypothesizes that mediator variables relevant to understanding how narratives operate include identification with characters, degree of engagement, and social proliferation (rehearsal, talking with friends and family). These mediators of narrative influence will be tested in a future study. Additionally, to better understand how peer and expert sources influence audiences with respect to vaccine compliance, mediators such as social and medical trust need to be examined.

Finally, advancing HPV prevention entails not only advancing theoretical work, but extending such prevention research to other populations. Future research will need to evaluate vaccine messages aimed at reaching not only men (since the HPV vaccine is FDA approved for males) but also populations who are at known higher relative risk for cervical cancer who are vulnerable because of their low access to preventive services such as Pap test screening and the HPV vaccine. Latina, African-American, Vietnamese-American, and Appalachian female populations have the highest rates of cervical cancer mortality in the United States and worldwide, and have the least access to Pap test screening and HPV vaccination (CDC 2009). Future efforts are needed to extend narrative prevention campaigns to reach these populations, increase HPV vaccination, and thereby reduce HPV-related morbidity and mortality.

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