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The effects of message framing and healthcare provider recommendation on adult hepatitis B vaccination: A randomized controlled trial

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ABSTRACT

Many adults in the U.S. do not receive recommended vaccines, and the research literature remains inconclusive on the best communication strategies for increasing this behavior. This study examined the association of message framing (gained-framed vs. loss-framed vs. control), and healthcare provider (HCP) recommendation (offered vs. recommended) on uptake of adult hepatitis B virus (HBV) vaccination in a high risk population using a 3 × 2 block design randomized controlled trial. Fear of shots, fear of vaccines, and perceived message framing were examined in secondary analyses. Of the 1747 participants, 47.7% (n = 833) received 0 doses of HBV vaccine, 27.8% (n = 485) received 1 dose, 10.4% received 2 doses, and 14.1% received all 3 recommended doses. There was not a significant interaction between message framing and HCP recommendation (p = .59). Mean number of doses received by the gain-framed group (m = 0.96) was not significantly different from the loss-framed group (m = 0.97, RR = 0.99, 95% CI = 0.88–1.12). However, those receiving any framing message received significantly more doses (m = 0.96) than those in the control condition (m = 0.81, RR = 1.17, 95%CI = 1.06–1.31). Participants who received a HCP recommendation received significantly more vaccine doses (m = 0.95) than those in the vaccine-offered condition (mean = 0.82, RR = 1.16, 95%CI = 1.05–1.28). These results suggest there is no difference in vaccine uptake between gain-frame and loss-frame messages, but both are better than a control message. These results also support advising HCP to provide a strong recommendation for vaccinations beyond merely offering it to patients. This study has implications for vaccine uptake beyond HBV, and can inform future research on effective vaccine communication research.

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1. Introduction

Despite clear evidence of effectiveness and safety, many adults in the United States have not received recommended vaccines and remain susceptible to vaccine-preventable diseases (Williams et al., 2016). The National Vaccine Advisory Committee (2014) and others (Malosh et al., 2014; Johnson et al., 2008a) note the importance of provider recommendation in adult vaccine receipt, yet there remains uncertainty regarding the structure and content of effective vaccine recommendations. This study presents a clinical intervention testing message framing and strength of provider recommendation on hepatitis B virus (HBV) vaccination receipt among previously unvaccinated adult patients attending sexually transmitted diseases (STD) clinics.

1.1. Framing

Rothman and Salovey (1997) interpreted Prospect Theory (Tversky and Kahneman, 1981) to suggest that messaging should be targeted on the perceived risk associated with a health behavior. They argued disease-prevention behaviors (e.g., vaccination) were low-risk, whereas disease-detection behaviors (e.g., mammography screening) were high-risk because of the potential for hearing bad news. The authors hypothesized disease-prevention behaviors could best be encouraged by gain-framed messages (i.e., emphasizing the advantages of a behavior), whereas disease-detection behaviors could be encouraged by loss-framed messages (i.e., emphasizing the disadvantages of forgoing disease detection). However, several research reports and meta-analytic reviews have presented persuasive theoretical and empirical refutations

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of this interpretation of Prospect Theory (O'Keefe and Jensen, 2007; O'Keefe and Jensen, 2009; Cox et al., 2006; O'Keefe and Nan, 2012; O'Keefe and Wu, 2012; Gallagher and Updegraff, 2012; Van 't Riet et al., 2014; Van 't Riet et al., 2016; Penta and Baban, 2018; Frew et al., 2014). Despite these critiques, both research and public health programs continue to use gain-framed messages for preventive behaviors and loss-framed messages for detection behaviors (Centers for Disease Control and Prevention, 2018a; Centers for Disease Control and Prevention, 2018b; Nakamura et al., 2017; De Jaegher, 2019).

While vaccination is considered a disease-prevention (low-risk) behavior in terms of Prospect Theory, many individuals also perceive vaccination as a high-risk behavior (e.g. injection pain, vaccine side effects) (Mouchet et al., 2018). Alternatively, strong arguments have been made that perceived risk/safety may be irrelevant with respect to message framing, particularly in light of the fact that "risk" in Prospect Theory refers to uncertainty, not to perceptions of harm (Cox et al., 2006; Van 't Riet et al., 2014; Van 't Riet et al., 2016). Given the public health importance of vaccination (Andre et al., 2008), it is essential to provide further evidence regarding the most effective message-framing approach for encouraging vaccination.

1.2. Provider recommendation

In addition to message framing, consensus has grown that the strength of a healthcare provider's (HCP; e.g. physician, nurse practitioner) recommendation can substantially influence vaccination rates. While it is not known whether vaccine recommendation varies across types of HCP, it is clear a strong HCP recommendation is one of the best predictors of vaccination behavior in both parents (deciding for their children) and adults (deciding for themselves) (Johnson et al., 2008b; Holman et al., 2014; Williams et al., 2014). However, *how* HCPs recommend vaccination may make a difference. Research suggests when HCPs use a presumptive approach to recommending vaccination (i.e., present vaccination as a default expectation) children and adolescents are more likely to get vaccinated (Opel et al., 2013; Sturm et al., 2017; Shay et al., 2016; Dempsey and O'Leary, 2018; Gilkey et al., 2015). However, the evidence supporting presumptive recommendations is based on observational studies (Opel et al., 2013; Sturm et al., 2017; Shay et al., 2016), cross-sectional self-report surveys or interviews (Gilkey and McRee, 2016), and interventions designed in a way that made it difficult to rigorously control the specific wording of the recommendation message delivered (Brewer et al., 2016; Dempsey et al., 2018).

1.3. Current study

The purpose of the present study was to evaluate the effects of message framing and HCP recommendation strength on HBV vaccination. HBV vaccine has been available for over 30 years (Meireles et al., 2015). It is a 3-dose series all children currently get starting at birth (Centers for Disease Control and Prevention, 2017). In 2017, 91.9% of adolescents aged 13–17 years had received all 3 HBV vaccine doses (Walker et al., 2018). In contrast, only 48.6% of adolescents were up-to-date on human papillomavirus (HPV) vaccination (Walker et al., 2018). Even though rates of childhood HBV vaccination are quite high, coverage among adults is variable, and vaccination is still recommended for high-risk adults (e.g., multiple sexual partners, injection-drug users) (Schillie et al., 2018). Though the data reported in this manuscript were collected 12–15 years ago, message communication around vaccine uptake in general and especially among at-risk populations remains a critical public health concern, as exemplified by outbreaks of vaccine-preventable diseases in the U.S. (Phadke et al., 2016). This present study examines the effect of message framing and HCP recommendation on HBV vaccine uptake in a randomized controlled trial of previously unvaccinated adults. The study also explores potential moderators of vaccination behavior, including fear of shots, fear of vaccines, and perception of message framing.

2. Methods

2.1. Procedures and participants

Research staff recruited participants from three STD clinics, one in Indianapolis, IN and two in Chicago, IL from 2003 to 2007. Patients 18 years of age or older who were able to understand spoken English, were HBV and HIV negative (by self-report), and had never received HBV vaccine (by self-report) were eligible to participate. Patients who enrolled completed an audio, computer-assisted self-interview (ACASI) in a private setting. After completing the ACASI, participants were seen by a nurse practitioner for STD-related care and vaccine administration. The study was approved by the institutional review boards of Indiana University-Purdue University Indianapolis and the Chicago Department of Public Health. All participants provided written informed consent and were compensated $20 for the time and effort involved in completing the ACASI.

2.2. Measures and interventions

The ACASI assessed socio-demographic variables (age, sex, education, race, employment status, relationship status, and family income). In addition, potential moderators of framing effects included two scales adapted from a previous study on predictors of HBV vaccination (Zimet et al., 2008): Fear of Shots and Fear of Vaccine, which were measured using a 5-point response format ranging from Strongly Disagree to Strongly Agree. Fear of Shots had four items (e.g., "Getting shots can be scary") and had good internal reliability (coefficient alpha = 0.79). Fear of vaccine had six items (e.g., "Hepatitis vaccine shots are dangerous") and also had good internal reliability (coefficient alpha = 0.78).

There were three message framing conditions related to receiving HBV vaccine (Gain-Framed; Loss-Framed; Control) and two HCP recommendation conditions (Vaccine Offered; Vaccine Recommended), resulting in a 3 × 2 experimental design. A block randomization approach programed into the ACASI ensured that for every block of 30 participants, 5 were assigned to each of the 6 experimental conditions. Participants and researchers were blinded to the framing intervention and participants, but not research staff, were blinded to the recommendation intervention.

2.2.1. Message framing

The message framing interventions were delivered via the ACASI. The gain-framed message emphasized the advantages of HBV vaccination, whereas the loss-framed message emphasized the disadvantages of not getting vaccinated. Both gain- and loss-framed messages involved non-narrative and narrative information (See Table 1 for examples). Narrative messages were targeted to the respondent's sex (e.g., using a female name for female respondents, and a male name for male respondents). The control condition simply re-iterated three basic facts about HBV vaccination that was provided to all participants: 1. HBV can be transmitted by unprotected sex and sharing needles; 2. A vaccine for HBV exists; and 3. The vaccine requires 3 shots over 6 months to be most effective at preventing infection. The messages appeared on the screen as text and participants had the option of having the ACASI read the text out loud to them through headphones.

As a manipulation check, we asked participants whether the message they received emphasized the benefits of receiving the HBV vaccine (i.e., gain-framed) or if it emphasized the risks associated with not receiving the vaccine (i.e., loss-framed).

2.2.2. HCP recommendation

The HCP interventions were delivered by the nurse practitioner at the end of the medical exam. Medical encounters were periodically

Table 1
Content of message framing interventions.

	Control	Gain-frame	Loss-frame
Intro	We want to remind you that hepatitis B virus can be transmitted by unprotected sex and by sharing needles. A vaccine for hepatitis B virus exists. It requires 3 shots over 6 months to be most effective at preventing infection with the hepatitis B virus	People who get the hepatitis B shot are gaining a chance to protect themselves and the ones they love.	People who don't get the hepatitis B shot are losing a chance to protect themselves and the ones they love.
Part 1		Michael/Angela felt very healthy and didn't believe s/he would be infected by the hepatitis B virus. But s/he followed the advice of the American Medical Association and got 3 hepatitis B vaccine shots over 6 months. Because of this, s/he is protected against hepatitis B infection. Now s/he is much less likely to get sick or die from serious liver disease, and s/he can look forward to a long and healthy life, watching his/her child grow up.	Michael/Angela felt very healthy and didn't believe s/he would be infected by the Hepatitis B virus. So s/he didn't follow the advice of the American Medical Association and didn't get 3 hepatitis B vaccine shots over 6 months. Because of this, s/he is not protected against hepatitis B infection. Now s/he is much more likely to get sick or die from serious liver disease, and s/he may miss out on a long and healthy life watching his/her child grow up.
Part 2		James/Michelle decided s/he needed to protect him(her) self and got the hepatitis B vaccine. As a result, s/he did not get infected after having sex with an infected partner. Because James/Michelle did not get infected with the hepatitis B virus, s/he did not pass it on to his/her new partner. So, his/her new partner did not get sick with hepatitis B, and now they have gained a chance for a healthy future together.	James/Michelle decided s/he didn't need to protect him (her)self and didn't get the hepatitis B vaccine. As a result, s/he got infected after having sex with an infected partner. Because James/Michelle got infected with the hepatitis B virus, s/he passed it on to his/her new partner. So, his/her new partner got sick with hepatitis B, and now they have lost their chance for a healthy future together.

audio-recorded to assess fidelity of intervention delivery. No problems with message delivery were identified through this process. The vaccine-offered message was, “We have free hepatitis B virus vaccine available. Would you like to get vaccinated?” The vaccine-recommended message was, “We have free hepatitis B virus vaccine available. I strongly recommend that you get vaccinated.”

2.2.3. Outcome

The outcome of interest was number of HBV vaccine doses received (i.e., 0, 1, 2, or 3 doses received). For those who agreed to receive vaccination, the first dose was provided by the nurse practitioner after the recommendation was delivered. Participants were sent reminders for second and third doses. Within the study protocol, participants were allowed up to eight months to complete the three-dose series.

Additional information on the study protocol is available at clinicaltrials.gov (NCT00739752) or by contacting the senior author (GDZ).

2.3. Analyses

The sample size requirement was modeled based on a 6-group ANOVA design (3 × 2). In order to detect a small effect size (f = 0.1) (Cohen, 1988), setting power at 80% and the significance level at 0.05, a sample size of 200 per group would be required (Faul et al., 2007). The actual sample sizes across the six groups ranged from 284 to 299, indicating sufficient power to detect a small effect size in number of HBV vaccine doses, even with the use of Poisson regression rather than ANOVA. The trial was stopped at the end of the funding period, after adequate power was achieved.

The primary outcome of interest was number of HBV vaccine doses received, which ranged from 0 to 3. We began by assessing whether there was an interaction between message framing and HCP recommendation. We then ran a series of Poisson regression analyses to assess the effect of message interventions on vaccine doses. The first set of analyses focused on direct evaluations of: 1. gain-framed vs. loss-framed messages; 2. framed vs. non-framed (i.e., control) messages; and 3. HCP recommended vaccine vs. HCP offered vaccine. The second set of analyses examined fear of shots and fear of vaccines as potential moderating factors influencing the association of message framing with vaccination. According to Prospect Theory, those who score high on fear of shots or fear of vaccine should be more responsive to a loss-framed message, whereas those who score low on fear of shots or fear of vaccine should be more responsive to a gain-framed message. The third set of analyses examined the effect of perceived message frame (perceived gain-framed vs. perceived loss-framed) on doses of vaccine.

3. Results

3.1. Sample description

A total of 3336 patients were screened for participation, with 716 refusing to participate, 866 ineligible, and 3 who withdrew prior to randomization, leaving 1751 participants. The main reasons for refusal were lack of time or not interested. Primary reasons for ineligibility were report of prior HBV vaccination, HBV or HIV positive, and under 18 years of age. There were four computer failures, resulting in a final sample of 1747 participants. Of the final sample 7.2% (n = 126) were collected in 2003, 29.4% (n = 514) were collected in 2004, 28.4% (n = 497) were collected in 2005, 25.5% (n = 445) were collected in 2006, and 9.4% (n = 165) were collected in 2007. Within the ACASI, 33.2% (n = 580) were randomized to the gain-framed message, 33.4% (n = 584) to the loss-framed message, and 33.4% (n = 583) to the control group. After the ACASI, participants were re-randomized to either the provider-offered condition (n = 50.5%) or the provider-recommended condition (n = 49.5%). See Fig. 1. The final sample was 60% male, 81.6% Black, and 18–80 years of age (Median = 29). For a full sample description by message framing and recommendation, see Table 2.

Of the 1747 participants, 47.7% (n = 833) refused vaccination. Of the 52.3% (n = 914) who received the first dose of vaccine, 46.9% (n = 429) returned for the second dose and 27.0% (n = 247) returned for the third dose. The main outcome variable, number of doses, breaks down as follows: 0 doses (n = 833; 47.7%); 1 dose (n = 485; 27.8%); 2 doses (n = 182; 10.4%); 3 doses (n = 247; 14.1%).

3.2. Intervention group comparisons at baseline

To confirm the randomization procedure resulted in similar groups we carried out one-way analyses of variance for continuous variables and chi-square tests for categorical variables using data from the pre-intervention survey. The six groups (framing by provider recommendation type) were not significantly different (i.e., $p > .05$) with respect to age, gender distribution, education, race, employment status, relationship status, family income, or study site. In addition,

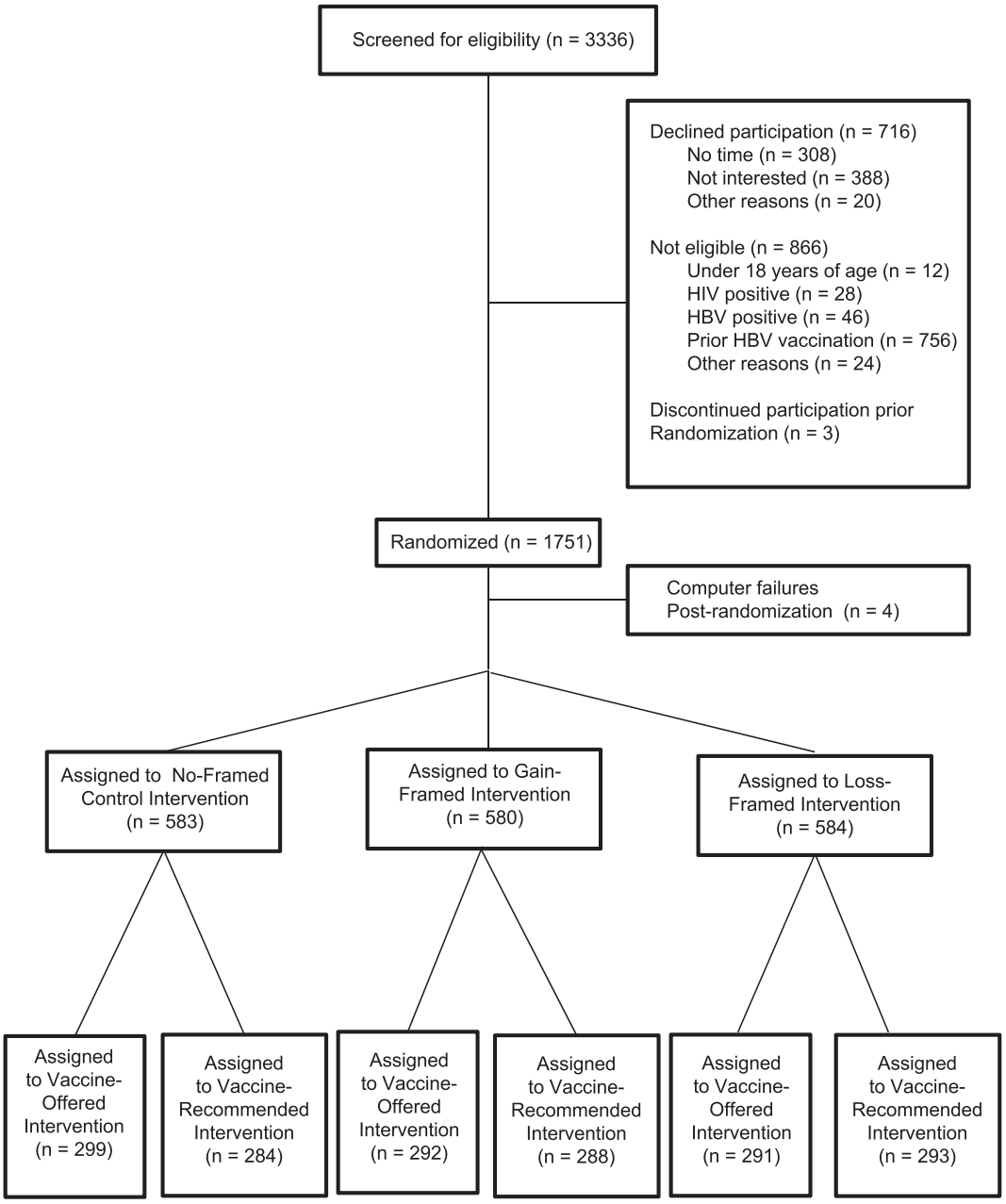

Fig. 1. CONSORT flow diagram.

there were no statistical differences on the two attitudinal measures, Fear of Shots and Fear of Vaccine (Table 2).

3.3. Message framing and HCP recommendation

We first tested the interaction of framing group with HCP recommendation group. The interaction was not significant (Wald Chi-Square = 0.30, $p = .59$, relative risk [RR] = 0.97 95%CI = 0.86–1.09), so all subsequent analyses examined only the main effects of the interventions. Those receiving a gain-framed message received a similar number of doses of vaccine (Mean = 0.96) as those receiving a loss-framed message (Mean = 0.97; Wald Chi-Square = 0.02, $p = .88$, RR = 0.99, 95%CI = 0.88–1.12). However, those receiving any framing message (either loss-framed or gain-framed) received significantly more doses (Mean = 0.96) than those in the control condition (Mean = 0.81; Wald Chi-Square = 8.54, $p < .01$, RR = 1.17, 95%CI = 1.06–1.31). Similarly, participants in the vaccine-recommended condition received significantly more vaccine doses (Mean = 0.95) than those in the vaccine-offered condition (Mean = 0.82; Wald Chi-Square = 8.47, $p < .01$, RR = 1.16, 95%CI = 1.05–1.28). Fig. 2a and b illustrate the percent of the sample receiving each dose of HBV vaccine by message group and HCP recommendation, respectively.

3.4. Moderation analyses for message framing

Results of the analysis showed no significant main effect for gain- vs. loss-framed message (Wald Chi-Square = 1.68, $p = .20$, RR = 1.44, 95%CI = 0.83–2.48) and no significant interactions of fear of shots (Wald Chi-Square = 3.17, $p = .08$, RR = 1.12, 95%CI = 0.83–1.24) or fear of vaccine (Wald Chi-Square = 0.03, $p = .86$, RR = 1.02, 95%CI = 0.83–1.24) with message framing. Furthermore, the trend towards significance for fear of shots was in the opposite direction of that predicted by the theory. Among those receiving the loss-framed

Table 2
Intervention group comparisons at baseline.

Characteristic	No-framed + offered	No-framed + recommended	Loss-framed + offered	Loss-framed + recommended	Gain-framed + offered	Gain-framed + recommended
Mean age (SD)	31.2 (9.7)	31.8 (9.8)	31.2 (9.8)	31.7 (9.4)	32.1 (10.1)	32.3 (10.6)
Gender						
% Female	40.5	37.0	38.5	39.6	40.1	42.4
Education						
% < High school	26.4	24.3	19.2	24.6	24.3	18.1
% High school graduate	39.1	37.7	40.2	44.7	41.1	41.2
% > High school	34.4	38.0	40.5	30.7	34.6	37.8
Race						
% African American	84.3	82.0	81.1	79.5	81.8	80.9
Employment status						
% Currently employed	47.8	54.6	57.7	51.0	53.4	52.1
Relationship status						
% Married/partnered	53.0	51.4	52.2	51.1	55.7	55.5
Annual family income						
% < $10,000	50.7	42.8	42.9	47.6	44.1	41.0
% $10,000–$29,0000	35.4	38.0	36.2	37.5	34.1	37.3
% > $30,000	13.9	19.2	20.9	14.9	21.9	21.8
Study site						
% Indianapolis	37.1	35.6	35.4	36.5	35.6	35.8
% Chicago site 1	32.4	33.1	34.4	32.4	33.6	33.3
% Chicago site 2	30.4	31.3	30.2	31.1	30.8	30.9
Mean fear of shots (SD)	2.8 (0.9)	2.9 (1.0)	3.0 (1.0)	2.9 (1.0)	2.8 (1.0)	2.9 (1.0)
Mean fear of vaccine (SD)	2.4 (0.6)	2.4 (0.6)	2.5 (0.6)	2.4 (0.6)	2.4 (0.6)	2.4 (0.6)

message, higher fear of shots was associated with fewer doses of vaccine ($r = -0.13$, $p < .01$). Among those receiving the gain-framed message, there was no significant association of fear of shots with doses ($r = -0.04$, $p = .30$). Overall, fear of shots was associated with fewer doses of vaccine received (Wald Chi-Square = 6.48, $p < .05$, RR = 0.78, 95%CI = 0.65–0.94). Fear of vaccines was not associated with vaccine receipt (Wald Chi-Square = 3.06, $p = .08$, RR = 0.75, 95%CI = 0.55–1.04).

3.5. Perceived message-framing analyses

Overall, message delivered was significantly associated with message perceived (Chi-Square = 87.35, p < .01), but the Kappa statistic (0.26) indicated only modest agreement between the two (see Fig. 3). Of those who received the gain-framed message, 80.6% accurately reported the message emphasized the advantages of HBV vaccination (19.4% reported the message emphasized the disadvantages of not getting vaccinated). However, of those who received the loss-framed message, only 45.3% accurately reported the message emphasized the disadvantages of not getting HBV vaccination (54.7% reported the message emphasized the advantages of vaccination). Therefore, we examined whether perceived message frame, rather than intended message frame, might be associated with number of vaccine doses received. However we found no significant effect for perceived frame on vaccination (Wald Chi-Square = 0.57, $p = .45$, RR = 0.95, 95%CI = 0.84–1.08) and no significant interaction of fear of shots (Wald Chi-Square = 0.26, $p = .61$, RR = 0.97, 95%CI = 0.85–1.10) or fear of vaccine (Wald Chi-Square = 0.93, $p = .34$, RR = 0.90, 95%CI = 0.73–1.12) with perceived frame.

4. Discussion

The purpose of this study was to examine the effect of message framing and provider recommendation type on receipt of HBV vaccine. We found no support for the idea that a gain-framed message would be more effective than a loss-framed message for HBV vaccination. The lack of difference between gain- and loss-framed messaging remained consistent even when considering the potential moderating factors of fear of vaccine and fear of shots. Moreover, the results held even when the analysis focused on perceived framing condition. Our findings, therefore, are contrary to the interpretation of Prospect Theory proposed by Rothman and Salovey (1997) and consistent with the literature that finds no distinct pattern of results related to gain/loss message framing and health behavior with respect to vaccination. Few prior studies of message framing have included a control condition, relevant moderating factors, perceived frame, and a behavioral outcome. This study, therefore, represents a particularly thorough and rigorous evaluation of message framing.

We found that either framing condition was more effective than the information-only control condition. That is, framed messages depicting the health consequences of HBV vaccination behavior increased vaccine acceptance, regardless of whether those messages were gain-framed or loss-framed. However, it is not possible to tease out whether this effect is due to the persuasive nature of the frame, to the narrative contexts provided within each frame, or to both combined. The persuasive effects of narrative are well-documented, suggesting a narrative with fictional characters, but containing scientific facts, may lead participants to identify with the characters, and therefore feel more vulnerable to the disease (Appel and Richter, 2007; Moyer-Gusé and Nabi, 2010). Indeed, another study found narrative evidence to be more effective in increasing perception of personal risk and intention to attain HBV vaccination when compared to statistics alone (De Wit et al., 2008).

Prospect Theory was originally developed to assess behavioral economics (Kahneman and Tversky, 1979). The notion of “risk” in Prospect Theory has to do with uncertainty in the probability of an outcome, not the risk of a negative health outcome (Kahneman and Tversky, 1979). Therefore, it is problematic to attempt to apply this theory to a health outcome such as HBV vaccine, or to vaccination more broadly, because a health outcome “risk” is contextually different from economic risk. Furthermore, prevention and early detection are not mutually exclusive behaviors. For example, many behaviors entail both prevention and early detection (e.g., colonoscopy). Also the domain of preventive behaviors is hardly homogeneous, entailing discrete, largely individually-determined behaviors (e.g., vaccination), repetitive, periodic behaviors (e.g., sunscreen use), daily, habitual behaviors (e.g., flossing or brushing teeth), and repetitive, socially-embedded behaviors (e.g., condom use). Therefore, it is difficult to broadly define a single health communication strategy that would work for prevention or early detection of disease.

We contend that defining all protective behaviors as “low-risk” and

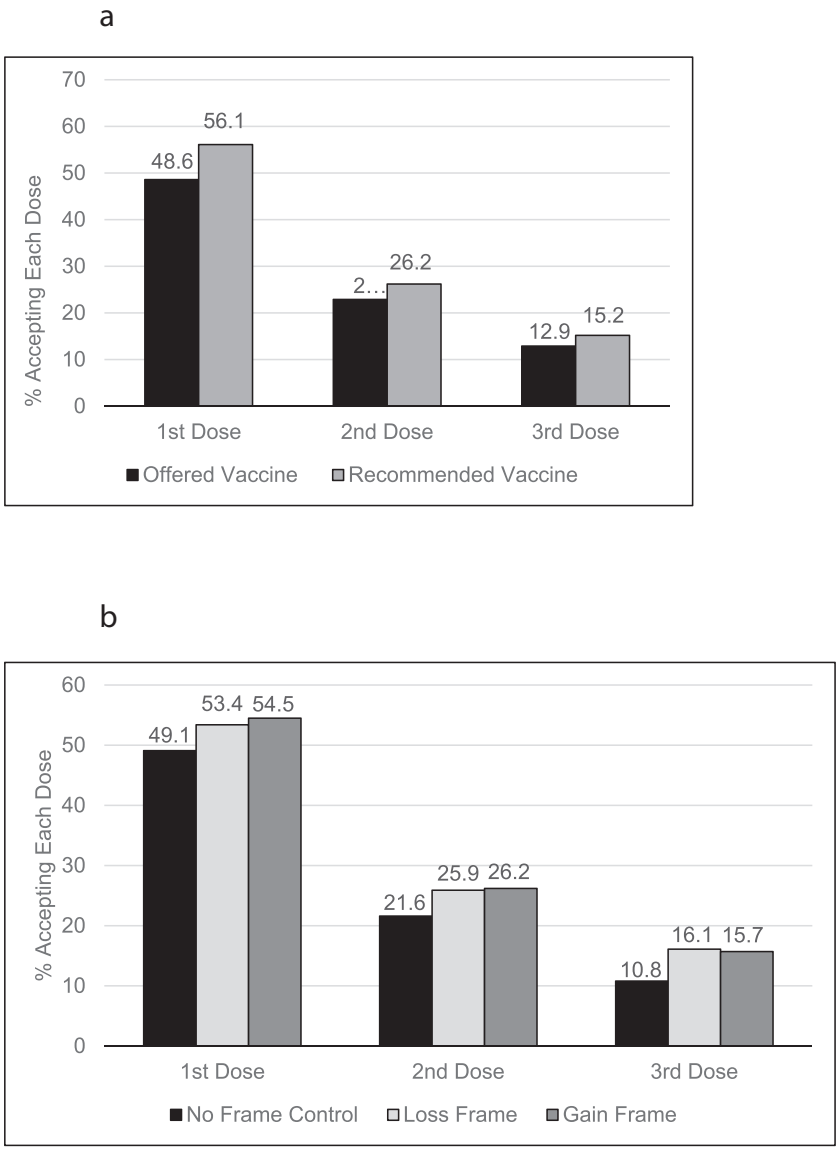

Fig. 2. Hepatitis B vaccine dose acceptance by intervention components.

all detection behaviors as "high-risk" is an inaccurate over-generalization and represents a top-down approach. As shown in this study, a substantial percentage of respondents perceived HBV vaccination as "high-risk" due to fear of the vaccine itself or fear of shots in general, indicating that, while Rothman and Salovey would define vaccination as "low-risk," many participants did not interpret vaccination this way. It is also possible the messages that are delivered may not correspond to the patients' perceptions of messages. In this study the majority of participants who received a loss-framed message interpreted the message as gain-framed, suggesting many of the participants cognitively recoded the message to be viewed in a positive light. This discrepancy points to the importance of manipulation checks to ensure the messages researchers construct are accurately interpreted by the recipients.

Patients in the vaccine-recommended group received more HBV vaccine doses than those in the vaccine-offered condition. The effect of HCP recommendation is not surprising and is consistent with other research, including research on HPV vaccination, which identifies provider recommendation as a significant predictor of vaccination uptake (Perkins et al., 2014; Brewer and Fazekas, 2007; Alexander et al., 2012; Donahue et al., 2014; Zimet et al., 2013). Future research should focus on continuing to identify the most relevant content to include in a strong provider recommendation, which may vary depending on the type of vaccination and population (e.g. HPV vaccination for adolescents, HBV vaccination for adults, etc.). Additionally, future research could explore any associations between the type of provider giving the recommendation (i.e. physician vs. nurse practitioner) on vaccine uptake.

This study has notable strengths and is a valuable addition to the literature. In particular, most of the research on provider recommendation and vaccine uptake relies on self-report data, or on broad clinical trials that could not precisely control for HCP recommendation delivery (Opel et al., 2013; Sturm et al., 2017; Shay et al., 2016; Gilkey and McRee, 2016; Brewer et al., 2016; Dempsey et al., 2018). Instead, this study involved controlled experimental manipulation of the recommendation conditions and examined actual vaccine uptake. While this study is a valuable addition to the scientific literature, there are limitations that may limit generalizability. First, participants for this study were recruited from public STD clinics, which tend to have a higher proportion of young, low income, male, racial/ethnic minorities, and individuals at higher risk for STD infection compared to the general population. Second, the HCP in this study was

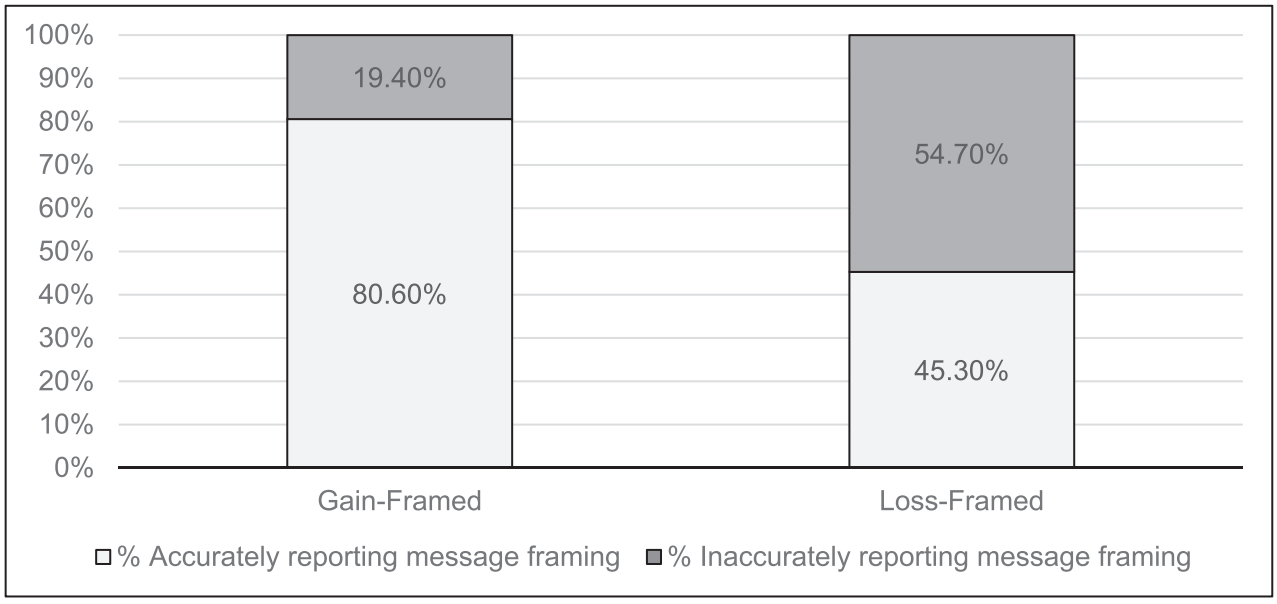

Fig. 3. Perceived message framing.

a nurse practitioner and it is possible the results may differ if the recommendation was made by a physician. However, many research studies use the term "healthcare provider" and do not specify whether this is a physician or advanced practice professional (nurse practitioner, physician assistant). Similar to our study, these studies also show HCP recommendation is one of the strongest predictors of vaccine uptake (Ylitalo et al., 2013; Caskey et al., 2009), indicating these results are similar regardless of provider type. Third, due to intervening projects with the study team, there was a delay in analyzing and publishing these data. Therefore, the data are older than is typical. While this may have implications for the specific STD services offered at the study clinics, and there may be fewer opportunities to provide HBV vaccination, the theory and implications of the results for framing interventions should not be diminished by the passage of time. Lastly, it is possible individuals' health beliefs may have had a moderating effect on the message framing. For example, previous research has shown message framing may have unintended negative effects for participants with certain preexisting health beliefs (Kasting et al., 2014). Future research should include health beliefs as possible moderators to a health communication intervention. Despite these limitations, this study adds to the growing body of literature suggesting there is no particular advantage of gain-framed messaging over loss-framed messaging (or vice-versa) for the preventive behavior of getting vaccinated against HBV.

5. Conclusion

This study demonstrated a framed message about the benefits of HBV vaccination (or risks of non-vaccination) may enhance vaccination rates in at-risk adults as compared to an unframed message, particularly in the context of a narrative. Further, as research on HPV vaccination has shown, the recommendation of a HCP is an important factor in motivating patients to accept vaccination (Perkins et al., 2014; Brewer and Fazekas, 2007; Alexander et al., 2012; Donahue et al., 2014; Zimet et al., 2013). This study highlights the importance of the accurate operationalization of theoretical constructs (e.g., "risk"). Additionally, it calls attention to the importance of rigorous study design which should include having a control group and manipulation checks. The findings have implications for vaccine uptake beyond HBV vaccination and have research and clinical implications for vaccinations more broadly.

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Declaration of competing interest

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References

Alexander, A.B., Stupiansky, N., Ott, M.A., Suah, A., Shew, M., Zimet, G.D., 2012. Parent-son decision-making about HPV vaccination. J. Adolesc. Health 50 (2), S69.
Andre, F.E., Booy, R., Bock, H.L., et al., 2008. Vaccination greatly reduces disease, disability, death and inequity worldwide. Bull. World Health Organ. 86 (2), 140–146.
Appel, M., Richter, T., 2007. Persuasive effects of fictional narratives increase over time. Media Psychol. 10 (1), 113–134.
Brewer, N.T., Fazekas, K.I., 2007. Predictors of HPV vaccine acceptability: a theory-informed, systematic review. Prev. Med. 45 (2–3), 107–114.
Brewer, N.T., Hall, M.E., Malo, T.L., Gilkey, M.B., Quinn, B., Lathren, C., 2017. Announcements versus conversations to improve HPV vaccination coverage: a randomized trial. Pediatrics 139 (1), e20161764.
Caskey, R., Lindau, S.T., Alexander, G.C., 2009. Knowledge and early adoption of the HPV vaccine among girls and young women: results of a national survey. J. Adolesc. Health. 45 (5), 453–462.
Centers for Disease Control and Prevention, 2017. Hepatitis B Vaccination: What Everyone Should Know. Atlanta, GA. .
Centers for Disease Control and Prevention, 2018a. 6 Reasons to Get HPV Vaccine for Your Child.
Centers for Disease Control and Prevention, 2018b. Screen for Life Campaign Public Service Announcements.
Cohen, J., 1988. Statistical Power Analysis for the Behavioral Sciences, 2nd ed. Lawrence Erlbaum Associates, Hillsdale, NJ.
Cox, A.D., Cox, D., Zimet, G.D., 2006. Understanding consumer responses to product risk information. J. Mark. 70, 79–91.
De Jaegher, K.J.T., 2019. Decision. Strategic framing to influence clients' risky decisions. 86 (3), 437–462.
De Wit, J.B.F., Das, E., Vet, R., 2008. What works best: objective statistics or a personal testimonial? An assessment of the persuasive effects of different types of message evidence on risk perception. Health Psychol. 27 (1), 110–115.
Dempsey, A.F., O'Leary, S.T., 2018. Human papillomavirus vaccination: narrative review of studies on how providers' vaccine communication affects attitudes and uptake. Acad. Pediatr. 18 (2), S23–S27.
Dempsey, A.F., Pyrznawoski, J., Lockhart, S., et al., 2018. Effect of a health care

professional communication training intervention on adolescent human papillomavirus vaccination: a cluster randomized clinical trial. JAMA Pediatr. 172 (5), e180016.
Donahue, K.L., Stupiansky, N.W., Alexander, A.B., Zimet, G.D., 2014. Acceptability of the human papillomavirus vaccine and reasons for non-vaccination among parents of adolescent sons. Vaccine 32 (31), 3883–3885.
Faul, F., Erdfelder, E., Lang, A.G., Buchner, A., 2007. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behav. Res. Methods 39 (2), 175–191.
Frew, P.M., Saint-Victor, D.S., Owens, L.E., Omer, S.B., 2014. Socioecological and message framing factors influencing maternal influenza immunization among minority women. Vaccine 32 (15), 1736–1744.
Gallagher, K.M., Updegraff, J.A., 2012. Health message framing effects on attitudes, intentions, and behavior: a meta-analytic review. Ann. Behav. Med. 43 (1), 101–116.
Gilkey, M.B., McRee, A.L., 2016. Provider communication about HPV vaccination: a systematic review. Hum. Vaccin. Immunother. 12 (6), 1454–1468.
Gilkey, M.B., Malo, T.L., Shah, P.D., Hall, M.E., Brewer, N.T., 2015. Quality of physician communication about human papillomavirus vaccine: findings from a national survey. Cancer Epidemiol. Biomark. Prev. 24 (11), 1673–1679.
Holman, D.M., Benard, V., Roland, K.B., Watson, M., Liddon, N., Stokley, S., 2014. Barriers to human papillomavirus vaccination among US adolescents: a systematic review of the literature. JAMA Pediatr. 168 (1), 76–82.
Johnson, D.R., Nichol, K.L., Lipczynski, K., 2008a. Barriers to adult immunization. Am. J. Med. 121 (7, Supplement 2), S28–S35.
Johnson, D.R., Nichol, K.L., Lipczynski, K., 2008b. Barriers to adult immunization. Am. J. Med. 121, S28–S35.
Kahneman, D., Tversky, A., 1979. Prospect theory: an analysis of decision under risk. Econometrica 47 (2), 263–291.
Kasting, M.L., Cox, A.D., Cox, D., Fife, K.H., Katz, B.P., Zimet, G.D., 2014. The effects of HIV testing advocacy messages on test acceptance: a randomized clinical trial. BMC Med. 12, 204.
Malosh, R., Ohmit, S.E., Petrie, J.G., Thompson, M.G., Aiello, A.E., Monto, A.S., 2014. Factors associated with influenza vaccine receipt in community dwelling adults and their children. Vaccine 32 (16), 1841–1847.
Meireles, L.C., Marinho, R.T., Van Damme, P., 2015. Three decades of hepatitis B control with vaccination. World J. Hepatol. 7 (18), 2127–2132.
Mouchet, J., Salvo, F., Raschi, E., et al., 2018. Hepatitis B vaccination and the putative risk of central demyelinating diseases - a systematic review and meta-analysis. Vaccine 36 (12), 1548–1555.
Moyer-Gusé, E., Nabi, R.L., 2010. Explaining the effects of narrative in an entertainment television program: overcoming resistance to persuasion. Hum. Commun. Res. 36 (1), 26–52.
Nakamura, R., Suhrcke, M., Zizzo, D.J.J.T., 2017. Decision. A triple test for behavioral economics models and public health policy. 83 (4), 513–533.
National Vaccine Advisory Committee, 2014. Recommendations from the National Vaccine Advisory Committee: standards for adult immunization practice. Public Health Rep. 129 (2), 115–123.
O'Keefe, D.J., Jensen, J.D., 2007. The relative persuasiveness of gain-framed loss-framed messages for encouraging disease prevention behaviors: a meta-analytic review. J. Health Commun. 12, 623–644.
O'Keefe, D.J., Jensen, J.D., 2009. The relative persuasiveness of gain-framed and loss-framed messages for encouraging disease detection behaviors: a meta-analytic review. J. Commun. 59, 296–316.
O'Keefe, D.J., Nan, X., 2012. The relative persuasiveness of gain- and loss-framed messages for promoting vaccination: a meta-analytic review. Health Commun. 27 (8), 776–783.
O'Keefe, D.J., Wu, D., 2012. Gain-framed messages do not motivate sun protection: a meta-analytic review of randomized trials comparing gain-framed and loss-framed appeals for promoting skin cancer prevention. Int. J. Environ. Res. Public Health 9 (6), 2121–2133.
Opel, D.J., Heritage, J., Taylor, J.A., et al., 2013. The architecture of provider-parent vaccine discussions at health supervision visits. Pediatrics 132 (6), 1037–1046.
Penta, M.A., Baban, A., 2018. Message framing in vaccine communication: a systematic review of published literature. Health Commun. 33 (3), 299–314.
Perkins, R.B., Apte, G., Belizaire, M., et al., 2014. Are parents or doctors the cause of low HPV vaccination rates: a qualitative study. J. Adolesc. Health 54 (2), S82–S83.
Phadke, V.K., Bednarczyk, R.A., Salmon, D.A., Omer, S.B., 2016. Association between vaccine refusal and vaccine-preventable diseases in the United States: a review of measles and pertussis. JAMA 315 (11), 1149–1158.
Rothman, A.J., Salovey, P., 1997. Shaping perceptions to motivate healthy behavior: the role of message framing. Psychol. Bull. 121, 3–19.
Schillie, S., Vellozzi, C., Reingold, A., et al., 2018. Prevention of hepatitis B virus infection in the United States: recommendations of the Advisory Committee on Immunization Practices. 67 (1), 1–31.
Shay, L.A., Street, R.L.J., Baldwin, A.S., et al., 2016. Characterizing safety-net providers' HPV vaccine recommendations to undecided parents: a pilot study. Patient Educ. Couns. 99 (9), 1452–1460.
Sturm, L., Donahue, K., Kasting, M., Kulkarni, A., Brewer, N.T., Zimet, G.D., 2017. Pediatrician-parent conversations about human papillomavirus vaccination: an analysis of audio recordings. J. Adolesc. Health 61, 246–251.
Tversky, A., Kahneman, D., 1981. The framing of decisions and the psychology of choice. Science (New York, N.Y.) 221, 453–458.
Van 't Riet, J., Cox, A.D., Cox, D., et al., 2014. Does perceived risk influence the effects of message framing? A new investigation of a widely held notion. Psychol. Health 29 (8), 933–949.
Van 't Riet, J., Cox, A.D., Cox, D., et al., 2016. Does perceived risk influence the effects of message framing? Revisiting the link between prospect theory and message framing. Health Psychol. Rev. 10 (4), 447–459.
Walker, T.Y., Elam-Evans, L.D., Yankey, D., et al., 2018. National, regional, state, and selected local area vaccination coverage among adolescents aged 13–17 years - United States, 2017. MMWR Morb. Mortal. Wkly Rep. 67 (33), 909–917.
Williams, W.W., Lu, P.J., O'Halloran, A., et al., 2014. Noninfluenza vaccination coverage among adults - United States, 2012. MMWR Morb. Mortal. Wkly Rep. 63 (5), 95–102.
Williams W, Lu P, O'Halloran A, et al. Surveillance of vaccination coverage among adult populations-United States, 2014. Morb. Mortal. Wkly Rep. 2016;66(NO. SS-11):1–28.
Ylitalo, K.R., Lee, H., Mehta, N.K., 2013. Health care provider recommendation, human papillomavirus vaccination, and race/ethnicity in the US National Immunization Survey. Am. J. Public Health 103 (1), 164–169.
Zimet, G.D., Perkins, S.M., Winston, Y., Kee, R., 2008. Predictors of first and second dose acceptance of hepatitis B vaccine among STD clinic patients. Int. J. STD AIDS 19, 246–250.
Zimet, G.D., Rosberger, Z., Fisher, W.A., Perez, S., Stupiansky, N.W., 2013. Beliefs, behaviors and HPV vaccine: correcting the myths and the misinformation. Prev. Med. 57 (5), 414–418.