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Designing Effective Messages to Promote Future Zika Vaccine Uptake

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Designing Effective Messages to Promote Future Zika Vaccine Uptake

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University

by

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"The most important weapon against the next flu pandemic will be a vaccine – the second most important one will be communication (Barry, 2009)."

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Abstract

DESIGNING EFFECTIVE MESSAGES TO PROMOTE FUTURE ZIKA VACCINE UPTAKE

By Jeanine P.D. Guidry, MS, MPS

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

Virginia Commonwealth University, 2017.

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The Zika virus is associated with the devastating birth defect microcephaly, and while a vaccine was not yet available in early-2017, several were under development. It is imperative to identify effective communication strategies to promote uptake of a new vaccine, particularly among women of reproductive age. Moreover, though the Zika outbreak has received much social media attention, little is known about these conversations on Instagram. The purpose of this dissertation, therefore, was to understand current Zika-focused communication on Instagram and to inform effective communication strategies to promote future Zika vaccine uptake intent.

The study aims were: (1) explore Zika conversations on Instagram; (2) determine effective message characteristics to increase Zika vaccine uptake intent; and (3) explore salient demographic, healthcare, and psychosocial factors related to Zika vaccine uptake intent.

A content analysis of 1,000 Zika-focused Instagram posts, found that these messages primarily focus on perceived threat constructs, yet they elicited little engagement. In addition, 10% of all Instagram posts mentioned conspiracy theories, and these messages elicited high engagement.

A 2x2 online experiment tested the effect of message framing and visual type on Zika vaccine uptake intent. The 339 participants – all women of reproductive age – each were exposed to one of four messages (gain vs. loss-framed, and infographic vs. photo). There was no interaction effect of framing and visual type ($p=.116$), nor main effect of either framing ($p=.185$) or visual type ($p=.724$) on vaccine uptake intent. When testing the effect of these variables on those known to be predictors of behavioral intent, gain-framed messages were associated with higher subjective norms, perceived benefits, and self-efficacy.

Data from the same online survey was used to examine whether demographics, healthcare-related variables, and psychosocial variables predict Zika vaccine uptake intent. Attitude ($p<.001$), subjective norms ($p=.002$), perceived benefits ($p=.001$), self-efficacy ($p=.031$), perceived susceptibility ($p=.030$), and cues to action ($p=.020$) were predictive of higher Zika vaccine uptake intent, as was being African-American ($p=.042$).

In summary, messages promoting the Zika vaccine should be designed to complement the high perceived threat of Zika while activating positive social norms and perceived benefits in order to allow the public to respond efficaciously.

CHAPTER 1

INTRODUCTION

Background

Historically, the Zika virus was viewed as a rare disease with mild flu-like symptoms. This changed in 2015, when Brazil reported cases of the Zika virus (World Health Organization, n.d.). By January 2016, Brazil reported 3,893 suspected cases of microcephaly, many potentially related to Zika transmission during pregnancy, and by February 2016 the World Health Organization (WHO) declared Zika a public health emergency (World Health Organization, n.d.).

Since the H1N1 flu outbreak in 2009, infectious disease outbreaks have been both tracked and discussed on social media platforms. A survey by Jones and Salathe (2009) found that the internet was the most used source of information at the start of the H1N1 outbreak. A seminal study on H1N1 discussions on microblogging platform Twitter found that only 4.5% of tweets contained misinformation (Chew & Eysenbach, 2010). However, during the recent Ebola outbreak, a study on Ebola-related tweets conducted at the height of the epidemic in September 2014 found that the majority of tweets contained misinformation. Moreover, these tweets spread faster than tweets with correct information (Oyeyemi, Gabarron, & Wynn, 2014).

Little research to date is available on social media conversations concerning the Zika virus. Early studies have shown that user-generated content is the preferred message type for Zika related information on Twitter (Fu, Bonhomme, Cooper, Joseph, & Zimet, 2014). In addition, pseudo-scientific claims about the Zika vaccine are already prevalent on Twitter, even though a vaccine is not available yet. In addition, many of these tweets express reluctance to get a future Zika-vaccine (Dredze, Broniatowski, & Hilyard, 2016). These Zika vaccine-hesitant tweets seem to originate with accounts that have a history of tweeting about vaccines in general,

and vaccine hesitancy specifically (Dredze et al., 2016). Finally, while literature focusing on social media continues to grow, studies examining infectious diseases and vaccines have primarily focused on Twitter (Betsch et al., 2012; Chew & Eysenbach, 2010; Kata, 2012; Oyeyemi et al., 2014). Few concentrate on visual social media platforms like Instagram and Pinterest (Guidry, Carlyle, Messner, & Jin, 2015).

Health behavior change theories provide an important lens through which to examine social media conversations. These theories play an important role in public health message design, providing an indication of what messages will be likely to result in the uptake of specific desirable behaviors and the rejection of undesirable behaviors. Of particular relevance to vaccine-related behaviors are the Theory of Planned Behavior (TPB) and Health Belief Model (HBM). The TPB posits that the most accurate predictor of behavior is intent to carry out that behavior. In addition, attitudes, subjective norms (perceived social pressure), and perceived behavioral control in turn predict behavioral intent (Ajzen, 1991). The HBM describes the following six constructs associated with carrying out a health behavior: perceived severity, perceived susceptibility, perceived benefits, perceived barriers, self-efficacy, and cues to action (Rosenstock, 1974). In addition, demographic and healthcare-related variables, (e.g., having a regular healthcare provider) play a predictive role in the uptake of vaccines like the HPV vaccine and the H1N1 flu vaccine (Gargano et al, 2011; Gerend & Shepherd, 2012). It is imperative to understand the role these variables play in determining future Zika vaccine uptake among one of the most at risk populations: women of reproductive age.

Aims, Research Questions, and Hypotheses

Given the ever-increasing role social media plays in infectious disease outbreak communication and our limited understanding of visual social media platforms in the scholarly

literature, it is important to examine visual social media conversations about Zika as well as how to effectively communication Zika preventive messages via this medium. Considering this, the specific aims, research questions, and hypotheses for this dissertation are as follows:

Aim 1: Explore the content of current posts on Instagram about Zika and a future Zika vaccine. Social media platforms can both help provide useful health information to the public, as well as spread misinformation online. Instagram is a popular visual social media platform among women 18-49 years of age, but little is known about how the Zika virus and the future vaccine are portrayed on and engaged with on this platform. Therefore, the first two research questions under Aim 1 are:

RQ1: How does the public discuss the Zika virus on Instagram?

RQ2: How does the public engage with posts about the Zika virus on Instagram?

Since Instagram is a visual platform, and visuals are markedly different from text in how they are processed, it is important to study the visual characteristics of Zika visuals on the platform:

RQ3: What are the characteristics of Zika-related Instagram visuals, and how do people engage with specific types of visual posts?

Because theories like the HBM and the TPB can help explain health behaviors, it is important to investigate if and how these theories are discussed on Instagram and how Instagram users engage with these posts. Thus, the fourth and fifth research questions under Aim 1 are:

RQ4: What health behavior theory constructs are present in Zika-focused posts on Instagram?

RQ5: How do Instagram users engage with Zika-related posts that contain health behavior constructs?

Aim 2: What message characteristics are most effective at increasing intentions to get the Zika vaccine? Both visual type and framing are important message characteristics to consider when working with visual message design. However, these have not been studied in a combined manner; therefore, Aim 2 starts with a research question that explores this interaction:

RQ1: Do message frame and visual type interact to influence intent to receive the Zika vaccine?

Research shows that loss-framed messages are more effective than gain-framed messages when promoting vaccine uptake and vaccine uptake intent (Gerend & Shepherd, 2007; Gerend & Shepherd, 2012; Nan, Xie, & Madden, 2012). As such, we hypothesize that:

H1: Messages with a loss frame will be more likely to result in women reporting intent to get the Zika vaccine than messages with a gain frame.

Because they may be processed differently, infographics and photos with text may have a different effect on vaccine uptake intent. However, currently there is not enough evidence available to state this with certainty, leading to the second research question under Aim 2:

RQ2: Are there any differences in intent to get the Zika vaccine between women who receive the infographic vs. the photo/text message?

Conversely, there is strong evidence that psychosocial constructs can predict health behaviors, and that intent to carry out a particular health behavior is one of the most reliable predictors of actual behavior. The next research question under Aim 2, therefore, is:

RQ3: What message characteristics are most effective at increasing the intermediate psychosocial constructs predicted by the HBM and TPB to lead to intent to get a future Zika vaccine?

Aim 3: Explore salient demographic and psychosocial factors that may be related to intent to get the Zika vaccine. Demographic factors (e.g., ethnicity), healthcare factors (e.g., previous season's flu vaccine uptake), and psychosocial variables (e.g., attitudes, perceived severity) all are associated with changes in H1N1, HPV, and MMR vaccine uptake intent. We, therefore, want to examine how these factors relate to the future Zika vaccine:

RQ1: How are demographic and healthcare factors related to intent to get a future Zika vaccine?

RQ2: Which psychosocial factors predict intent to get a future Zika vaccine?

The investigation of these aims is presented in the three-paper format. The first paper presents a quantitative content analysis of 1,000 randomly selected Zika-focused Instagram posts to determine the visual and textual characteristics as well as the engagement levels for these messages. The second paper focuses on an experiment (administered using an online survey) testing the effect of message framing and visual characteristics on future Zika vaccine uptake intent, as well as intermediate psychosocial outcomes that can predict uptake intent. The third paper builds on the second paper - drawing on the same online survey data - exploring to what extent demographic variables, healthcare-related variables, and psychosocial constructs predict future Zika vaccine uptake intent.

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CHAPTER 2

PAPER 1

Abstract

Despite significant advances in public health, infectious disease control, and vaccine development and distribution over the past 200 years, infectious diseases remain one of the main causes of morbidity and mortality worldwide. Social media has developed into a source of health information for many people, and recent epidemics have all been discussed in detail on various social media platforms (Moorhead et al., 2013). However, to date the discussion of Zika on the social media platform Instagram has not been studied, which is striking considering the popularity of the platform. This study used a quantitative content analysis of 1,000 randomly selected Instagram posts to explore the content of current conversations on Instagram about Zika and a future Zika vaccine. Results of this study indicate a high presence of threat constructs related to the Zika vaccine, yet little engagement with these Instagram posts. In addition, posts focused more on mosquitoes and prevention of Zika through using mosquito repellent than on the risks of Zika to pregnant women and their fetuses. Finally, relatively few posts originated with public health or other healthcare related sources.

#ZIKA ON INSTAGRAM: HOW THE PUBLIC DISCUSSES THE HEALTH CRISIS THROUGH ONLINE VISUALS AND TEXT

Background

Zika, a virus with similarities to Dengue Fever, is mainly transmitted by mosquitoes and via sexual transmission (D'Ortenzio et al., 2016; Fauci & Morens, 2016; Vogel, 2016). Until recently, Zika was relatively obscure with only 14 cases documented worldwide before 2007 (Centers for Disease Control and Prevention, 2016a). While Zika was a fairly unknown disease prior to 2015, as of March 1, 2017, outbreaks were occurring in 84 countries. As of February 13, 2017, 5,040 travel-associated cases were reported in the U.S. (44 of which were sexually transmitted); 220 locally acquired mosquito-borne cases were reported in Florida and Texas; and 36,882 locally acquired cases were reported in U.S. territories (Centers for Disease Control and Prevention, 2016a; Rosenstock, 1974). The outbreak is associated with a dramatically increased incidence of microcephaly in newborns whose mothers were infected with the virus while pregnant. This makes Zika a particularly salient threat for women of reproductive age (Centers for Disease Control and Prevention, 2016b). By mid-2017, no vaccine was available for Zika; however, vaccine development was underway (Dredze et al., 2016).

Effective Risk Communication about Zika

Epidemics and pandemics, such as Zika, are characterized by an urgent need for effective communication, interventions, and community cooperation within the shortest time possible, especially for government and health officials and other emergency management personnel (Lee & Basnyat, 2013). Media – and particularly social media – play a crucial role in framing the public's understanding of a complex, highly contagious virus. Effective communication practices are critical for engaging with an often-fearful public (Freimuth, Linnan, & Potter, 2000; Holmes, 2008). People increasingly search for health information on the Internet, and the information

they locate often influences their health-related decisions (Moorhead et al., 2013). Social media can facilitate what now is called a viral spread of information (Moorhead et al., 2013; Seymour, Getman, Saraf, Zhang, & Kalenderian, 2015). While trustworthy information can spread fast via the Internet, misinformation (frequently in the form of conspiracy theories) often spreads faster and farther than the disease itself – with the Internet in general and social media in particular – aiding a rapid spread of unrestricted and often inaccurate information (Moorhead et al., 2013; Seymour et al., 2015).

As a recent example, the 2014 Ebola outbreak was accompanied by a near-constant stream of misinformation and panic on social media like Twitter (Blair, 2014; Dalrymple, Young, & Tully, 2016; Luckerson, 2014). Another example of health-related misinformation on social media platforms is the increasing presence of anti-vaccine posts on various platforms (Guidry, Carlyle, Messner, & Jin, 2015; Kata, 2012). Because of social media's near-instant character, a single false message can quickly reach tens of thousands of people (Moorhead et al., 2013). Most research in this area so far has focused on older social media platforms like Facebook and Twitter (Muralidharan, Rasmussen, Patterson, & Shin, 2011; Rodriguez-Morales, Castañeda-Hernández, & McGregor, 2015; Sharma, Yadav, Yadav, & Ferdinand, 2017). Little attention has been directed toward newer, more visual platforms such as Instagram, a social networking platform used for photo- and video-sharing. Instagram's growth has been explosive, surpassing 700 million monthly active users in 2017 (Constine, 2017), and surpassing Twitter in popularity with 24% of U.S. online adults using the platform in 2016 (Pew Research Center, 2016). As of late 2016, 59% of Millennials (those in the age-range 18-29) use Instagram. In addition, women are particularly likely to use the platform, along with Hispanics and African-

Americans (Pew Research Center, 2016), making the platform a particular good fit for women of reproductive age.

Little is known, however, about the optimal way to communicate Zika-related prevention messages, especially considering Zika's complex and evolving nature. In August of 2016 two babies were born in California with Zika-related microcephaly (Karlamangla, 2016) and a baby born with Zika-related microcephaly died in Texas the same month (Zimmerman, 2016), adding to the perceived urgency of the outbreak in the continental United States. This urgency is perhaps best defined by the fact that a mosquito-borne disease has never before been associated with both human birth defects and the possibility of sexual transmission (Frieden, Schuchat, & Petersen, 2016). Considering this complex disease and its context, combined with the widespread use of Instagram in the population and the paucity of research involving Instagram, discovering the characteristics of Zika-focused posts on the platform and how they represent the public's needs and concerns surrounding this emerging public health threat is of interest. The first research question for this study, therefore, is:

RQ1: How does the public discuss the Zika virus on Instagram?

Much of the existing literature on communication during disease outbreaks is focused on discussions of one-way communication strategies, which emphasize the downstream flow of information to the public by the media, health authorities, and governmental agencies (Frewer, 2004; Holmes, 2008; Sandman, 1989). While not inherently problematic, this top-to-bottom communication paradigm fails to account for public responses and feedback (Holmes, 2008; Slovic, Finucane, Peters, & MacGregor, 2004). By not adequately considering how messages will be received and perceived by the public, this approach to risk communication greatly

inhibits mutual engagement with the public and may inadvertently contribute to misperceptions of risk and mistrust of health authorities.

In contrast, two-way communication strategies emphasize engagement from the ground level up, listening to the beliefs, perceptions, and attitudes of the public before addressing them in any messages or communication campaigns. Instead of viewing the public as passive recipients of information and guidance, current best practices recommend that health communicators view the public as a valuable source of insight into the unique needs and concerns of different populations and surrounding different diseases (Covello, Peters, Wojtecki, & Hyde, 2001; Holmes, 2008). Effective communication during outbreaks, therefore, should look more like a dialogue *between* the public and authorities, rather than a unidirectional flow of information. Additionally, ongoing engagement and feedback from the public should be utilized to inform up-to-date messages addressing emerging concerns that arise throughout the course of an outbreak or other public health emergency (World Health Organization, 2011).

In order to better understand how to communicate with the public about the Zika virus and about Zika preventive measures on Instagram, it is first necessary to identify how people respond to existing Zika messages on the platform. Given the current growth of Instagram as a platform for public discussions and sharing of information, exploring users' engagement with various Zika-related content can yield important insights for the development of timely and relevant health messages. As such, this study's second research question is:

RQ2: How does the public engage with posts about the Zika virus on Instagram?

Types of Visual Information

The concept of risk is often difficult for people to grasp (Lipkus, 2007). Most risk information is either portrayed as numeric values alone or as a combination of numbers and text,

but visual representations can facilitate comprehension and recall of this type of information (Lipkus & Hollands, 1998). Visual-focused messages are processed differently from text-based messages: Dual coding theory, for example, explains that visuals have an advantage over text, because they are coded into both visual as well as verbal memory. They are more easily retrieved from the brain, because they are encoded more uniquely (Houts, Doak, Doak, & Loscalzo, 2006; McWhirter & Hoffman-Goetz, 2014; Paivio, 1991; Smith, Moriarty, Barbatsis, & Kenney, 2004). Information communicated through visuals, and text accompanied by visuals, increase attention to and recall of health education information compared to text alone. This may be of particular significance when communicating with those with lower literacy – often from vulnerable populations (Easton, Entwistle, & Williams, 2010) – who may not possess the literacy skills to read, interpret, and act on text-only health information (Garcia-Retamero & Cokely, 2013; Houts et al., 2006; Kirsch, Jungeblut, Jenkins, & Kolstad, 2002). Visuals often serve to improve risk comprehension as well as other types of complex information (Lipkus, 2007). And finally, human brains process visual images with great speed and respond to them substantially faster than to verbal symbols (Barry, 2004).

Given evidence in favor of visual communication, Instagram could be a particularly powerful tool for communicating health-related and risk information, yet limited work has been done specifically focused on this platform. Therefore, the third research question is:

RQ3: What are the characteristics of Zika-related Instagram visuals, and how do people engage with specific types of visual posts?

Health Belief Model

Health behavior theories provide a way to both better understand health-related behaviors as well as design effective public health messaging (Glanz, Rimer, & Lewis, 2015). The Health

Belief Model (HBM) provides a theoretical framework to help explain and predict the uptake of preventive behaviors. The HBM posits that individuals will engage in a health-protective action if they: 1) believe that a negative health condition can be avoided; 2) believe that, by taking a recommended action, they will avoid a negative health condition; and 3) believe that they can successfully take a recommended health action (Rosenstock, 1974). According to the model, individuals' likelihood of engaging in health-promoting behavior (or reducing health risk behavior) is determined by four main antecedents: 1) perceived susceptibility to a certain health condition; 2) perceived severity of the health condition and its consequences; 3) perceived barriers to engaging in the advised action; and 4) perceived benefits to taking health action. Together, these four perceptions are theorized to account for individuals' readiness to take health-related action, and are activated by: 1) cues to action and 2) self-efficacy to successfully perform the action (Janz & Becker, 1984).

There is strong empirical support for the use of HBM as a framework for developing health education and promotion messages and campaigns (Glanz, Rimer, & Lewis, 2008; Janz & Becker, 1984). However, to our knowledge, the model has not yet been applied to Zika-specific health behaviors. Therefore, the final two research questions are:

RQ4: What health behavior theory constructs are present in Zika-focused posts on Instagram; and

RQ5: How do Instagram users engage with Zika-related posts that contain HBM constructs posts?

Method

This study analyzed Zika-related posts on the social media platform Instagram using quantitative content analysis. Between August 1 and 31, 2016, Instagram posts using the #Zika

and #zikavirus hashtags were collected using the web-based social media mining tool netlytic.org[1], which uses the Instagram API search/posts endpoint and returns a collection of Instagram posts matching a specified query. At the end of this collection, simple random sampling was used to collect 1,000 distinct Instagram posts from the larger sample of 100,000. The results of the selected hashtags were imported into an Excel spreadsheet.

Coding protocols for the content analysis were developed, tested, and implemented for the coding process. Posts were coded for Instagram-specific variables like hashtags, mentions, and visual type; Instagram engagement variables in the form of likes and comments, website connection, and visual characteristics, such as the presence of mosquitoes in an image; Health Belief Model variables (perceived benefits, perceived barriers, perceived severity, perceived susceptibility, self-efficacy, and cues to action), for emotions like fear, anger, cynicism, and confusion; for the presence of conspiracy theories; and for the language of the post. A complete list of coding variables and their definitions is available in Appendix 1. The main coder is fluent in English, Dutch, and German, with working knowledge of French and Spanish. Posts in French, Spanish, and Portuguese were translated by a native speaker before being coded. No other languages were present in the study sample. The second coder (see below) coded messages in English, Portuguese, and Spanish.

Applied to Zika and Zika-preventive behaviors (since no treatment except for supportive care is currently known for Zika), the HBM constructs are operationalized as follows: perceived benefits of the Zika preventive measures, such as protection against disease; perceived barriers to Zika preventive measures, such as complex instructions; perceived susceptibility to the Zika virus; perceived severity of Zika; self-efficacy related to Zika preventive measures; and cues to

[1] Netlytic.org is a community-supported text and social networks analyzer that can automatically summarize and discover from social media platforms and conversations.

action related to Zika preventive measures, such as a physician's recommendation or an advertisement encouraging the use of mosquito repellent.

Two coders were trained and coded a random sample of 10% of the posts (n =100) for intercoder reliability. After pre-testing and subsequent changes to the coding protocol, the intercoder reliability test with the ReCal statistical program showed *Scott's Pi* (Scott, 1955) was on average .82. The individual coefficients were all considered to be reliable, with the lowest coefficient at .71 (the complete list is included in Appendix 2). A coefficient of .70 is considered low, but appropriate; most coefficients were at .80 or higher (Lombard, Snyder-Duch, & Bracken, 2002). After intercoder reliability was established, the first coder coded the remaining 900 posts for all study variables.

Statistical Analyses

Mann-Whitney U tests were used to check for differences in Instagram engagement between posts with versus without a range of dichotomous variables, and Kruskal-Wallis tests were used to check for differences in Instagram engagement between posts with versus without a range of nominal variables. For both tests, distributions of the engagement frequencies were evaluated and found similar based on visual inspection of a box plot for all variables involved. Whenever the Kruskal-Wallis tests found statistically significant differences, post-hoc analyses via pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons, with adjusted p-values presented.

Results

RQ1: How does the public discuss the Zika virus on Instagram?

The first research question analyzed the public's conversations about the Zika virus on Instagram. The majority of the posts, 75.0% (n=750) were in English, an additional 18.7%

(n=187) in Portuguese, 3.7% (n=37) in Spanish, 1.2% (n=12) in other languages, and 1.4% (n=14) consisted of two languages. Almost half of the posts (49.3%, n=493) were published by individual Instagram accounts, while 30.7% (n=307) originated with commercial/organizational accounts, 8.9% (n=89) were published by public health Instagram accounts, 7.5% (n=75) by news organization accounts, and 1.1% (n=11) by users identified as medical professionals, i.e. physicians and nurses. The remaining 2.5% (n=25) were published by other types of entities.

Instagram posts consisted of at least one hashtag – either #Zika or #zikavirus. The mean number of hashtags was 10.08 per post (SD=9.287, R=121). While most Instagram posts did not include mentions[2] (85.9%, n=859), 14.1% (n=141) did. The mean number of mentions was .28 (SD=.953, R=11). Finally, 5.7% (n=57) of posts contained a hyperlink. Among these 57 posts, 35.1% (n=20), pointed to a commercial website, 31.6% (n=18) to a health-related website, and 19.3% (n=11) to a news website.

Posts mentioned the following: 37.1% (n=371) mosquitos, 10.0% (n=100) microcephaly, and 2.4% (n=24) Zika symptoms. While 7.4% (n=74) portrayed or mentioned a current Zika patient, only .5% (n=5) of the Instagram posts mentioned a future Zika vaccine and the fact that it was not (yet) available. Close to 10% (9.5%, n=95) of the posts mentioned some form of conspiracy theory related to the Zika vaccine: 9.3% (n=93) governmental conspiracy, 6.3% (n=63) pharmaceutical conspiracy, and 4.2% (n=42) medical conspiracy. In addition, 5.4% (n=54) mentioned violation of civil liberties related to Zika prevention. Finally, 74.7% (n=747) of posts indicated fear of the Zika virus, .9% (n=9) indicated confusion about information about Zika, 3.9% (n=39) referred to anger about Zika, and 7.4% (n=74) of the posts referred to

[2] An Instagram username or handle, starting with the "@" symbol.

cynicism about Zika. Preventive measures related to Zika were present in 23.8% (n=238) of the sample posts.

Logistic regressions were performed to determine the effect of language (English, Portuguese, and Spanish) on the likelihood that Instagram posts mentioned mosquitos, microcephaly, risk to pregnant women; or showed a mosquito or a baby with microcephaly. None of the logistic regression models were statistically significant.

RQ2: How does the public engage with posts about the Zika virus on Instagram?

The mean number of likes for this sample was 2830.1 (SD=15,178.84, R=253,000). Since these numbers clearly indicate outliers among the number of likes, we also report the median: 72.0. The mean number of comments was 65.0 (SD=212.79, R=1,938); again, these numbers indicate the presence of outliers. The median for the number of comments was 6.0.

Mann-Whitney U tests were run to determine if there were differences in the frequency of likes and comments between posts with the presence versus absence of the following variables: mentioning mosquitoes, mentioning microcephaly, conspiracy theories, emotions, and Instagram post source. Like and comment frequencies were significantly higher in posts that mentioned conspiracy theories ($p<.001$ for both) compared with those that did not and in posts that reflected cynicism versus posts that did not ($p=.004$ for likes, $p<.001$ for comments). Like ($p<.001$) and comment ($p<.001$) frequencies were significantly lower in posts reflecting fear; like frequencies were significantly lower in posts mentioning mosquitoes ($p=.027$); and comment frequencies were significantly higher in posts reflecting anger ($p=.007$) (see Table 1). There were no significant differences in like and comment frequencies between posts that indicated confusion compared to posts that did not.

Kruskal-Wallis tests were run to determine if there were differences in like and comment frequencies between groups of Instagram posts that differed in their source/origin (individual, commercial, public health/NGO, news, physician/medical professional, or other). Median like frequencies were statistically significantly different by source type, $X^2(5)=52.474$, $p<.001$. Post hoc analysis revealed significant differences in like frequencies between several of the groups. For example, median like frequencies were significantly higher for news sources compared to NGOs, individual accounts, and commercial sources, respectively. Median comment frequencies were also significantly different between the different types of sources, $X^2(5)=45.138$, $p<.001$. Again, pairwise comparisons showed significant differences in comment frequencies between several of the groups. For example, median comment frequencies were significantly higher for news sources compared to NGOs as well as for news sources as compared to individual accounts; and similarly, were higher for individual Instagram accounts versus NGO accounts (see Table 2).

Table 1
Dichotomous independent variables and median engagement

Engagement variable	Variable	Mdn present	Mdn absent	U	Z	p-value
Likes	Mosquito mention	61.00	80.00	106,896.000	-2.218	.027
Likes	Conspiracy theories	188.00	64.00	52,426.000	3.525	<.001
Comments	Conspiracy theories	19.00	6.00	56,533.500	5.070	<.001
Likes	Fear	61.00	102.00	78,434.000	-4.045	<.001
Comments	Fear	6.00	10.00	78,619.000	-4.008	<.001
Comments	Anger	14.00	6.00	23,516.000	2.708	.007
Likes	Cynicism	178.50	65.50	41,154.500	2.883	.004
Comments	Cynicism	19.00	6.00	44,882.500	4.453	<.001
Likes	Mosquito visual	57.50	77.50	63,749.500	-2.343	.019
Likes	Person visual	89.50	57.50	141,628.000	3.733	<.001
Likes	Perceived benefits prevention	45.00	78.50	46,042.000	-2.277	.023
Comments	Perceived benefits prevention	4.00	7.00	45,176.000	-2.575	.010
Likes	Perceived severity	61.00	112.00	74.914.000	-4.356	<.001
Comments	Perceived severity	6.00	10.00	75,207.500	-4.291	<.001

Table 2
Nominal independent variables and median engagement

Variable	Engagement variable	Mdn high	Mdn low	p-value
Source	Likes	News: 1130.00	NGO: 52.00	<.001
Source	Likes	News: 1130.00	Individual: 64.00	<.001
Source	Likes	News: 1130.00	Commercial: 63.00	<.001
Source	Likes	Other: 349.00	NGO: 52.00	.014
Source	Likes	Other: 349.00	Individual: 64.00	.026
Source	Likes	Other: 349.00	Commercial: 63.00	.034
Source	Comments	News: 43.00	Individual: 7.00	.001
Source	Comments	News: 43.00	Commercial: 6.00	<.001
Source	Comments	News: 43.00	NGO: 2.00	<.001
Source	Comments	Other: 14.00	Commercial: 6.00	.041
Source	Comments	Other: 14.00	NGO: 2.00	<.001
Source	Comments	Individual: 7.00	NGO: 2.00	.002
Visual type	Likes	Other: 443.00	Text: 26.00	<.001
Visual type	Likes	Other: 443.00	Infographic: 15.50	.001
Visual type	Likes	Video: 224.00	Image: 77.00	.009
Visual type	Likes	Video: 224.00	Mix: 73.00	.015
Visual type	Likes	Video: 224.00	Drawing: 39.50	.010
Visual type	Likes	Video: 224.00	Text: 26.00	<.001
Visual type	Likes	Video: 224.00	Infographic: 15.50	<.001
Visual type	Likes	Image: 77.00	Text: 26.00	<.001
Visual type	Likes	Image: 77.00	Infographic: 15.50	.017
Visual type	Likes	Mix: 73.00	Text: 26.00	<.001
Visual type	Likes	Mix: 73.00	Infographic: 15.50	.019
Visual type	Comments	Other: 20.00	Image: 6.00	.017
Visual type	Comments	Other: 20.00	Drawing: 3.50	.005
Visual type	Comments	Other: 20.00	Text: 3.00	<.001
Visual type	Comments	Other: 20.00	Infographic: 2.00	<.001
Visual type	Comments	Video: 9.50	Infographic: 2.00	.011
Visual type	Comments	Mix: 8.00	Text: 3.00	.010
Visual type	Comments	Mix: 8.00	Infographic: 2.00	.003
Visual type	Comments	Image: 6.00	Infographic: 2.00	.013

RQ3: What are the characteristics of Zika-related Instagram visuals, and how do people engage with specific types of visual posts?

The results show that 51.0% (n=510) of Instagram visuals in this sample consisted of primarily image (a photo with little or no text), while 29.8% (n=298) consisted of a mix of photo and text, and 7.2% (n=72) were comprised of primarily text. Videos were present less frequently (5.6%, n=56), as were drawings (3.0%, n=30) and infographics (1.4%, n=14). Other types of images – most frequently maps – were represented in 2.0% (n=20) of the sample. In addition, 33.6% (n=336) of the visuals consisted of a "fear image" – that is an image with elements likely to trigger a level of fear in people who view the image (e.g., an image of an oversized syringe or an image of a baby with microcephaly); 17.4% (n=174) contained an image of a mosquito; and 2.4% (n=24) featured a pregnant woman. Finally, 52.8% (n=528) of visuals showed at least one person. Of the visuals showing people, 48.7% (n=257) showed at least one White/Caucasian person, 16.3% (n=86) at least one African-American/Black person, 41.9 (n=221) at least one Hispanic person, and 2.3% (n=12) at least one Asian person; 62.8% (n=330) featured at least one male person, and 51.9 (n=274) featured at least one female person.

Mann-Whitney U tests were run to determine if there were differences in likes and comments between posts that showed mosquitoes, persons, pregnant women, or fear images such as images of microcephaly – and posts that did not. Frequency of likes were significantly lower in posts that showed mosquitoes ($p=.019$) and higher in posts that showed a person ($p<.001$). There were no significant differences in comment frequencies (see Table 1). In addition, there were no significant differences in like and comment frequencies based on the use of a fear image, those containing an image of microcephaly, or showing the image of a pregnant woman.

A Kruskal-Wallis test was conducted to determine if there were differences in like frequencies between groups of Instagram posts that differed in visual type (primarily image, primarily text, mix of image and text, infographic, drawing, video, or other). Median like frequencies were statistically significantly different between the different types of sources, $X^2(5)=61.863$, $p<.001$. Post hoc analyses revealed significant differences in like frequencies between several of the groups. For example, video visuals elicited significantly higher like frequencies than primarily image visuals, text-based visuals, mixed visuals, drawings, and infographics. In addition, both primarily image-based visuals and image/text mixed visuals produced higher like frequencies than both text-based visuals and infographics (see Table 2).

Kruskal-Wallis tests were also conducted to determine if there were differences in comment frequencies between groups of Instagram posts that differed in visual type (primarily image, primarily text, mix of image and text, infographic, drawing, video, or other). Median comment frequencies were statistically significantly different between the different types of sources, $X^2(5)=39.312$, $p<.001$. Pairwise comparisons showed significant differences in comment frequencies between several of the groups. For example, "Other" visuals (primarily maps) received significantly higher comment frequencies than primarily image visuals, text-based visuals, drawings, and infographics. In addition, Video-based visuals, image/text mixed visuals, and primarily image-based visuals all elicited more comments than infographics (see Table 2).

RQ4: What Health Belief Model constructs are present in Zika-focused posts on Instagram?

Perceived severity. The following variables were used to determine perceived severity of the Zika virus: fear of the Zika virus, getting very sick because of Zika, serious complications of Zika for a pregnant woman and her fetus, fear of getting pregnant because of Zika, mention of microcephaly, visual shows microcephaly, mention of Zika being deadly, and mention of risk to pregnant women (note: for this and the other Health Belief Model constructs, posts could be in more than one category). Table 3 shows the presence of each of these variables in the Instagram posts of this sample. In totality, 75.8% (n=758) of Instagram posts in this sample mentioned the perceived severity of Zika.

Perceived susceptibility. The following variables were used to measure perceived susceptibility to the Zika virus: high chance of contracting Zika when in an area with a lot of mosquitoes, living in an area with ongoing local Zika transmission, traveling to an area with ongoing local Zika transmission, living in an area with a lot of mosquitoes, mention of travel restrictions, mention of sexual transmission, and mention that getting infected with Zika is currently a possibility. Table 4 shows the presence of each of these variables in the Instagram posts of this sample. In total, 59.9% (n=599) of Instagram posts in this sample mentioned the perceived susceptibility of the Zika virus.

Perceived benefits. The following variables were used to measure perceived benefits of Zika preventive measures: benefits of use of mosquito repellent, benefits of postponing travel to Zika areas, benefits of avoiding travel to Zika areas, benefits of wearing long sleeves and long pants when outdoors, and benefits of using condoms. Table 5 shows the presence of each of these variables in the Instagram posts of this sample. In total, 21.7% (n=217) of Instagram posts

in this sample mentioned the perceived benefits of Zika preventive measures. However, of the number of posts that mentioned Zika preventive measures in general, 91.2% (n=217) mentioned perceived benefits of these measures.

Perceived barriers. The following variables were used to gauge perceived barriers to Zika prevention: lack of funds for Zika prevention, complex instructions for Zika prevention, questioning the safety of Zika preventive measures, Zika preventions are unrealistic, and Zika is hard to prevent. Table 6 shows the presence of each of these variables in the Instagram posts of this sample. Looking at the total presence, 2.8% (n=28) of Instagram posts in this sample mentioned the perceived barriers to Zika preventive measures. However, of the number of posts that mentioned Zika preventive measures in general, 11.8% (n=28) mentioned perceived barriers to these measures.

Cues to action and self-efficacy. Mentions of cues to action for Zika preventive measures were present in 10.2% (n=102) of the posts, while mentions of self-efficacy related to Zika preventive measures were present in 9.6% (n=96) of the Instagram posts.

Table 3
Perceived severity of Zika

Variable	Percentage
Fear of the Zika virus	74.7% (n=747)
Getting very sick because of Zika	2.9% (n=29)
Serious Zika complications for a pregnant woman and her fetus	11.5% (n=115)
Fear of getting pregnant because of Zika	1.2% (n=12)
Mention microcephaly	10.0% (n=100)
Microcephaly visual	4.4% (n=44)
Zika is deadly	.4% (n=4)
Mention of risk to pregnant women	12.6% (n=126)

Table 4
Perceived susceptibility to Zika

Variable	Percentage
High chance of contracting Zika when in an area with a lot of mosquitoes	10.7% (n=107)
Living in area with local Zika transmission	32.7% (n=327)
Traveling to area with local Zika transmission	16.0% (n=160)
Mention of travel restrictions	3.1% (n=31)
Mention of sexual transmission	2.3% (n=23)
Living in area with a lot of mosquitoes	24.8% (n=248)
Zika infection is currently a possibility	35.2% (n=352)

Table 5
Perceived benefits of Zika preventive measures

Variable	Percentage
Benefits of use of mosquito repellent	15.7% (n=157)
Benefits of postponing travel to Zika areas	1.9% (n=19)
Benefits of avoiding travel to Zika areas	4.4% (n=44)
Benefits of wearing long sleeves and long pants when outdoors	3.3% (n=33
Benefits of using condoms	1.2% (n=12)

Table 6
Perceived barriers to Zika preventive measures

Variable	Percentage
Lack of funds for Zika prevention	.7% (n=7)
Complex instructions for Zika prevention	.3% (n=3)
Questioning the safety of Zika preventive measures	1.0% (n=10)
Zika preventions are unrealistic	.3% (n=3)
Zika is hard to prevent	.7% (n=7)

RQ5: How do Instagram users engage with Zika-related HBM constructs posts?

Mann-Whitney U tests were run to determine if there were differences in likes and comments between posts with the presence vs. absence of HBM constructs (i.e., perceived benefits, perceived barriers, perceived susceptibility, perceived severity, perceived self-efficacy, and cues to action). Like ($p=.023$) and comment ($p=.010$) frequencies were significantly lower both in posts that mentioned perceived benefits of Zika prevention as well as in posts that mentioned the perceived severity of Zika, versus posts that did not ($p<.001$ for both likes and comments). There were no significant differences between Instagram engagement metrics for perceived barriers, perceived susceptibility, self-efficacy, and cues to action (see Table 1).

Discussion

This study analyzed Zika-focused messages on the visual social media platform Instagram to gain a better understanding about these conversations on social media. Instagram, like most social media platforms, has a diverse and international user base. It is not surprising, therefore, that several languages were present in this Instagram sample. Three quarters of the posts were in English, while one fifth were in Portuguese, and the rest represented a variety of languages. However, this is a much higher percentage of non-English posts than seen in other social media studies. This language distribution breakdown is reflective of the international nature of the Zika crisis, and could also be higher because of the visual nature of Instagram, which allows for easier communication across languages. At the same time, although only a few American states have seen local Zika transmission so far, this result also points to the existing salience of Zika among English-speaking populations.

Regarding the origin of the posts in this sample, half were published by individual Instagram accounts, and approximately 30% by commercial Instagram accounts (e.g., mosquito repellent manufacturers). This is concerning, since individual and commercial accounts often contain a mix of trustworthy and untrustworthy information (Moorhead et al., 2013). In addition, only 9.5% of the posts originated with more inherently reliable health sources like public health organizations. This finding suggests that public health organizations should increase their presence and activity regarding the Zika crisis on platforms like Instagram. Moreover, news sources in this sample elicited higher engagement. Public health entities should consider an increase in partnering with news outlets to help disseminate crucial information about the nature and risks of a disease; correct misinformation; and calm fears, especially during an infectious disease outbreak.

Regarding the presence of HBM constructs in the Zika-focused Instagram messages, perceived severity (e.g., fear of Zika; risk to pregnant women) and perceived susceptibility (e.g., mentioning the perception of infection with Zika as a current possibility; living in an area with active Zika transmission) were most frequently present (75.8% and 59.9%, respectively). In other words, these Zika-focused Instagram posts reflect a high level of perceived threat. One explanation for this may relate to how individuals process a threat response. The Extended Parallel Processing Model (EPPM), another health behavior theory, provides two pathways as a threat response: danger control and fear control (Witte, 1992). Fear control takes place when a perceived threat is greater than the perceived efficacy to deal with the threat. Instead of addressing the threat (danger control), people's response will be focused on controlling their fear and these responses likely will be maladaptive, (e.g., through disengagement with the issue). This may explain the lower level of engagement with posts that highlight these in this sample. Similarly, posts mentioning fear and danger also produced less engagement than posts that did not indicate these emotions. Given what could be perceived as low efficacy responses to the Zika threat currently available (e.g., wearing long sleeves, using repellent), this fear control response makes sense. Future research should investigate if this pattern holds once a high efficacy response like the Zika vaccine becomes available, or whether engagement increases, as would be predicted by the danger control path of the EPPM.

The high prevalence of threat constructs is consistent with other health visual social media studies in which, similarly, fear messages were the overwhelming majority compared to preventive measures (Guidry et al., 2015). In contrast, less than a quarter of this sample focused on preventive measures. Of these, again, fewer than 10% originate with public health organizations, and close to 50% with commercial entities, suggesting that public health entities

should increase their involvement on this platform and lead the conversation on prevention of infectious diseases on these platforms.

Perceived barriers to Zika preventive behaviors were barely present (2.8%) as a percentage of the total sample, and present in just over 10% of the posts specifically mentioning Zika preventive measures. Using mosquito repellent was mentioned most frequently – more so than other available options such as postponing or avoiding travel to areas with local Zika activity, wearing long sleeved shirts or long pants, and using condoms or abstaining from sexual contact. This makes sense on two levels – close to half of all preventive measure posts originate with commercial accounts, which often are promoting mosquito repellent as their product. In addition, using mosquito repellent is not a complex behavior, and few barriers to its use exist. Again, public health organizations need to intensify their involvement in Zika social media conversations during an active outbreak on this and other platforms, to ensure that preventive Zika measures are presented on these platforms from a primarily public health perspective, as well as to highlight the efficacy of these steps.

Of the current options for prevention, using mosquito repellent requires the least amount of lifestyle change, which combined with the relatively low level of self-efficacy mentions (9.6% in this sample) could explain the relatively high prevalence of this specific preventive measure. Only .5% of the posts mention a future Zika vaccine, and mention that it is not available yet. When a Zika vaccine becomes available, the conversation about Zika preventive measures on Instagram will likely change.

Finally, the HBM constructs of cues to action and self-efficacy were only present in 10.2% and 9.6% of the total sample, respectively, suggesting that self-efficacy may not be salient with regard to using mosquito repellent since the action is sufficiently simple not to need express

self-efficacy mentions. Public health communications professionals should focus on increasing these forms of messaging on social media, especially when considering communication strategies to promote uptake of a future Zika vaccine, considering self-efficacy's role in changing behavioral intent as well as the role of verbal persuasion both in online communications and as a source of self-efficacy (Bandura, 1997; Wang, Willis, & Rodgers, 2014).

Overall, the posts seem to focus on mosquitoes instead of the risk to pregnant women and the risk to their fetuses: 37.1% mention mosquitoes and 17.4% show a mosquito visual, while only 10% mention or show microcephaly. A potential explanation may be that connecting Zika risks with pregnancy and its images may be too much of a fear appeal. Therefore, public health organizations should emphasize the benefits of prevention for a healthy pregnancy and be cautious about fear appeals of showing the devastating potential effects of Zika on a pregnancy (i.e., microcephaly).

Approximately 10% of posts mention different types of conspiracy theories – referring to conspiracies by government entities, medical professionals, or pharmaceutical companies. This percentage is similar to other recent social media vaccine studies (Guidry et al., 2015; Guidry & Messner, In press). A similar percentage indicate cynicism. Posts with either of these characteristics produced statistically significant higher levels of engagement in the form of likes and comments, which may be another form of the abovementioned maladaptive responses. While Instagram engagement in this manner, like most social media engagement, is a limited form of engagement because it is not always associated with real-life actions (Du & Jiang, 2014), it points to the importance of both countering conspiracy theories and disseminating correct information on social media platforms. An additional concern is the presence of anti-vaccine messaging on social media platforms: once the Zika vaccine becomes available, these anti-

vaccine messages may only increase as perceived vaccine adverse effects appear. Therefore, it may be advisable to promote both the vaccine as well as other preventive methods (e.g., personal mosquito protection) in the hope that those who may refuse the vaccine at least will use other preventive methods. A further complication is that a part of the public is concerned with the safety of mosquito repellents like DEET, even though its safety has long been supported (Katz, Miller, & Hebert, 2008; Mascarelli, 2011).

While videos and infographics represented only a small percentage of the total images in the sample, videos elicited more engagement than other visual types while infographics produced the lowest level of engagement. Although one should be careful not to overemphasize these findings, it is worth noting that videos are more likely to appeal to peripheral processing (using less effort, often when an individual may not be able to carefully process information). Infographics are more likely to utilize central processing (using scrutiny and care, often when a person has the ability to process information regarding an important issue) (Flynn, Worden, Bunn, Connolly, & Dorwaldt, 2011; Lazard & Atkinson, 2014). It is plausible that the complex and compressed information format of infographics may be too overwhelming, for Zika's main population at risk – women of childbearing age, who are already in a heightened state of arousal because of the high perceived threat and the high level of uncertainty – to process pro-actively (Lazard & Atkinson, 2014). The high engagement with the "other" category – primarily maps of areas where Zika local transmission is taking place – may point to simpler forms of information producing higher levels of engagement. In addition, women of childbearing age likely have an increased need for information related to Zika, and videos, even if processed peripherally, may be more attractive for both getting information and eliciting engagement.

Strength, Limitations and Future Directions

This study has several limitations – and several of these point to future directions for research. First, this paper focuses on social media platform Instagram, and there are many other platforms – Twitter, Facebook, Pinterest, Snapchat, Tumblr – on which Zika conversations take place and could provide significant information for public health professionals. Future studies should consider focusing on these platforms, and on comparing the Zika-focused posts on Instagram with the ones found on other platforms.

Second, this study did not yield much information about perceived barriers to Zika preventive measures, which limits the ability to address barriers on this social media platform. A possible reason could be that the barriers are not as prevalent or salient in this population, possibly because local U.S. transmitted cases have so far been limited. Knowing what specific perceived barriers exist for Instagram users will help inform the development of more comprehensive Zika communication strategies for this platform. Since the perceived barriers construct was not present in most Instagram posts, future studies should consider pursuing this by using other methods like interviews, focus groups, and surveys.

Finally, this study primarily approached Zika-focused posts on Instagram through the theoretical lens of the Health Belief Model. Other health behavior theories like the Extended Parallel Processing Model, Social Cognitive Theory, and others could provide helpful additional insights for public health and health communication professionals, and could provide additional approaches to both explaining and influencing desired health behaviors in this area.

Despite its limitations, this study had several strengths. First, this is the first quantitative content analysis of Zika-related messages on Instagram, providing a much-needed snapshot of the conversation regarding Zika on this popular visual platform. Second, random sampling was

used to collect the sample, which allows for a level of generalization to the population of interest: Zika-focused Instagram posts in later summer of 2016. Finally, the application of health behavior theories adds rigor to this study, and allows specific integration with health communication campaigns.

Conclusion

In summary, the Zika Instagram posts in this sample reflect a high perceived level of threat with three quarters of the sample expressing fear of Zika, and a low level of expressed self-efficacy. At least some of the responses seem to be maladaptive in nature, such as low engagement with posts that mention fear and perceived severity of Zika and high engagement with conspiracy theories and with posts that indicate cynicism. Even when an effective vaccine is developed and released, the relatively uncontrollable nature of Zika will continue to be a cause of concern, and misinformation spreading as evidenced by the presence of and engagement with conspiracy theory posts will likely continue as well. Public health organizations should consider increasing their activity regarding the Zika virus and preventive measures on Instagram, and emphasize self-efficacy and cues to action related to known Zika-preventive behaviors. This will be particularly relevant for public health communications related to the future release of a Zika vaccine.

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CHAPTER 3

PAPER 2

Abstract

The Zika virus outbreak is a particular threat for pregnant women and their fetuses because of the incidence of microcephaly among babies born to mothers with Zika. A Zika vaccine is under development, and it will be crucial for women of reproductive age to get the vaccine once it becomes available, and for effective messages to be developed to encourage vaccine uptake intent. In order to study the effects of Zika message framing (gain vs. loss) and visual type (photo vs. infographic) on future Zika vaccine uptake intent, a 2 x 2 between-subjects experiment was performed via an online survey among 339 U.S. women of reproductive age (18-49 years). The mean age of the respondents was 33.9 years (SD=7.88). Of the participants, 73.5% were White, 9.4% African-American, 8.8% Hispanic, 5.0% Asian, American Indian 1.2%, and other 2.1%. Participants were exposed to one of four messages, all formatted to look like Instagram posts: gain-framed infographic, loss-framed infographic, gain-framed photo/text, loss-framed photo/text. These messages were followed by questions about future Zika vaccine uptake intent as well as intermediate psychosocial variables that could lead to intent, such as attitude and subjective norm.

There was no interaction present between framing and visual type (p=.116), and there was no effect for framing (p=.185) or visual type (p=.724) on future Zika vaccine uptake intent, which is likely indicative of insufficient dosage of the intervention. However, when focusing on intermediate psychosocial constructs that are known to influence behavior and behavioral intent, gain-framed messages were more effective in increasing subjective norms (p=.005) as related to a future Zika vaccine, as well as perceived benefits (p=.016) and self-efficacy (p=.032). This is a novel finding since, traditionally, loss-framed messages are considered more beneficial in

promoting vaccine-related health behaviors. This finding could have implications for health messaging related to a future Zika vaccine, such as the need for repeated exposure to social media messages in health communication interventions and the possibility of using gain-framed messages when promoting the future Zika vaccine.

FRAMING AND VISUAL TYPE:
TESTING THEIR EFFECT ON ZIKA VACCINE UPTAKE INTENT

Literature Review

Until recently, Zika was a relatively unknown virus with mild flu-like symptoms. However, in the past few years it has quickly transformed into a global health threat across 84 countries, territories, or subnational areas with evidence of Zika transmission (World Health Organization, 2017). Originally thought to be spread only by mosquitoes, we now know the virus can also be transmitted sexually, via blood transfusions, and from mother to fetus during pregnancy. The severity of Zika is perhaps best illustrated by one of its most devastating consequences: a study by the New England Journal of Medicine estimated that between 1-13% of women who contract Zika while pregnant could give birth to a baby with microcephaly, an underdeveloped brain frequently accompanied by other abnormalities (Johansson, Mier-y-Teran-Romero, Reefhuis, Gilboa, and Hills, 2016). No vaccine is currently available, but several vaccine candidates are under development and in clinical trial testing phases.

Public health emergencies such as infectious disease outbreaks like Zika require quick, effective communication about both the issue itself and the availability of interventions (Lee & Basnyat, 2013). Effective communication practices are especially critical when educating a potentially apprehensive public (Freimuth, Linnan, & Potter, 2000). More and more people search for health information online, and social media platforms play an increasing role in framing health issues (Moorhead et al., 2013). While social media can play a significant role in distributing reliable information, it can just as easily contribute to the viral spread of misinformation, such as the increasing presence of vaccine-hesitant posts online (Dredze, Broniatowski, & Hilyard, 2016). Therefore, it is critical to develop future Zika vaccine

messaging and communication strategies specifically for social media communications (Dredze et al., 2016; World Health Organization, 2011).

Among social media platforms, the mobile social networking platform Instagram is of particular interest. The photo- and video-sharing platform is primarily a mobile application and has become one of the main visual engagement channels for smartphones and tablets. Instagram's growth has been rapid, surpassing 700 million users as of April 2017 (Constine, 2017). As of early 2015, 53% of those aged between 18-29 years use Instagram; an increase from 37% in 2013. In addition, women are particularly likely to use the service, along with Hispanics and African-Americans (Duggan, Ellison, Lampe, Lenhart, & Madden, 2015). In addition, the Zika epidemic is international in nature, and one of Instagram's strengths is its ability to communicate across languages with visuals. As such, Instagram is the medium of focus in this study.

Specific predictors—both message-related as well as psychosocial—for future Zika vaccine uptake are not known. However, predictors of vaccine uptake are known for other pandemic vaccines like H1N1, as well as for vaccines like the HPV vaccine, and these might provide insight into future Zika vaccine predictors and aid in future communications planning. This paper examines two key message-related variables—message framing and visual type—and their influence on reported future Zika vaccine uptake intent, as well as on the psychosocial variables leading to intent as described by leading health behavior change theories.

Message-Related Variables

Gain and Loss Framing

Message framing can have an impact on the ultimate effect of messages on health behavior intent and actions. One of the most often used framing techniques is gain- versus loss-

framed messages. Gain-framed messages generally focus on the benefits of engaging in a specific behavior and can both refer to good things that will happen as well as bad things that will not happen. On the other hand, loss-framed messages focus on the consequences of not engaging in a particular behavior and can refer to bad things that will happen and good things that will not happen (Gallagher & Updegraff, 2012; Rothman, Bartels, Wlaschin, & Salovey, 2006). The foundation for these concepts originate with Prospect Theory, which reasons that people are sensitive to the framing of messages. More specifically, people will try to avoid risks (be risk averse) when considering the possible gains offered by a solution, and be willing to take risks when considering potential losses (risk seeking) (Rothman et al., 2006).

Studies show that gain-framed messages tend to be more effective in promoting greater adherence to prevention behaviors, such as adhering to a recommended diet (Brug, Ruiter, & Van Assema, 2003), physical activity (Gallagher & Updegraff, 2012), skin cancer preventive behaviors (Detweiler, Bedell, Salovey, Pronin, & Rothman, 1999), and smoking cessation (Gallagher & Updegraff, 2012; Toll et al., 2007). These preventive behaviors are perceived as safe and less risky because they serve to prevent a future health issue (Rothman et al., 2006). Loss-framed messages are more effective in promoting illness-detecting, diagnostic behaviors such as mammography screenings (Abood, Black, & Coster, 2005) and HIV screenings (Apanovitch, McCarthy, & Salovey, 2003; Garcia-Retamero & Cokely, 2011). Diagnostic behaviors are perceived as risky or uncertain because people may find out they have a potentially serious illness (Rothman et al., 2006). However, a meta-analysis focused on the effect of gain- versus loss-framed messages on prevention behaviors concluded that, overall, gain-framed messages held only a small advantage over loss-framed messages – a difference that seemed to primarily be on account of a cluster of studies focused on dental health prevention behaviors like

flossing and brushing (O'Keefe & Jensen, 2007). A more recent meta-analysis by Gallagher and Updegraff (2012) found the same weak advantage of gain- over loss-framed messages when dealing with attitudes toward a health behavior and intentions to perform a health behavior. Yet, they found a much larger significant advantage of gain- over loss-framed messages when dealing with actual health behaviors (as opposed to attitude or intent).

Given the extant literature, it would be reasonable to hypothesize that vaccinations, a known preventive behavior, would be most effectively promoted using gain-framed messages. However, several studies have found that, instead, loss-framed messages work better to promote the HPV vaccine (Gerend, Shepherd, & Monday, 2008), the MMR vaccine (Abhyankar, O'Connor, & Lawton, 2008), and the H1N1vaccine (Chien, 2011; Nan, Xie, & Madden, 2012). A reason for this may be that, while vaccinations are preventive behaviors, they are also often associated with presumed, often disproven adverse consequences. Rothman et al. (1999) tested gain- and loss-framed messages to determine whether they would affect prevention or detection intent related to a fictional infectious disease among a college student population. Participants in study were more likely to indicate willingness to perform the detection behavior after reading the loss-framed message, and appeared to be more likely to indicate willingness to perform the prevention behavior after reading the gain-framed message, but only the loss-framed message was statistically significant. The effect of gain and loss framed messages seems to switch for vaccine uptake and vaccine uptake intent, likely due to increased attention paid to perceived or real vaccine side effects. However, there is both a gap in knowledge regarding how these dynamics may function in online, visual, social environments as well as a more general gap in the understanding of the inconsistent findings in gain/loss messaging effects in the vaccine context. These are two of the gaps in knowledge this study endeavored to address.

Types of Visual Information

The concept of risk is often a difficult one for people to grasp (Lipkus, 2007). Most risk information is either portrayed as numbers alone or as a combination of numbers and text, but visual representations can facilitate comprehension and recall of risk information (Lipkus & Hollands, 1998). Visuals of all kinds—including graphs, infographics, and photos—are recommended and used more frequently than numeric and verbal communications of risk (Lipkus, 2007). Graphics—visual displays such as histograms, pie charts, stick figures, dots, and line charts—can improve the comprehension of numeric risk, revealing patterns that are not easily visible otherwise and attracting attention by displaying information in concrete terms (Ancker, Senathirajah, Kukafka, & Starren, 2006; Lipkus & Hollands, 1998). For example, in a study by Goodyear-Smith et al. (2008), patients expressed a preference for pictures over numbers when interpreting cardiovascular benefit from treatment. Further, simple pictographs can reduce the risk of anecdotal reasoning when presenting statistical information about healthcare choices (Fagerlin, Wang, & Ubel, 2005).

It is well established that visuals are processed differently than text-based messages: Dual coding theory, for example, explains that visuals have an advantage over text because they are coded into both visual as well as verbal memory and are more easily retrieved from the brain because they are encoded more uniquely (Houts, Doak, Doak, & Loscalzo, 2006; McWhirter & Hoffman-Goetz, 2014; Paivio, 1991; Smith, Moriarty, Barbatsis, & Kenney, 2004). Information communicated through visuals, and text accompanied by visuals, increase attention to and recall of health education information compared to text alone. This may be of particular significance when communicating with those with lower literacy—often from vulnerable populations—who may not possess the literacy skills to read, interpret, and act on text-only health information (Garcia-

Retamero & Cokely, 2013; Houts et al., 2006; Kirsch, Jungeblut, Jenkins, & Kolstad, 2002). Visuals often serve to improve risk comprehension as well as the processing of other types of complex information (Lipkus, 2007). Finally, human brains process visual images with great speed and respond to them substantially faster than to verbal symbols, which is particularly relevant considering the average time spent on social media messages (Barry, 2004; Nielsen, 2016).

The next, relatively unanswered, question, however, is whether there is a difference between distinct types of visuals and their effect on message comprehension and risk perception. Infographics – graphic representations of information - are a popular tool for presenting online health information (Arcia et al., 2016; Lazard & Atkinson, 2015). Infographics boost understanding of health information by utilizing a person's visual ability to see patterns and trends, can present complex information or data in a visual format that is both quick and easy to comprehend, and can increase cognitive functions such as inference making (Dunleavy, 2015; Miller & Barnett, 2010; Occa & Suggs, 2015; Otten, Cheng, & Drewnowski, 2015). Regular photographs overlaid with text—whether in color or black and white—are an example of what Houts et al. call a combination of visual and text (Houts et al., 2006). These types of visuals have not been the focus of much research, but as far as format, seem to be similar to Internet memes, which tend to have a high level of virality (Börzsei, 2013). From the perspective of the Elaboration Likelihood Model (ELM), which explains attitude change based on information processing mechanisms, the effectiveness of photos versus infographics could depend on whether someone is processing the visual content centrally (involving effortful thinking) or peripherally (using less effortful thinking) (Petty, Priester, & Brinol, 2002).

Research Questions and Hypothesis

The research reviewed thus far makes it clear that visual type and framing are important message characteristics to consider. However, to date these have not been studied in conjunction, therefore we begin with a research question that explores this interaction:

RQ1: Do message frame and visual type interact to influence intent to receive the Zika vaccine?

There is more evidence regarding gain- and loss-frames as they relate to vaccine uptake. As stated earlier, studies show that in many cases, loss-framed messages are more likely than gain-framed messages to promote vaccine uptake (Gerend & Shepherd, 2007; Gerend & Shepherd, 2012; Nan, Xie, & Madden, 2012). Thus, this study's hypothesis is:

H1: Messages with a loss frame will be more likely to result in women reporting intent to get the Zika vaccine than messages with a gain frame.

Conversely, while there are reasons to think infographics and photos with text may have a different effect, there is not enough evidence yet to know with confidence. The second research question, therefore, is:

RQ2: Are there differences in intent to get the Zika vaccine between women who receive the infographic vs. the photo/text message?

Having narrowed the focus to message frame and type of visual, this paper now turns to the role of health behavior theory in designing message content.

Health Behavior Theories

Health behavior theories are an essential component of designing effective public health messaging (Glanz, Rimer, & Visnawath, 2015). Two of the most frequently-used theories are the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB) (Ajzen, 1985, 1991;

Bandura, 2004; Janz & Becker, 1984; Rosenstock, 1974). The HBM's constructs are perceived severity, perceived susceptibility, perceived benefits, perceived barriers, self-efficacy, and cues to action. The TPB's constructs are attitudes, subjective norms, perceived behavioral control, and behavioral intent. The HBM constructs of perceived severity and susceptibility are similar to attitudes in the TPB, and the HBM's self-efficacy construct is similar to the TPB's perceived behavioral control.

The HBM was developed specifically for preventive behaviors such as vaccination; however, examining vaccination behavior through the lens of both the HBM and TPB offers several advantages. First, the prevalence of social media has brought with it an increased focus on the normative components of health behavior theories. This is an advantage of including the TPB, as subjective norm is one of its three main constructs. Additionally, as with all behaviors, there is a difference between vaccine uptake and vaccine uptake intent. For this study, only vaccine update intent is used because, while the Zika vaccine is under development, it is not available yet. The TPB explicitly distinguishes between intent and behavior, making it particularly appropriate for Zika. The next sections review how HBM and TPB constructs relate to vaccination uptake for existing vaccines such as the seasonal flu and H1N1, and conclude by exploring how these constructs may influence uptake for a future Zika vaccine.

Health Belief Model

Higher seasonal flu vaccine uptake is associated with low perceived barriers to obtaining the vaccine (Mo & Lau, 2015; Shahrabani & Benzion, 2012), high perceived susceptibility to contracting the flu (Gorman, Brewer, Wang, & Chambers, 2012), high perceived benefits of the vaccine (Gorman et al., 2012; Shahrabani & Benzion, 2012), high perceived severity of the flu and high self-efficacy for obtaining the vaccine (Gargano et al., 2011), and finally, cues to action

(Mo & Lau, 2015). Higher H1N1 vaccine uptake is also associated with low perceived barriers (Gargano et al., 2011), and, correspondingly, low vaccine uptake is associated with high perceived barriers (Ding et al., 2011; Fisher et al., 2011). In addition, people who receive a seasonal flu vaccine are more likely to get the H1N1 vaccine and vice versa – in other words, those who have experienced the benefits of one type of flu vaccine are more likely to also accept the benefits of another type (Coe, Gatewood, & Moczygemba, 2012; Teitler-Regev, Shahrabani, & Benzion, 2011). Finally, higher HPV vaccine uptake is associated with low perceived barriers to the vaccine (Brewer & Fazekas, 2007b), high perceived susceptibility to the HPV virus (Brewer & Fazekas, 2007b), high self-efficacy to get the vaccine (Brewer & Fazekas, 2007b; Gerend & Shepherd, 2012), and cues to action (Brewer & Fazekas, 2007b; Ding et al., 2011).

Similarly, higher seasonal flu vaccine uptake *intent* is associated with high perceived susceptibility to the flu, as well as high perceived benefits of and low perceived barriers to getting the vaccine (Chen et al., 2011) and cues to action (Bennett, Buchanan, & Adams, 2012). Higher H1N1 flu vaccine uptake intent is associated with high susceptibility to the H1N1 flu, high perceived severity (Fridman et al., 2011), high perceived benefits of the H1N1 vaccine (Myers & Goodwin, 2011), and cues to action (Coe et al., 2012). Low perceived barriers are associated with high H1Nl flu vaccine uptake intent (Coe et al., 2012; Fridman et al., 2011; Myers & Goodwin, 2011). Finally, higher HPV vaccine uptake intent is associated with high susceptibility to and high perceived severity of the HPV virus (Bennett et al., 2012), while low perceived barriers are associated with higher HPV vaccine uptake intent (Kahn et al., 2008).

Theory of Planned Behavior

Lower seasonal flu vaccine uptake is associated with higher levels of negative attitudes to the vaccine (Gargano et al., 2011). Higher H1N1 vaccine uptake is associated with higher

positive subjective norm (Gerend & Shepherd, 2012), while lower H1N1 flu vaccine uptake, similar to the seasonal flu vaccine, is associated with higher negative attitudes toward to getting the vaccine (Gargano et al., 2011). Higher HPV vaccine uptake, meanwhile, is associated with higher positive subjective norms (Brewer & Fazekas, 2007a).

Finally, higher H1N1 flu vaccine uptake *intent* is associated with a positive attitude toward the H1N1 vaccine, positive subjective norms, and a higher level of perceived behavioral control related to vaccine uptake intent (Myers & Goodwin, 2011). Higher HPV vaccine uptake intent, meanwhile, is associated with a positive attitude toward the HPV vaccine, and with positive subjective norms related to the vaccine (Bennett et al., 2012; Kahn et al., 2008). The third research question of this study is, therefore:

> **RQ3:** What message characteristics are most effective at increasing the intermediate psychosocial constructs predicted by the HBM and TPB associated with intent to get a future Zika vaccine?

This study addresses gaps in the literature by examining the impact of message framing and visual type on intentions to receive a future Zika vaccine. While loss-framed messages are typically associated with increased vaccine uptake, neither the Zika vaccine nor the interaction between framing and visual have been studied to date. This study also seeks to answer the novel question of which visual format (infographic vs. the photo/text) is more effective in promoting intentions. Finally, this study is proactive in addressing gaps in our understanding of the role of psychosocial constructs in predicting future Zika vaccine uptake intent.

Method

The psychosocial and behavioral impacts of Zika vaccine message framing and image type were examined via a 2 x 2 between-subjects experiment with a U.S. sample of 339 women

of reproductive age. Participants were randomized to one of four arms. Randomization was carried out by Qualtrics using the Mersenne Twister algorithm, a common and widely accepted form of random number generation. Each participant was shown one of four Zika vaccine-related messages: Gain-framed photo/text (Figure 1), gain-framed infographic (Figure 2), loss-framed photo/text (Figure 3), or loss-framed infographic (Figure 4), followed by a questionnaire focused on attitudes and beliefs related to the future Zika vaccine, and with the main outcome being intent to get the vaccine. Because the study focused on a future Zika vaccine and one of Zika's most harmful side effects affect pregnant women and their fetuses, all participants were women of childbearing age (18-49). In addition, all participants were living in the U.S. and English-speaking. All procedures were approved by the Institutional Review Board (IRB) at a large research university in the Mid-Atlantic U.S. The experiment was conducted online, with participants exposed first to the stimuli message for their respective condition and then asked to complete a survey questionnaire.

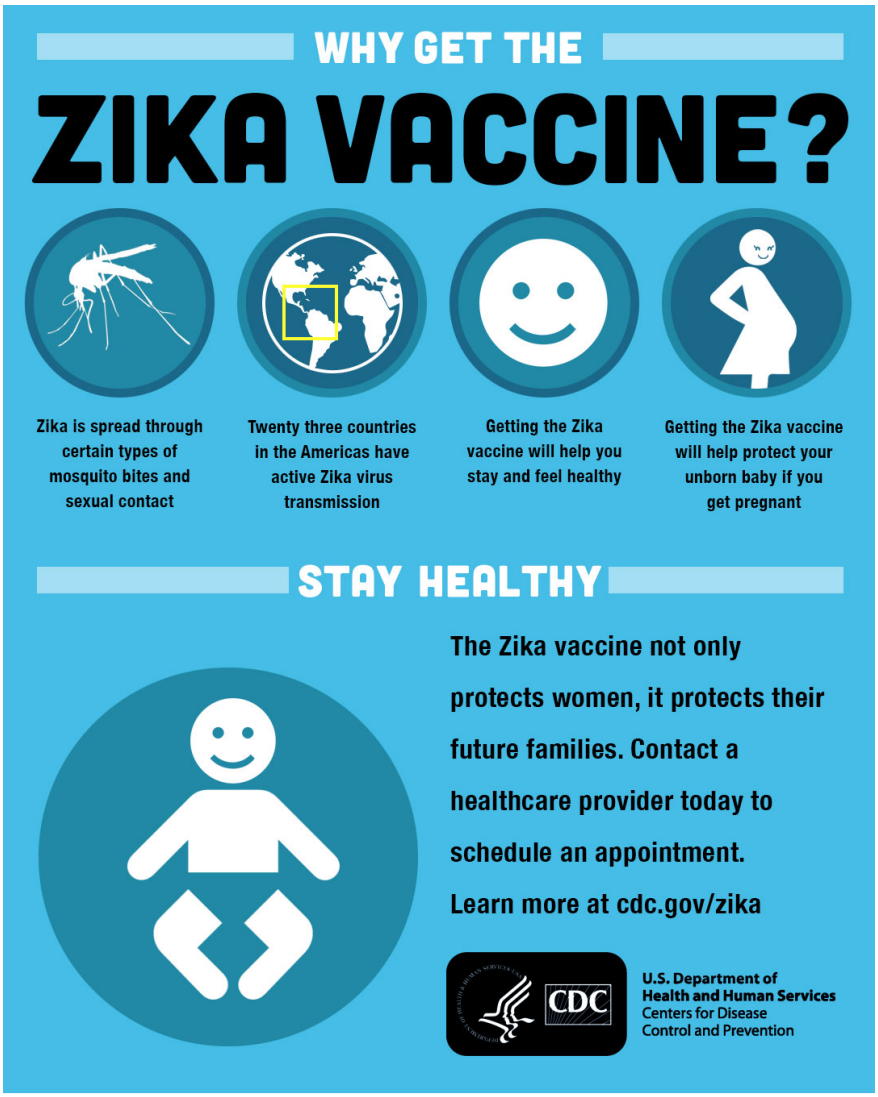
Stimuli Development

Four versions of the stimuli message about the future Zika vaccine were created in the visual form of an Instagram post (see Figures 1-4), incorporating the following independent variables: message framing (gain vs. loss) and visual type (photo vs. infographic). To maximize internal validity, the Zika virus information and Zika vaccine recommendation were held constant across conditions, as were color and formatting. The stimuli were reviewed by a panel of experts in message design using an iterative process until they reached agreement that the manipulations of frame and visual type had strong face validity and the remaining message content was as consistent as plausible for the design. External validity was addressed by creating stimuli that appeared as if they were screenshots from Instagram posts originating with the

Centers for Disease Control and Prevention (CDC), because it has established itself as the online public health authority with respect to infectious disease outbreaks like the H1N1 outbreak (Chew & Eysenbach, 2010) and the recent Ebola epidemic (Fu et al., 2016).

Figure 1
Gain-framed photo

Figure 2
Gain-framed infographic



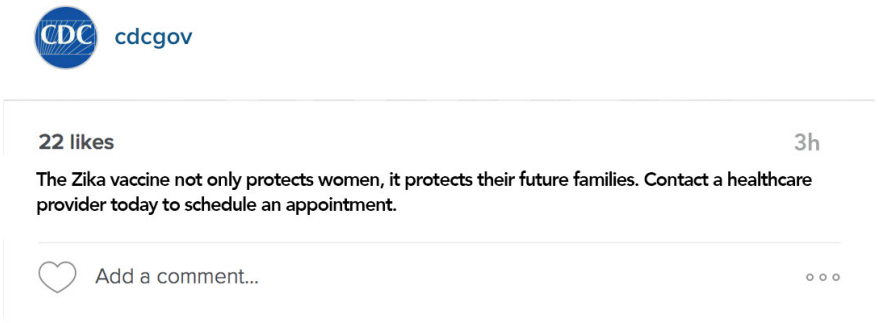
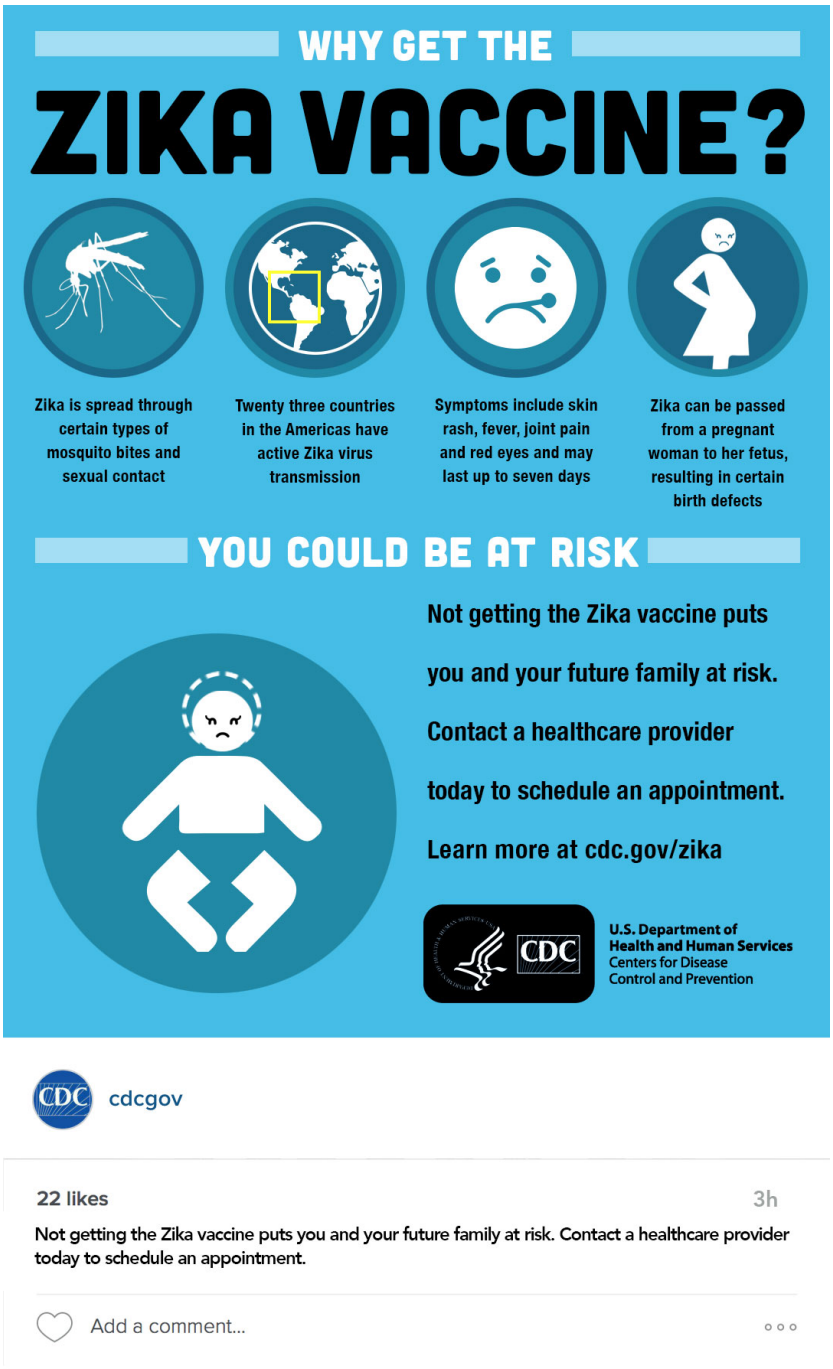


Figure 3
Loss-framed photo

Figure 4
Loss-framed infographic



Recruitment Procedures

A nationwide sample of 339 participants was recruited by Qualtrics, a survey research firm. Quota sampling by U.S. geographic region was used to help achieve a geographically

balanced sample. Data collection was initiated and completed in March 2017. Qualtrics recruited participants from their existing database, using a double opt-in process. Potential respondents were sent an email invitation informing them that the survey was for research purposes only, how long the survey was expected to take, and what incentives were available (a variable number of Qualtrics "points," worth approximately $5.20, which participants can exchange for gift cards, certificates, and other goods. A total of 808 individuals initiated participation. Of the 808 who began the process, 23 withheld consent and exited the survey. Three hundred and thirteen respondents were dropped from the survey through attention checks (i.e., questions inserted into the survey flow and require specific answers given in the question). Finally, another 133 were dropped because they finished less than one third of the survey, resulting in a final sample of 339.

Measures

Demographic variables. Demographic variables collected included age, region, ethnicity, level of education, and household income.

Healthcare-related variables. Healthcare-related variables were measured using single items with response categories of "yes" and "no" and included: previous seasonal flu vaccine uptake ("Last year, did you get a vaccination for the ordinary seasonal flu?"); future seasonal vaccine uptake intent ("This year, do you intend to get a vaccination for ordinary seasonal flu?"); and whether they have a regular healthcare provider ("Do you have a healthcare provider you see regularly?").

HBM and TPB constructs were assessed using scales adapted from Myers and Goodwin (2011), which focused on the H1N1 vaccine, unless otherwise noted. All measures showed good

reliability (ranging from .75 to .97), and were measured on a six-point Likert scale, unless otherwise noted.

Perceived severity. Perceived severity of the Zika virus was measured using three items from the Myers and Goodwin study – for example, "Complications of Zika are serious." Cronbach's alpha for items on the scale was .76 (Myers & Goodwin, 2011). In addition, two items were added relating specifically to perceived severity relating to Zika infection during pregnancy: "Complications of Zika for a pregnant woman and her fetus are serious," and "I am afraid to get pregnant because of Zika." The answers to these questions ranged between "strongly disagree" to "strongly agree," on a seven-item Likert scale.

Perceived susceptibility. Perceived susceptibility to the Zika virus was measured using three items (e.g., "I am worried about the likelihood of getting Zika in the near future."). An additional question was added relating to the presence of mosquitos: "When in an area with a lot of mosquitoes, my chances of getting Zika are high." The answers to these questions ranged between "strongly disagree" to "strongly agree," measured on a seven-item Likert scale. Cronbach's alpha for items on the scale was .75 (Myers & Goodwin, 2011).

Perceived benefits. Perceived benefits were measured using two items focused on the benefits of a future Zika vaccine: "Vaccination will decrease my chance of getting Zika or its complications" and "A future Zika vaccination will help me feel less worried about getting Zika." Since these two items measure separate benefits, no internal reliability analysis was available (Myers & Goodwin, 2011). Answers to these questions ranged between "strongly disagree" to "strongly agree."

Perceived barriers. Perceived barriers were measured using three items from the Myers and Goodwin study and an additional two from the Carolina HPV Immunization Attitudes and

Beliefs Scale (CHIAS) (McRee, Brewer, Reiter, Gottlieb, & Smith, 2010). An example item from the Myers and Goodwin study is "I am concerned that the side effects of a future Zika vaccination will interfere with my usual activities," and an example from the CHIAS is "I am concerned I won't know where to get the future Zika vaccine when it becomes available." As with perceived benefits, since these items measure separate benefits, no internal reliability analysis was available (Myers & Goodwin, 2011). The answers to these questions ranged between "strongly disagree" to "strongly agree," measured on a six-point Likert scale.

Self-efficacy. Self-efficacy was measured by two items: "How certain are you that you could get a future Zika vaccination?" with responses ranging from "very uncertain" to "very certain," and "If I wanted to, I am confident that I could get the future Zika vaccination," with responses ranging from "strongly disagree" to "strongly agree." Both were measured on a six-point Likert scale. Cronbach's alpha for items on the scale was .89 (Myers & Goodwin, 2011).

Cues to action. Cues to action were measured by one item, adapted from a study by Gerend and Shepherd (2012): "Has a physician, health care provider, or clinic spoken to you about Zika prevention?" with response options "yes" and "no."

Attitude. Attitude was measured using the prompt statement: "If I were to get a vaccination for Zika, it would be," with five semantic differential responses: harmful-beneficial, worthless-valuable, bad-good, negative-positive, and foolish-wise. Cronbach's alpha for items on the scale was .97 (Myers & Goodwin, 2011).

Subjective norms. Subjective norms were measured using five items, for example "My family would approve of me getting a future Zika vaccination," and "My friends would approve of me getting a future Zika vaccination," with responses ranging from "strongly disagree" to "strongly agree." Cronbach's alpha for items on the scale was .79 (Myers & Goodwin, 2011).

Perceived behavioral control. Perceived behavioral control was measured using three items, for example "How much personal control will you have over whether you do or do not get a future Zika vaccination?" with responses ranging from "very little control" to "total control." Cronbach's alpha for items on the scale was .79 (Myers & Goodwin, 2011).

Intention. Respondents' intentions to get the Zika vaccine when it becomes available were measured using a single item, "I intend to get the Zika vaccine when it becomes available," with responses ranging from "strongly disagree" to "strongly agree."

Analytic Approach

Simmons, Nelson, and Simonsohn (2011) state that cells in statistical analyses should include at least 20 observations. Therefore, the lowest two education variable options, "some high school" and "high school completed," were combined into one "high school or less" option. In addition, only Caucasian, African-American, and Hispanic ethnicity options were included in the analyses due to this constraint.

Descriptive analyses were conducted for the stimulus manipulation variables of gain/loss framing and photo/infographic visual type, as well as for vaccine intent. A two-way analysis of variance (ANOVA) was used to test the following effects on the primary dependent variable, vaccine uptake intent, as expressed by a six-level Likert outcome (and regarded as a continuous variable): the interaction between framing and visual type, main effect of framing, and main effect of visual type, as appropriate. Subsequently, two-way ANOVAs were used to test the interaction between framing and visual type as well as main effects of framing and visual type (where appropriate) on intermediate psychosocial constructs: Attitudes, subjective norms, perceived behavioral control, perceived severity and susceptibility, perceived benefits and

barriers, self-efficacy, and cues to action. Lastly, psychosocial construct items were examined individually to gain a more nuanced understanding of the observed relationships.

Results

Participant Characteristics

The mean age of the respondents was 33.9 (SD=7.88). Most participants were from the South (38.9%), followed by the Western region (24.5%), Midwest (20.9%), and Northeast (15.6%). In terms of education, 4.1% (n=14) reported having some high school, 20.4% (n=69) a high school diploma, 33.0% (n=112) some college, 11.5% (n=39) reported getting a 2-year degree, 22.4% (n=76) a 4-year college degree, and 8.6% (n=29) reported having a graduate degree. Finally, 9.4% (n=32) were African-American, 1.2% (n=4) American Indian, 5.0% (n=17) Asian, 8.8% (n=30) Hispanic, 73.5% (n=249) Caucasian, and 2.1% (n=7) other.

Of the 339 respondents, 49.6% (n=168) viewed a gain-framed message, and 50.4% (n=171) viewed a loss-framed message; 47.5% (n=161) of the messages were photo-based visuals, and 52.5% (n=178) were infographics-based visuals. Of the total sample, 26.5% (n=90) viewed the gain-framed infographic, 26.0% (n=88) viewed the loss-framed infographic, 23.0% (n=78) the gain-framed photo, and 24.5% (n=83) the loss-framed infographic.

The overarching aim was to understand which message characteristics would be most effective at increasing intentions to get the Zika vaccine, and led to three research questions: 1) Do message frame and visual type interact to influence intent to receive the Zika vaccine; 2) Are there differences in intent to get the Zika vaccine between women who receive the infographic vs. the photo/text message; and 3) What message characteristics are most effective at increasing the intermediate psychosocial constructs predicted by the HBM and TPB associated with intent to get a future Zika vaccine. In addition, one hypothesis was proposed: 1) that messages with a loss

frame will be more likely to result in women reporting intent to get the Zika vaccine than messages with a gain frame.

When asked for their response to the question "I intend to get the future Zika vaccine when it becomes available," 25.4% (n=86) indicated "strongly agree," 26.5% (n=90) "agree," and 25.1% (n=85) "somewhat agree." In addition, 6.8% (n=23) responded "strongly disagree," 8.6% (n=29) "disagree," and 7.7% (n=26) "somewhat disagree." Collapsing this, 77.0% (n=261) of the study respondents reported they agreed to an extent with getting the Zika vaccine, while 23.0% (n=78) disagreed to an extent (M=4.3, SD=1.49).

A two-way ANOVA was conducted to examine the effects of framing and visual type on intent to get the future Zika vaccine. Data were normally distributed, as assessed by a Q-Q plot. There were six outliers, as assessed by standardized scores greater than 3.0. These outliers were left in the analysis, since Cohen (2003) suggests leaving in a limited number of outliers (1-2%, in this case just under 2%) that are not too extreme. There was homogeneity of variances, as assessed by Levene's test for equality of variances, p=.473.

The interaction effect between framing and visual type was not statistically significant, $F(1,335)=2.488$, $p=.116$, partial $\eta^2=.007$. Therefore, an analysis of the main effect of both framing and visual type was performed, which indicated there was no statistically significant main effect of framing on intent to vaccinate, $F(1,335)=1.761$, $p=.185$, partial $\eta^2=.005$. In addition, there was no statistically significant main effect of visual type on intent to vaccinate, $F(1,335)=.125$, $p=.724$, partial $\eta^2=<.001$. Therefore, the study's hypothesis was not supported. The research questions show there to be no difference between visual types, and no interaction between visual type and message framing on intent to get the future Zika vaccine.

Intermediate Outcomes

A secondary aim of the current study was to determine what message characteristics are most effective at increasing intermediate psychosocial constructs that may contribute to intent to get the Zika vaccine. Again, two-way ANOVAs were conducted to address this aim. For these tests, data were largely normally distributed, as assessed by Q-Q plots. There were six outliers, as assessed as standardized scores being greater than 3.0. These outliers were left in the analysis. There was homogeneity of variances for all variables, as assessed by Levene's test for equality of variances with $p>.05$. None of the interactions were significant. Therefore, an analysis of the main effect of both framing and visual type was performed for all intermediate outcomes. These results can be found in Table 1; the significant results are also outlined below.

Table 1
Two-way ANOVA results

Variable	Interaction F	df	p	partial η^2	Gain/Loss F	df	p	partial η^2	Photo/Infographic F	df	p	partial η^2
Attitude	1.197	1,335	.275	.004	1.966	1,335	.081	.006	.755	1,335	.385	.002
Subjective norms	2.275	1,335	.132	.007	6.546	1,335	.005*	.019	.065	1,335	.799	<.001
Perceived Behavioral Control	.282	1,335	.596	.001	1.329	1,335	.125	.004	.008	1,335	.929	.001
Perceived severity	2.566	1,335	.110	.008	.593	1,335	.221	.002	.283	1,335	.595	.001
Perceived susceptibility	.036	1,335	.850	<.001	1.642	1,335	.101	.005	3.065	1,335	.081	.009
Perceived benefits	.440	1,335	.508	.001	4.665	1,335	.016*	.014	.046	1,335	.829	<.001
Perceived barriers	.161	1,335	.689	<.001	.030	1,335	.431	<.001	1.813	1,335	.179	.005
Perceived barriers incl. emotion	.615	1,335	.433	.002	.460	1,335	.249	.001	.013	1,335	.908	<.001
Self-efficacy	.660	1,335	.417	.002	3.471	1,335	.032*	.010	1.687	1,335	.195	.005
Foolish-wise	.484	1,335	.487	.002	1.532	1,335	.109	.005	.504	1,335	.478	.002
Harmful-beneficial	1.019	1,335	.314	.003	4.333	1,335	.019*	.013	.513	1,335	.475	.002
Worthless-Valuable	1.615	1,335	.205	.005	1.753	1,335	.093	.005	.957	1,335	.329	.003
Bad-good	.292	1,335	.589	.001	.258	1,335	.306	.001	.200	1,335	.655	.001
Negative-positive	2.713	1,335	.100	.008	2.297	1,335	.066	.007	1.579	1,335	.210	.005
Zika vax out of own control	1.204	1,335	.273	.004	.892	1,335	.173	.003	.318	1,335	.573	.001
Up to me to get Zika vax	.036	1,335	.850	<.001	1.062	1,335	.152	.003	.257	1,335	.612	.001
Zika vax: very little control	.059	1,335	.807	<.001	<.001	1,335	.496	<.001	.880	1,335	.349	.003
Norms: people important to me	3.389	1,335	.067	.010	6.065	1,335	.007*	.018	.028	1,335	.867	<.001
Norms: family would approve	2.026	1,335	.156	.006	7.818	1,335	.003*	.023	.164	1,335	.686	<.001
Norms: friends would approve	2.044	1,335	.154	.006	8.282	1,335	.002*	.024	.018	1,335	.894	<.001
Norms: PCP would approve	3.335	1,335	.069	.010	5.719	1,335	.009*	.017	.047	1,335	.828	<.001
Norms: want to please people	.018	1,335	.894	<.001	.351	1,335	.227	.001	.988	1,335	.321	.003
Benefits: less worry	.290	1,335	.591	.001	4.797	1,335	.015*	.014	.187	1,335	.665	.001
Benefits: less chance at Zika	.465	1,335	.496	.001	3.178	1,335	.038*	.009	.001	1,335	.970	<.001
Barriers: interfere with activities	.572	1,335	.450	.002	.099	1,335	.377	<.001	.043	1,335	.835	<.001
Barriers: fear of needles	.435	1,335	.510	.001	.078	1,335	.390	<.001	2.301	1,335	.130	.007
Barriers: inconvenience	.316	1,335	.574	.001	.340	1,335	.280	.001	2.732	1,335	.099	.008
Barriers: expensive	.416	1,335	.519	.001	.199	1,335	.328	.001	2.969	1,335	.086	.009

Variable	Interaction				Gain/Loss				Photo/Infographic			
	F	df	p	partial η^2	F	df	p	partial η^2	F	df	p	partial η^2
Barriers: where to get vax	.003	1,335	.959	<.001	.016	1,335	.450	<.001	.569	1,335	.451	.002
Emotion vax: fear	.569	1,335	.451	.002	.280	1,335	.299	.001	1.580	1,335	.210	.005
Emotion vax: nervous	.022	1,335	.881	<.001	.436	1,335	.255	.001	2.247	1,335	.135	.007
Emotion vax: confusion	.039	1,335	.843	<.001	.161	1,335	.345	<.001	6.415	1,335	.012*	.019
Emotion vax: anger	.080	1,335	.778	<.001	1.484	1,335	.112	.004	3.708	1,335	.055	.011
Emotion vax: cynicism	.046	1,335	.831	<.001	.009	1,335	.463	<.001	.724	1,335	.396	.002
Self-efficacy: confidence	.436	1,335	.510	.001	3.572	1,335	.030*	.011	.277	1,335	.599	.001
Self-efficacy: certainty	.741	1,335	.390	.002	2.645	1,335	.053	.008	3.488	1,335	.063	.010
Susc: high chance at infection	1.053	1,335	.306	.003	.495	1,335	.241	.001	3.561	1,335	.060	.011
Susc: possibility of infection	.284	1,335	.595	.001	.843	1,335	.180	.003	5.013	1,335	.026*	.015
Susc: worry about likelihood	.324	1,335	.569	.001	1.306	1,335	.127	.004	.452	1,335	.502	.001
Susc: chance high mosquitoes	.180	1,335	.672	.001	2.080	1,335	.075	.006	1.240	1,335	.266	.004
Severity: serious complications	.065	1,335	.799	<.001	1.421	1,335	.117	.004	1.360	1,335	.244	.004
Severity: very sick with Zika	2.789	1,335	.096	.008	.124	1,335	.363	<.001	1.006	1,335	.316	.003
Severity: afraid of getting Zika	2.319	1,335	.129	.007	.033	1,335	.428	<.001	.048	1,335	.826	<.001
Severity: complications pregnancy	1.108	1,335	.293	.003	.003	1,335	.480	<.001	.797	1,335	.373	.002
Severity: afraid to get pregnant	.946	1,335	.332	.003	.916	1,335	.170	.003	.757	1,335	.385	.002
Emotion virus: fear	.041	1,335	.839	<.001	1.769	1,335	.090	.005	.527	1,335	.469	.002
Emotion virus: nervous	.082	1,335	.775	<.001	1.457	1,335	.114	.004	1.355	1,335	.245	.004
Emotion virus: confusion	.798	1,335	.372	.002	.120	1,335	.365	<.001	.451	1,335	.502	.001
Emotion virus: anger	.294	1,335	.588	.001	<.001	1,335	.498	<.001	.262	1,335	.609	.001
Emotion virus: cynicism	.001	1,335	.980	<.001	.005	1,335	.472	<.001	.421	1,335	.517	.001

Main Effects of Framing

First, a main effect of framing was present on subjective norms as a composite score consisting of five items: Gain-framed messages were associated with a higher subjective norm related to the Zika vaccine ($p=.005$, partial $\eta^2=.019$) (see Tables 1 and 2). When assessing these items individually, a main effect of framing was present on subjective norm operationalized as "people who are important to me would approve of me getting a future Zika vaccination" ($p=.007$, partial $\eta^2=.018$); "my family would approve of me getting a future Zika vaccination" ($p=.003$, partial $\eta^2=.023$); "my friends would approve of me getting a future Zika vaccination" ($p=.002$, partial $\eta^2=.024$); "my primary care provider would approve of me getting a future Zika vaccination" ($p=.009$, partial $\eta^2=.017$). Gain-framed messages resulted in higher subjective norms item scores than loss-framed messages (see Tables 1 and 2).

Second, a main effect of framing was present on perceived benefits as a composite score consisting of two items ($p=.016$, partial $\eta^2=.014$) (see Tables 1 and 2). When considering the individual items, a main effect of framing was present on perceived benefits (of a future Zika vaccine), operationalized as "A future Zika vaccination will help me feel less worried about Zika" ($p=.015$, partial $\eta^2=.014$) and "A future Zika vaccination will decrease my chance of getting Zika or its complications" ($p=.038$, partial $\eta^2=.009$) (see Tables 1 and 2).

Finally, a main effect of framing was present on self-efficacy as a composite score consisting of two items ($p=.032$, partial $\eta^2=.010$) (see Tables 1 and 2). When considering the individual items, a main effect of framing was present on self-efficacy operationalized as "If I wanted to, I am confident I could get the future Zika vaccination" ($p=.030$, partial $\eta^2=.011$) (see Tables 1 and 2). However, the other item, "How certain are you that you could get the future Zika vaccination," was not significant.

Table 2
Unweighted marginal means for main effects

Variable	Unweighted marginal mean gain-frame, SD	Unweighted marginal mean loss-frame, SD	p-value
Subjective norm	4.93, .081	4.63, .080	.005
Norm: people	5.03, .093	4.71, .092	.007
Norm: family	5.04, .095	4.67, .094	.003
Norm: friends	4.98, .096	4.59, .095	.002
Norm: PCP	5.16, .084	4.88, .083	.009
Perceived benefits	4.98, .090	4.71, .089	.016
Benefits: worry	5.02, .098	4.72, .097	.015
Benefits: less chance at Zika	4.94, .097	4.70, .097	.038
Self-efficacy	4.95, .083	4.73, .082	.032
Self-efficacy: confidence	5.10, .084	4.87, .084	.030

Main Effects of Visual Type

No main effect of visual type was present for any of the composite scores. Among individual items, only two individual items displayed a main effect of visual type: perceived barriers operationalized as the likelihood to feel confused about a future Zika vaccine, (p=.012); the unweighted marginal means of confusion was 2.86 +/- .116 for photo-based messages and 2.45 +/- .110 for infographic-based messages. In addition, a main effect of visual type was present on perceived susceptibility operationalized as "Getting infected with Zika is currently a possibility for me," (p=.026); the unweighted marginal means of 3.33 +/- .127 for infographic-based messages and 2.92 +/- .134 for photo-based messages (see Table 1).

Discussion

This study examined the effect of Zika message framing (gain vs. loss) and image type (photo vs. infographic) on future Zika vaccine uptake intent and other psychosocial outcomes, using a 2 x 2 between-subjects experiment conducted via an online survey. The initial research question asked what message characteristics would be most effective at increasing intentions to get a future Zika vaccine, but the corresponding analyses yielded no significant results and the

accompanying hypotheses were not supported. There are a number of plausible reasons for this outcome: First and foremost, the dose of the intervention—the frequency and length of exposure—may not have been strong enough with a single image exposure, and repeated exposure to the message may be needed (Farrelly, Davis, Haviland, Messeri, & Healton, 2005). This brief exposure, however, is typical for social media in general and Instagram in particular. Second, respondents may not have read the message or read it for comprehension. Third, the survey was carried out in early March, considered off-season for mosquitoes in much of the U.S. The public conversation about Zika at this time was less intense than during the previous summer, a time of heightened risk perception and widespread media coverage.

Other factors that were not manipulated in the current study may have influenced the outcome include message source and virality. For example, whether the message was shared through a trusted Instagram connection (e.g., friend or relative) instead of directly from the CDC could potentially influence responses. Additionally, the study posts were portrayed with limited virality (i.e., the engagement frequency; 22 likes); increased virality may have increased the salience of and response to the post.

Another consideration regarding the lack of differences in reported intent to get the Zika vaccine between gain- and loss-framed messages: Both gain- and loss-framed messages may be equally effective in promoting Zika vaccine messages. This could indicate the relevance of using both message frames for Zika vaccine public health communication campaigns.

The third research question asked what message characteristics are most effective at increasing intermediate psychosocial constructs that contribute to intent to get a future Zika vaccine. While no interaction effects were present, there were a few significant main effects. First, a main effect of framing was present for the subjective norm composite variable, as well as

for four of the five subjective norm items—valuing the opinion people important to the person in general, parents, friends, and primary care. In spite of what the literature states about loss-framed messages being more effective in promoting vaccinations, the current study did not support this. Moreover, gain-framed messages were more effective in increasing subjective norms related to a future Zika vaccine uptake. In addition, gain-framed messages were also more effective in increasing perceived benefits of a future Zika vaccine, and, to a lesser extent, self-efficacy related to the vaccine. For example, gain-framed messages emphasized the benefits of getting the vaccine (e.g., it helps you stay healthy), while loss-framed messages underscored the consequences of not getting the vaccine (e.g., you will be at risk for having a baby with microcephaly).

This is a novel finding given that the existing literature indicates that loss-framed messages are more beneficial in promoting vaccine uptake and vaccine uptake intent. The unique nature of the future Zika vaccine could provide a potential explanation: While the vaccine is administered to women, the most salient prevention affects the (potential) fetus. O'Keefe and Nan (2012) suggest that people may be differentially susceptible to gain vs. loss-framed vaccine messages depending on whether the vaccine is for themselves or for their child(ren). In addition, even though the available literature shows indications that loss-framed messages are more effective than gain-framed messages when promoting vaccines, the debate over effectiveness of gain- vs. loss-framed messages related to vaccines is not settled (O'Keefe and Nan, 2012). A final potential reason for the apparent effect of gain-framed messages in this study could be that, since the Zika vaccine is not available to the public yet, no reports about perceived adverse effects of the vaccine exist at this time. Thus, the vaccine may be perceived as less risky, which

points to a greater effectiveness of gain-framed promotion messages. Future research should examine whether these findings are reproduced when the Zika vaccine becomes available.

Strengths and Limitations

There are several limitations of the current study that should be taken into account in interpreting the findings. First, the exposure to the message was brief. Thus, the dose was likely insufficient to produce meaningful engagement with the content at the level needed to promote change in intent. The results for this study were limited, likely at least in part because of the brief exposure to the message. Second, this study was carried out in March of 2017, when Zika was perceived as less of a threat than during the summer of 2016. In addition, the CDC was used as the source for the intervention messages. Results may be different based on the perceived origin of messages, such as a news source or a post from a trusted friend. Moreover, Puerto Rico, the U.S. territory with the highest prevalence of Zika thus far, was excluded from the experiment. Puerto Rico residents may well have had different responses to the intervention messages. Future studies should include Puerto Rico as well as include other nations affected by Zika.

Finally, this experiment was implemented before a Zika vaccine was available to the general public. This means that the public had not experienced the benefits of the vaccine first hand. Conversely, perceived adverse effects of the vaccine were not present yet, either. Both factors could influence intent to get the vaccine. Therefore, it would be beneficial for this study to be repeated once the vaccine is available, and during the peak summer months when the perceived threat of Zika is higher. The intervention could then be adapted by increasing exposure to the messages. In addition, visuals consisting of moving images such as videos were outside the scope of this study, but should be considered for future studies. Finally, the experimental

messages primarily focused on the adverse effects of Zika on pregnant women and their fetuses. Other images are needed focused on both other Zika adverse effects and on other populations. In addition, messages are needed that emphasize threats to self versus potential offspring among women of reproductive age, as not all women in this age bracket are or intend to become pregnant.

Despite these limitations, the study has several notable strengths. It takes a proactive approach in studying messaging focused on the Zika vaccine before that vaccine is available, allowing for quick implementation of its limited results. In addition, this study centers on messaging in the form of realistic images consistent with those that could be posted on Instagram, thereby focusing on a relatively new yet immensely popular communications platform that few are focusing on presently. These messages were grounded in theory as well as findings from the earlier content analysis. Finally, participants were randomly assigned to conditions.

Conclusion and Future Directions

The current visual, Instagram-targeted, social media intervention did not find an effect on reported future Zika vaccine uptake intent, and resulted in limited effects on intermediate outcomes that could lead to either future Zika vaccine uptake intent or future Zika vaccine uptake. This is likely indicative of the intervention not being dosed sufficiently for the desired result. This underscores the importance of not over-estimating the efficacy of social media messages as stand-alone interventions and emphasizes the importance of continued research into effective integration of these types of interventions as part of a larger campaign.

However, based on this study, it seems there might be an effect of gain-framed visual messaging on subjective norm and many of its items (the importance of parents', friends', and

healthcare providers' opinions in the decision to get a future Zika vaccine). In addition, there may be a smaller effect of gain-framed messaging on the perceived benefits of a future Zika vaccination as well as self-efficacy related to the vaccine. Therefore, public health and health communication professionals should consider targeting social norms and perceived benefits related to the Zika vaccine, using gain-framed messages, especially when considering platforms like Instagram. Communication campaigns should include repeated exposure to messages to enhance dose and increase potential effects. Because social media is still a relatively recent phenomenon, and there still is a relative paucity of research into the field, it is essential to continue to expand the small but growing body of interdisciplinary research in this area.

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CHAPTER 4

PAPER 3

Abstract

This study examined the predictive effects of attitudes, emotional responses, behavioral intentions, and other behavioral constructs as well as demographic and healthcare-related variables on reported intent to get the future Zika vaccine among women of reproductive age. Data were collected using an online survey with a representative sample of 339 adults from the continental United States. Three quarters of all respondents reported intention to get a future Zika vaccine. A hierarchical multiple regression revealed unique predictors of future Zika vaccine uptake intent. Specifically, each of the following were significant predictors of intention to get the vaccine: perceived susceptibility to the Zika virus; positive attitude toward a future Zika vaccine; perceived benefits of such a vaccine; self-efficacy related to the vaccine; being African-American as compared to Caucasian; making between $25,000 and $34,999 per year as compared to making less than $25,000; and having a healthcare provider talk to you about Zika and available preventive measures to address the virus. Of note, fewer than 10% of respondents reported that their regular healthcare provider brought up the issue of Zika during an appointment. In addition, the finding that African-Americans are more likely to report intent to get a future Zika vaccine contradicts the available literature, and is a finding that should be further investigated. These findings have implications for future Zika vaccine promotion campaigns, particularly when considering target audience segmentation and targeted message design.

WHO WILL GET THE ZIKA VACCINE?
THE EFFECT OF DEMOGRAPHICS, HEALTHCARE-RELATED VARIABLES, AND PSYCHOSOCIAL CONSTRUCTS ON UPTAKE INTENT

Background

Until recently, the Zika virus was regarded as a rare, mosquito-borne, infectious disease with few, if any, serious symptoms (Fauci & Morens, 2016). The Zika virus was not discovered until 1947, and its first human patients only date back to 1953 (Bogoch et al., 2016). However, over the past two years, Zika has developed into an epidemic – to date it has affected 5,139 persons in the United States and 38,188 persons in U.S. territories (Centers for Disease Control and Prevention, 2017). In addition to mosquito-based transmission, the disease can also spread through sexual contact (D'Ortenzio et al., 2016; Foy, 2011; Mansuy et al., 2016), blood transfusions (Musso et al., 2014), and during pregnancy from mother to fetus (Soni, 2016; Vogel, 2016; World Health Organization, 2017). While most patients either have no or mild symptoms, Zika has been linked with Guillain-Barre syndrome (Cao-Lormeau et al., 2016) and with microcephaly in babies born to mothers infected with Zika during pregnancy (Mlakar et al., 2016; Rasmussen, Jamieson, Honein, & Petersen, 2016). Zika cases have been diagnosed in 84 countries (World Health Organization, 2017), and while the World Health Organization (WHO) in late 2016 declared the Zika global health emergency to be over, they also determined it to be a dangerous mosquito-borne disease which should be viewed as an ongoing threat (World Health Organization, 2017).

Currently, treatment for Zika is supportive in nature only (Frieden, Schuchat, & Petersen, 2016), and no vaccine is available for the general public; however, a National Institutes of Health (NIH)-developed vaccine entered Phase 2 clinical trial testing in March 2017 (NIH, 2017). Once a Zika vaccine becomes available, it will be important to quickly promote vaccine uptake by women of reproductive age (Lipsitch & Cowling, 2016). However, increasing public concern

about vaccines and vaccine safety is likely to play a role in Zika vaccine uptake decisions. Effective vaccine promotion requires an understanding of what might encourage as well as deter the public from seeking out a future Zika vaccine.

Vaccines

Vaccines have long been considered one of public health's greatest victories, and have contributed greatly to the remarkable decline in morbidity and mortality due to infectious diseases over the course of the past 100 years—including eradicating smallpox worldwide and poliomyelitis in the U.S. (Dubé et al., 2013; Siddiqui, Salmon, & Omer, 2013; Yaqub, Castle-Clarke, Sevdalis, & Chataway, 2014). However, every vaccination breakthrough has been accompanied by opposition to vaccines (Poland & Jacobson, 2011). Recent unsubstantiated concerns about vaccine safety have resulted in an increase in parents who either delay their children's vaccinations or do not vaccinate their children at all (Omer, Salmon, Orenstein, Dehart, & Halsey, 2009). While relatively few people refuse all vaccines outright, far larger numbers refuse some vaccines or delay them, or vaccinate their children but have questions about vaccinations' safety and effectiveness (MacDonald, 2015; Omer et al., 2009). This phenomenon is called vaccine hesitancy and is defined as expressing concern or doubt about vaccine uptake, either for oneself or for one's children (MacDonald, 2015; Yaqub et al., 2014). Reasons why people either refuse or delay vaccines include fears that vaccines do harm, that vaccines do not work, and that vaccines will overload children's immune systems. Additional reasons include: convictions that they or their children are not at risk for a specific disease; that the disease itself is not dangerous; lack of trust in pharmaceutical companies and government entities; and the idea that it is preferable to build up one's immune system naturally as opposed to through vaccinations (Betsch & Sachse, 2013; Kata, 2012; MacDonald, 2015; Siddiqui et al.,

2013). In addition, people often exhibit a preference for errors of omission (the risk of not vaccinating) versus errors of commission (the risk of vaccinating) (Siddiqui et al., 2013). Given this, it is unsurprising that interventions targeting anti-vaccination attitudes are seldom effective—health communication specialists recommend instead to focus on those who are unsure about vaccines (Betsch, Korn, & Holtmann, 2015; Sadaf, Richards, Glanz, Salmon, & Omer, 2013; Salmon, Dudley, Glanz, & Omer, 2015). Although demographic, healthcare related, and psychosocial variables are traditionally considered important predictors of vaccine intentions and behavior, how these factors will influence Zika vaccine intentions is not known. It will be critical to understand how individual characteristics drive Zika vaccine uptake intent and to develop health messages tailored to relevant segments of the at-risk population. Accordingly, this study examines the demographic, healthcare-related, and psychosocial predictors of future Zika vaccine uptake intent.

Demographics and Healthcare Variables

Socio-economic status (SES) as operationalized by income has been identified in several studies as a factor affecting vaccine acceptance for childhood vaccines; interestingly both high and low income/SES are reported as both barriers to as well as promoters of vaccine acceptance (Larson, Jarrett, Eckersberger, Smith, & Paterson, 2014; Wei et al., 2009). Similarly, level of completed education is also reported as both as a barrier and a promoter of vaccine uptake—while several studies in India found caregivers' high education level to be a promoter of vaccine uptake (Kumar et al., 2012), studies in China, the U.S., and Israel found it to be a barrier to vaccine uptake (Muhsen et al., 2012; Stockwell, Irigoyen, Martinez, & Findley, 2011). Caregivers' low education level was also identified as both a barrier and promoter to vaccine uptake in the U.S. (Kim, Frimpong, Rivers, & Kronenfeld, 2007; Stockwell et al., 2011) and as a

barrier in Kyrgyzstan, China, and India (Akmatov, Mikolajczyk, Kretzschmar, & Krämer, 2009; Patel & Pandit, 2011; Wang, Wang, Zhang, Kang, & Duan, 2007).

Considering adult vaccine uptake, there is a trend toward higher vaccine acceptance by non-Hispanic White women compared with women in other subgroups (Englund, 2003; Fisher et al., 2011), and more specifically, that Black respondents were less likely than White or Asian respondents to report intent to get the H1N1 vaccine during the H1N1 outbreak (Myers & Goodwin, 2011). The same dynamic is visible with the seasonal flu vaccine—African-Americans display significantly lower odds of getting the flu vaccine, even after correcting for other factors like SES and access to care (Lindley, Wortley, Winston, & Bardenheier, 2006). In addition, a higher education is associated with higher acceptance of the H1N1 vaccine (Myers & Goodwin, 2011). Having a regular primary care physician is also associated with higher acceptance of this H1N1 vaccine (Myers & Goodwin, 2011), as is previously having gotten the seasonal flu vaccine (Chapman & Coups, 1999; Maurer, Harris, Parker, & Lurie, 2009; Teitler-Regev, Shahrabani, & Benzion, 2011).

The future Zika vaccine will be administered to women of reproductive age to protect both them and their potential future offspring. This direct impact on both mother and child makes direct comparisons with either other adult or childhood vaccines challenging. Given this and the conflicting findings within each of these literatures, we propose the following research question:

RQ1: How are demographic and healthcare-related factors related to psychosocial variables to get a future Zika vaccine?

In addition to the demographic and healthcare-related variables, psychosocial variables can also aid in understanding vaccine-related behavior. When placed in a theoretical framework, psychosocial variables can predict and explain intent to receive a future Zika vaccine and are,

thus, important to consider. as well as have proven to be useful for developing public health communication campaigns. Therefore, these factors should also be considered related to the future Zika vaccine.

Health Behavior Theories

Health behavior theories provide a way to both better understand healthcare-related behaviors as well as design effective public health messaging (Glanz, Rimer, & Lewis, 2015). Consequently, this study focuses on determining which psychosocial determinants may most effectively encourage intent to vaccinate based on the most often-used health behavior theories in this area: The Health Belief Model (HBM) and the Theory of Planned Behavior (TPB).

Both theories—like many other health behavior theories—have several overlapping constructs (Bandura, 2004). The HBM focuses primarily on attitudes and beliefs, with the following constructs as applied to vaccination: Perceived benefits of a vaccine, such as protection against disease; perceived barriers to taking a vaccine, such as perceived vaccine side effects (Kata, 2010; Nan, Xie, & Madden, 2012; Setbon & Raude, 2010) as well as mistrust in medical, science, pharmaceutical, and government authorities (Kata, 2010); perceived susceptibility to the disease a vaccine is supposed to prevent; perceived severity of the disease a vaccine is supposed to prevent; self-efficacy related to vaccine uptake; and cues to action related to vaccine uptake, such as a physician's recommendation (Guidry, Carlyle, Messner, & Jin, 2015; Rosenstock, 1974; Shahrabani & Benzion, 2012; Skinner, Tiro, & Champion, 2015). The TPB's primary constructs are attitudes toward vaccination, subjective norms, and perceived behavioral control, which together produce intentions that, in turn, are said to determine vaccine uptake intent (Ajzen, 1985, 1991; Montano & Kasprzyk, 2015).

According to Bandura (2004), most HBM and TPB constructs are forms of outcome expectancies—HBM's perceived susceptibility and severity, for example, are negative expected outcomes, perceived benefits are a positive expected outcome, and social norms are a form of social outcome. These constructs overlap with TPB's attitudes toward vaccination, which is measured by perceived outcomes and their accompanying value. In addition, HBM's construct of self-efficacy has long been compared to TPB's perceived behavioral control. Finally, the TPB distinguishes between behavioral intent and behavior. For the current study, vaccine uptake intent is the most relevant construct since a Zika vaccine is not available to the public yet.

Health Belief Model

Within the HBM, high vaccine uptake is associated with low perceived barriers to the seasonal flu (Mo & Lau, 2015; Shahrabani & Benzion, 2012), HPV (Brewer & Fazekas, 2007), and H1N1 vaccines (Gargano et al., 2011). In contrast, low vaccine uptake is associated with high perceived barriers to the H1N1 vaccine (Ding et al., 2011; Fisher et al., 2011). Common barriers to vaccination include fear of perceived vaccine side effects, pain associated with vaccination, as well as conspiracy theories blaming government or medical authorities for intentionally creating a perceived faulty vaccine (Ding et al., 2011; Kata, 2012; Shahrabani & Benzion, 2012). High vaccine uptake is also associated with high perceived susceptibility to the disease the vaccine is supposed to protect against in case of the seasonal flu (Gorman, Brewer, Wang, & Chambers, 2012) and in case of HPV infection (Brewer & Fazekas, 2007). In addition, flu vaccine uptake is also associated with higher perceived benefits (Gorman et al., 2012; Shahrabani & Benzion, 2012), such as that the vaccine will protect against the disease it is supposed to protect against (Shahrabani & Benzion, 2012).

Higher perceived severity of the seasonal flu is associated with higher uptake of the seasonal flu vaccine (Gargano et al., 2011). High self-efficacy to get a vaccine is associated with greater uptake of the seasonal flu vaccine (Gargano et al., 2011), as well as with greater uptake of the HPV vaccine (Brewer & Fazekas, 2007; Gerend & Shepherd, 2012). Finally, cues to action, specifically in the form of recommendations from a physician or other medical providers, are associated with higher seasonal flu uptake (Gorman et al., 2012; Mo & Lau, 2015) as well as higher HPV vaccine uptake (Brewer & Fazekas, 2007; Ding et al., 2011). Additionally, several studies have indicated that people who received a seasonal flu vaccine were more likely to get the H1N1 vaccine and vice versa—in other words, those who have experienced the benefits of the seasonal flu vaccine are more likely to also accept the benefits of one of the more recent pandemic vaccines (Coe, Gatewood, & Moczygemba, 2012; Teitler-Regev et al., 2011).

A similar pattern of results is evident for vaccine uptake intent. Vaccine uptake intent is associated with high perceived susceptibility in case of the seasonal flu (Chen et al., 2011), HPV (Bennett, Buchanan, & Adams, 2012), and the H1N1 flu (Myers & Goodwin, 2011). High perceived vaccine benefits are positively associated with both high seasonal flu vaccine uptake intent (Chen et al., 2011) and high H1N1 vaccine uptake intent (Myers & Goodwin, 2011). Low perceived barriers are associated with high seasonal flu vaccine uptake intent (Chen et al., 2011), high H1Nl flu vaccine uptake intent (Coe et al., 2012; Fridman et al., 2011; Myers & Goodwin, 2011), as well as high HPV vaccine uptake intent (Kahn et al., 2008). High perceived severity of the disease is associated with high H1N1 vaccine uptake intent (Fridman et al., 2011) as well as high HPV vaccine uptake intent (Bennett et al., 2012). Finally, cues to action are associated with higher seasonal flu vaccine uptake intent (Bennett et al., 2012) and higher H1N1 vaccine uptake intent (Coe et al., 2012). The TPB links health beliefs and intent to perform a health behavior.

Theory of Planned Behavior

Higher positive subjective norms are associated with higher HPV vaccine uptake (Brewer & Fazekas, 2007; Gerend & Shepherd, 2012) and higher H1N1 vaccine uptake (Gargano et al., 2011). Lower seasonal flu vaccine uptake and H1N1 uptake both are associated with higher barriers (or more negative attitudes towards) to getting these vaccines (Gargano et al., 2011).

In terms of vaccine uptake intent, positive attitude toward a vaccine is associated with higher intent to get the H1N1 vaccine (Myers & Goodwin, 2011) and the HPV vaccine (Bennett et al., 2012; Kahn et al., 2008). Positive subjective norms are associated with higher H1N1 vaccine uptake intent (Myers & Goodwin, 2011) as well as higher HPV vaccine uptake intent (Bennett et al., 2012; Kahn et al., 2008). Finally, higher perceived behavioral control is associated with higher H1N1 vaccine uptake intent (Myers & Goodwin, 2011).

In addition to the psychosocial factors described above, both the TPB and HBM consider predisposing factors. In the case of vaccine uptake, as was described in the previous section, four salient predisposing factors are ethnicity/race, level of education, having a primary care physician, and previous seasonal flu vaccine uptake.

Since the Zika vaccine at time of this writing is not available yet, and considering the severity of some of Zika's consequences, such as microcephaly, it is important to know what effect these psychosocial constructs might have on a future Zika vaccine uptake intent. The second research question for this study is, therefore:

RQ2: Which psychosocial factors predict intent to get a future Zika vaccine?

Method

A survey of 339 women of reproductive age (18-49, as defined by the World Health Organization) (World Health Organization, 2011) was conducted to explore the relationships of

demographics, healthcare-related variables, and psychosocial factors with the intent to get a future Zika vaccine. The study was approved by the Institutional Review Board (IRB) at a large research university in the Mid-Atlantic U.S.

Sample

Leading survey research firm Qualtrics was hired to recruit participants and administer the online survey. A national quota sample of 339 participants completed the study in March 2017. The recruitment process ensured that all participants were women and were of childbearing age (18-49 years) because Zika's potential harmful side effects affect pregnant women and their fetuses most severely. Public health authorities have therefore designated women in this age group to be a priority target group for the future Zika vaccine. Qualtrics recruited participants from their existing database, using a double opt-in process. Potential respondents were sent an email invitation informing them that the survey was for research purposes only, how long the survey was expected to take, and the incentives offered (i.e., a variable number of Qualtrics "points," worth approximately $5.20, which participants can exchange for gift cards, certificates, and other goods). This survey was a part of a larger study, of which a total of 808 individuals initiated participation[3]. Of those, 23 withheld consent and exited the survey. Three hundred and thirteen respondents were dropped from the survey through attention checks (questions inserted into the survey flow which require specific answers given in the question). An additional 133 were dropped because they finished less than one third of the survey, for a final sample of 339.

[3] This paper is part of a larger study examining the effect of message framing and visual type on future Zika vaccine uptake intent as well as intermediate psychosocial variables. No main effects were found for either variable on intent. Of the nine intermediate psychosocial variables analyzed, there were main effects for message framing on subjective norm, perceived benefits, and one item of the self-efficacy scale only, and these impacted the magnitude, not the direction of the relationships. Given this, and the paucity of main effects overall, these conditions were not controlled for in the analyses here.

Instrumentation

Demographic variables. Demographic variables included age, income, ethnicity, level of education, and household income.

Healthcare-related variables. Healthcare-related variables were measured using single-item scales with response categories of "yes" and "no" and included: previous seasonal flu vaccine uptake ("Last year, did you get a vaccination for ordinary seasonal flu?"); future seasonal vaccine uptake intent ("This year, do you intend to get a vaccination for ordinary seasonal flu?"); and having a relationship with a regular healthcare provider ("Do you have a healthcare provider you see regularly").

Unless otherwise noted, scales adapted from Myers and Goodwin (2011), focused on the H1N1 vaccine, were used to assess HBM and TPB constructs. All measures showed good reliability (ranging from .75 to .97), and were measured on a six-point Likert scale, unless otherwise noted.

Perceived severity. Perceived severity of the Zika virus was determined using three items from the Myers and Goodwin study—for example, "Complications of Zika are serious." Cronbach's alpha for items on the scale was .76 (Myers & Goodwin, 2011). In addition, two items were added relating specifically to perceived severity relating to Zika infection during pregnancy: "Complications of Zika for a pregnant woman and her fetus are serious," and "I am afraid to get pregnant because of Zika." The answers to all these questions ranged between "strongly disagree" to "strongly agree," on a seven-item Likert scale.

Perceived susceptibility. Perceived susceptibility to the Zika virus was measured using three items (e.g., "I am worried about the likelihood of getting Zika in the near future"). An additional question was added relating to the presence of mosquitos: "When in an area with a lot

of mosquitoes, my chances of getting Zika are high." The answers to these questions ranged between "strongly disagree" to "strongly agree," measure on a seven-item Likert scale. Cronbach's alpha for items on the scale was .75 (Myers & Goodwin, 2011).

Perceived benefits. Perceived benefits were measured using two items focused on the benefits of a future Zika vaccine: "Vaccination will decrease my chance of getting Zika or its complications" and "A future Zika vaccination will help me feel less worried about getting Zika." Since these two items measure separate benefits, no internal reliability analysis was available (Myers & Goodwin, 2011). Answers to these questions ranged between "strongly disagree" to "strongly agree."

Perceived barriers. Perceived barriers were measured using three items from the Myers and Goodwin study and an additional two from the Carolina HPV Immunization Attitudes and Beliefs Scale (CHIAS) (McRee, Brewer, Reiter, Gottlieb, & Smith, 2010). An example of from the Myers and Goodwin study is "I am concerned that the side effects of a future Zika vaccination will interfere with my usual activities," and an example from the CHIAS is "I am concerned I won't know where to get the future Zika vaccine when it becomes available." As with perceived benefits, since these items measure separate benefits, no internal reliability analysis was available here either (Myers & Goodwin, 2011). The answers to these questions ranged between "strongly disagree" to "strongly agree."

Self-efficacy. Self-efficacy was measured by two items: "How certain are you that you could get a future Zika vaccination?" with responses ranging from "very uncertain" to "very certain," and "If I wanted to, I am confident that I could get the future Zika vaccination," with responses ranging from "strongly disagree" to "strongly agree." Cronbach's alpha for items on the scale was .89 (Myers & Goodwin, 2011).

Cues to action. Cues to action were measured by one item, adapted from a study by Gerend and Shepherd (2012): "Has a physician, health care provider, or clinic spoken to you about Zika prevention?" with response options "yes" and "no."

Attitude. Attitude was measured using the prompt statement: "If I were to get a vaccination for Zika, it would be," with five semantic differential responses: harmful-beneficial, worthless-valuable, bad-good, negative-positive, and foolish-wise. Cronbach's alpha for items on the scale was .97 (Myers & Goodwin, 2011).

Subjective norms. Subjective norms were measured using five items, for example "My family would approve of me getting a future Zika vaccination," and "My friends would approve of me getting a future Zika vaccination," with responses ranging from "strongly disagree" to "strongly agree." Cronbach's alpha for items on the scale was .79 (Myers & Goodwin, 2011).

Perceived behavioral control. Perceived behavioral control was measured using three items, for example "How much personal control will you have over whether you do or do not get a future Zika vaccination?" with responses ranging from "very little control" to "total control." Cronbach's alpha for items on the scale was .79 (Myers & Goodwin, 2011).

Intention. Respondents' intention to get the future Zika vaccine was measured using a single item, "I intend to get the Zika vaccine when it becomes available," with responses ranging from "strongly disagree" to "strongly agree." This item was followed by an open-ended question: "If not, why?"

Statistical Analyses

According to Simmons, Nelson, and Simonsohn (2011), cells in statistical analyses should include at least 20 observations. Therefore, the lowest two education variable options, "some high school" and "high school completed," were combined into one "high school or less"

option. In addition, for the ethnicity variable, only Caucasian, African-American, and Hispanic were included in the analyses.

Descriptive analyses were performed for all variables. In addition, differences in psychosocial variables including intent to get a future Zika vaccine level between the different degrees of ethnicity, education, and income were explored using one-way analyses of variance (ANOVAs), and, when appropriate, Tukey post-hoc analyses. Differences in previous flu vaccine uptake and having a regular healthcare provider between the different degrees of psychosocial variables including intent to get a future Zika vaccine were explored using independent sample *t*-tests.

Finally, hierarchical multiple linear regression analyses were used to explore which of the health behavior variables, controlling for education, ethnicity, income, previous flu vaccine uptake, and having a regular healthcare provider, predicted Zika vaccine uptake intent.

Qualitative Analysis

The sole open-ended question – "If you do not intend to get the future Zika vaccine, why not?" – was analyzed using qualitative conventional content analysis methods, where coding categories are directly obtained from the text itself Hsieh & Shannon, 2005). The responses to this question were analyzed for overarching themes.

Results

Participant Characteristics

All participants resided in the U.S. and were English-speaking. The mean age of respondents was 33.9 years (SD=7.88). Most participants were from the South[4] (38.9%),

[4] AL, AR, DC, DE, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA, WV

followed by the Western region[5] (24.5%), Midwest[6] (20.9%), and Northeast[7] (15.6%). In terms of education, 4.1% (n=14) reported having some high school, 20.4% (n=69) a high school diploma, 33.0% (n=112) some college, 11.5% (n=39) reported getting a 2-year degree, 22.4% (n=76) a 4-year college degree, and 8.6% (n=29) reported having a graduate degree. Finally, 9.4% (n=32) were African-American, 1.2% (n=4) American Indian, 5.0% (n=17) Asian, 8.8% (n=30) Hispanic, 73.5% (n=249) Caucasian, and 2.1% (n=7) other.

Intent to get the Zika Vaccine

When asked to respond to the statement "I intend to get a future Zika vaccine when it becomes available," 6.8% (n=23) responded they strongly disagreed, 8.6% (n=29) reported they disagreed, 7.7% (n=26) somewhat disagreed, 25.1% (n=85) somewhat agreed, 26.5% (n=90) agreed, and 25.3% (n=86) strongly agreed. Breaking this down to a binary variable, 23.1% (n=78) disagreed to some level with the vaccine intent statement, while 76.9% (n=261) agreed to some level.

An independent sample t-test was run to determine whether there were differences in reported intent to get the Zika vaccine between those who answered the attention checks correctly and those who were dropped from the study because of missed attention checks. There was no significant difference between the two groups, $t(858)=-1.040$, $p=.299$).

One hundred eighteen respondents answer the open-ended question inquiring why someone would not get the future Zika vaccine. Four overarching themes were identified:

Anti-vaccine. Many of those who responded they would not be likely to get the future Zika vaccine were outright anti-vaccine:

[5] AK, AZ, CA, CO, HI, ID, MT, NM, NV, OR, UT, WA, WY
[6] IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI
[7] CT, MA, ME, NH, NJ, NY, PA, RI, VT

"It is a new vaccine and I'm terrified of finding out that side effects aren't always predicted. Like the so controversial vaccine Guardassil (sic) that has harmed women in several countries. It is either not tested widely enough or pharmaceuticals are not being honest with the public."

"I don't do vaccinations in any situation."

"First and foremost it is against my faith to rely on injected chemicals for my health. Second is I have seen firsthand severe vaccine reactions, in children, and pets. The aluminum alone, by the FDA's own admission, is an overdose for anyone under 500lbs."

"Because of the toxicity of the fillers most vaccines come with. It's not just the vaccine that's in vaccines. They add inappropriate ingredients I disapprove of to vaccines and until that changes, I'm anti-vax. Also, I don't want to reproduce, and so that part of the fearmongering doesn't faze me."

"I would be afraid of the vaccine. I haven't heard of this vaccines before today."

Vaccine hesitancy. Others seemed to feel more in the vaccine-hesitant, not ruling the vaccine out entirely but expressing reservations:

"The biggest concern would be possible side effects of the vaccine, of course. So weighing benefit vs risk"

"I am not a fan of vaccines in general. There are so many unproven side effects later in life caused by vaccines. I would wait to see if my area was in great risk and if I was considering pregnancy at that time."

"I would need to ask some more questions about it first."

"Don't know how it will affect me."

Vaccine unnecessary. Still other seemed to be convinced it was not necessary for them to get the vaccine:

"I am not planning on getting pregnant for (sic) having any sex."

"I am almost 47 and will not be having children."

"I have no intention of traveling to any countries where contracting Zika is possible and I have no intention of getting pregnant."

"I do not feel that I am at risk."

"I don't see this being prevalent where I live and is unlikely to happen. I don't think my insurance would pay for this and I have no plans to have children."

"It seems like something for women who will have a baby someday. I am done having children."

"I do not plan on bearing any more children. I have an understanding that the virus is only harmful to pregnant women. So unless I have more children I do not see why I would need the vaccine."

"Because I do not plan to get pregnant again and do not see the risk as being as high for me as it would for someone planning on getting pregnant."

"I thought I only needed it if I was leaving the country."

"I don't see a point.... Zika isn't that big of a concern."

Getting the vaccine. While the question asked why respondents would *not* get the future vaccine, several participants who indicated they *would* get the vaccine also provided feedback in the open-ended question.

> *"I do intend if my primary care physician and gynecologist recommend it."*
>
> *"I fully intend to get the vaccine if it becomes available."*
>
> *"I would want to protect myself and my unborn child."*
>
> *"Although I am not having any more children, this disease can still make you quite ill and also it's a fairly new disease so there might be more reasons to get the vaccine."*

Demographic and Healthcare-Related Variables

The first research question asked how demographic and healthcare-related factors related to intent to get a future Zika vaccine. Of the 339 respondents, 40.4% (n=137) indicated they had gotten the seasonal flu (influenza) vaccine, while 59.6% (n=202) did not. Of those who had not gotten the vaccine yet, 13.9% (n=28) said they were still planning to get it, 69.3% (n=140) said they were not planning to get it, and 16.8% (n=34) said they were not certain if they would get the vaccine. When asked whether they received the flu vaccine the previous season, 53.1% (n=180) answered yes and 46.9% (n=159) answered no.

When asked if there was a healthcare provider they saw most often, 81.7% (n=277) answered affirmative, while 16.8% answered negatively (n=57). The remaining (1.5%, n=5) did not answer the question. Only 9.7% (n=33) of all respondents reported that a physician, clinician, or other type of healthcare provider, or other type of healthcare provider had spoken to them about the Zika virus and Zika prevention. When asked what their total household income level

was before taxes during the preceding 12 months, a plurality (24.5%, n=83) reported between $50,000 and $74,999.

One way ANOVAs were used to determine whether there were differences in health behavior construct measures between education levels, ethnicity categories, and income levels. Most health behavior constructs are strongly endorsed in those who report a higher education—for example, those with a graduate degree had a significantly higher mean score for both norm as expressed as family approval (p=.002) and norm as expressed as friends' approval (p=.019) to get the Zika vaccine than those who reported completing some or all of high school (see Table 1).

African-Americans scored lower in almost all constructs than Hispanics or Caucasians—for example, both Caucasians and Hispanics had a higher mean score for norms as expressed as family approval (p=.001), friends' approval (p=.006), and people's approval in general (p=.001) to get the Zika vaccine than African-Americans. Hispanics and Caucasians also had a higher mean score for both perceived severity of Zika (p<.001) and perceived susceptibility of Zika (p=.026) than African-Americans (see Table 2 for all significant results).

Respondents who reported making less than $25,000 per year and between $25,000 and $34,999 per year scored lower in self-efficacy related to getting the Zika vaccine than all other income categories (p<.001). All three categories of respondents making more than $75,000 per year reported a higher intent to get a future Zika vaccine than those in the lowest income category—less than $25,000 per year (p=.004). Respondents in all income categories under $150,000 reported a higher mean of perceived severity related to Zika and its risk to pregnant women/fetuses than those making more than $150,000 (p=.015). Finally, both those in the lowest and highest income categories—making either less than $25,000 or more than $150,000—

reported a lower mean subjective norm (p<.001), for norm as expressed as family approval (p<.001), friends' approval (p<.001), PCP's approval (p=.004), and people's approval in general (p<.001) to get the Zika vaccine than those in all other income categories (see Table 3 for all significant results).

Independent sample *t*-tests were run to determine if there were differences in demographics and psychosocial constructs between those who got the flu vaccine the previous year and those who did not, and between those who reported having a regular healthcare provider and those who did not. Vaccine uptake intent (p<.001), attitude (p<.001), subjective norms (p<.001), perceived benefits (p<.001), perceived susceptibility (p<.001), perceived severity (p<.001), and self-efficacy (p<.001) were all higher for those who got the flu vaccine last season, while perceived barriers (p=.001) were higher for those who did not get the flu vaccine last season (see Table 4). In addition, vaccine uptake intent (.015), attitude (viewing getting the vaccine as wise) (p=.033), perceived behavioral control (p=.009), subjective norms (p=.028), perceived benefits (less worry about Zika) (p=.017), and self-efficacy (p=.002) were all higher for those who reported having a healthcare provider they see regularly, while perceived barriers (p=.002) were higher for those who reported not having a healthcare provider they see regularly (see Table 5).

Psychosocial Variables

The second research question asked how psychosocial factors related to intent to get a future Zika vaccine. A hierarchical multiple linear regression was run to determine if the addition of attitude, perceived behavioral control, subjective norms, perceived benefits, perceived barriers, perceived susceptibility, perceived severity, self-efficacy, and cues to action improved the prediction of Zika vaccine uptake intent over and above education, income, ethnicity, previous year flu vaccine uptake, and Primary Care Provider (PCP) status alone. Dummy variables were created

for ethnicity (with Caucasian as the reference category), education (with high school or below as the reference category), and income (with income less than $25,000 as the reference category).

There was independence of residuals, as assessed by a Durbin-Watson statistic of 2.057. There was a linear relationship between both the dependent variable and each of the independent variables as well as between the dependent variables and the independent variables collectively, as assessed by scatterplots and partial regression plots.

There were three outliers as measured by studentized deleted residuals greater than +/- 3 standard deviations—these were left in the sample since they were on the edge. There was no evidence of multicollinearity, as assessed by tolerance values greater than .1. The assumption of normality was met, as assessed by a Q-Q Plot.

The addition of PCP status and previous flu vaccine uptake to the prediction of Zika vaccine uptake intent (Model 2) led to a statistically significant increase in R^2 of .134, $F(2,319)=26.516$, $p<.001$. This means that the addition of both TPB and HBM health behavior constructs—attitude, perceived behavioral control, subjective norms, perceived benefits, perceived barriers, perceived severity, perceived susceptibility, self-efficacy, and cues to action—to the prediction of Zika vaccine uptake intent (Model 3) led to a statistically significant increase, $R^2 = .481$, $F(11,308)=41.594$, $p<.001$. The full model of education, ethnicity, income, PCP status, and health behavior variables to predict Zika vaccine uptake intent (Model 3) was statistically significant, $R^2=.677$, $F(25,308)=25.767$, $p<.001$. See Table 6 for full details on each regression model.

Full Model Interpretation

Compared to Caucasians, African-Americans reported significantly higher intentions to get the Zika vaccine, B=.38, p=.042, keeping everything else constant (unstandardized B weights were

used because they correspond to the original measurement units). Compared to those who make less than $25,000, respondents who made between $25,000 and $34,999 reported higher intentions to get the Zika vaccine, B=.43, p=.019, keeping everything else constant. Increasing attitude scores (higher scores indicate a more positive attitude) were associated with higher intentions to get the vaccine, B=.45, p<.001. Similarly, as the subjective norm score increased, the intent to get a future Zika vaccine increased, B=.25, p=.002. As the perceived benefits score increased, so too did the intent to get a future Zika vaccine, B=.25, p=.001; as the perceived susceptibility score increased, the intent to get a future Zika vaccine increased as well, B=.09, p=.030; and as the self-efficacy score increased, the intent to get a future Zika vaccine increased, B=.13, p=.031. Finally, respondents who reported that a healthcare provider had discussed Zika and Zika prevention with them displayed a .42 increase in the intent to get a future Zika vaccine, p=.020. These were all significant at a p-value<.05). The remaining variables were not associated with a significant change in intent to vaccinate, keeping everything else constant.

Table 1
One way ANOVA: Education

Variable	**F**	**df**	**p-value**	**Mean, SD high**	**Mean, SD low**
Norms: family approval	4.360	4,334	.002	4-year degree: 5.03, 1.107	(Some) high school: 4.49, 1.549
		4,334		Graduate degree: 5.52, .738	(Some) high school: 4.49, 1.549
Norms: friend approval	3.004	4,334	.019	Graduate degree: 5.31, .850	(Some) high school: 4.45, 1.556
Barriers: vaccine interferes with activities	3.077	4,334	.016	Some college: 3.91, 1.551	Graduate degree: 2.93, 1.438
Severity: Zika complications serious	3.394	4,334	.010	Some college: 5.87, 1.270	(Some) high school: 5.25, 1.731
Emotion: cynicism (Zika virus)	2.584	4,334	.037	Some college: 3.11, 1.460	4-year degree: 2.54, 1.248

Table 2
One way ANOVA: Ethnicity

Variable	F	df	p-value	Mean, SD high	Mean, SD low
Subjective norms					
Norms: people approval	6.697	2,308	.001	Hispanic: 5.03, .999	African-American: 4.16, 1.919
				Caucasian: 4.94, 1.065	African-American: 4.16, 1.919
Norms: family approval	7.440	2,308	.001	Hispanic: 5.13, .937	African-American: 4.13, 1.897
				Caucasian: 4.93, 1,083	African-American: 4.13, 1.897
Norms: friends' approval	5.276	2,308	.006	Hispanic: 5.13, .937	African-American: 4.16, 1.903
				Caucasian: 4.88, 1.071	African-American: 4.16, 1.903
Perceived barriers					
Barriers: vax expensive	8.455	2,308	<.001	Hispanic: 3.77, 1.501	African-American: 2.84, 1.743
				Caucasian: 4.00, 1,470	African-American: 2.84, 1.743
Emotion re. vaccine: fear	2.904	2,308	.056	African-American: 4.97, 1.750	Hispanic: 3.73, 1.929
Emotion re. vaccine: confusion	3.012	2,308	.051	African-American: 4.97, 1.750	Caucasian: 4.38, 2.058
Emotion re. vaccine: cynicism	3.381	2,308	.035	African-American: 5.03, 1.656	Caucasian: 4.14, 1.930
Perceived susceptibility					
Susceptibility: worry about likelihood of infection	4.677	2,308	.010	Hispanic: 4.03, 1.991	African-American: 2.63, 1.718
Susc.: infection risk mosquitoes	8.342	2,308	<.001	Hispanic: 5.43, 1.591	African-American: 3.69, 2.264
				Caucasian: 4.78, 1.674	African-American: 3.69, 2.264
Perceived severity					
Severity: serious complications	14.835	2,308	<.001	Hispanic: 6.03, 1.098	African-American: 4.47, 2.369
				Caucasian: 5.81, 1.203	African-American: 4.47, 2.369
Severity: very sick with Zika	4.896	2,308	.008	Hispanic: 5.53, 1.548	African-American: 4.22, 2.366

Variable	F	df	p-value	Mean, SD high	Mean, SD low
Severity: pregnant women/fetus	9.393	2,308	<.001	Hispanic: 6.67, .884	African-American: 5.59, 2.153
				Caucasian: 6.51, 1.200	African-American: 5.59, 2.153
Emotion: fear of Zika virus	5.879	2,308	.003	Hispanic: 4.10, 1.423	African-American: 1.86, 1.069
				Caucasian: 3.77, 1.537	African-American: 2.84, 2.034
Emotion: worried re. Zika virus	5.975	2,308	.003	Hispanic: 4.13, 1.432	African-American: 2.91, 2.022
				Caucasian: 3.89, 1.564	African-American: 2.91, 2.022
Emotion: confused re. Zika virus	6.697	2,308	.001	Caucasian: 3.04, 1.441	African-American: 2.06, 1.585
Emotion: cynicism re. Zika virus	5.086	2,308	.007	Caucasian: 2.96, 1.450	African-American: 2.09, 1.353
Travel likely to Zika area	5.814	2,308	.003	Hispanic: 2.90, 1.749	African-American: 1.72, 1.224
				Hispanic: 2.90, 1.749	Caucasian: 2.06, 1.433
Live in area with mosquitoes	14.667	2,308	<.001	Hispanic: 3.37, 1.810	African-American: 2.25, 1.344
				Caucasian: 3.81, 1.543	African-American: 2.25, 1.344
Composite constructs					
Barriers	3.497	2,308	.031	Caucasian: 15.62, 4.848	African-American: 13.25, 5.714
Susceptibility	3.667	2,308	.026	Hispanic: 15.13, 5.251	African-American: 11.53, 6.154
				Caucasian: 14.18, 5.737	African-American: 11.53, 6.154
Severity	9.080	2,308	<.001	Hispanic: 26.83, 5.639	African-American: 20.97, 9.029
				Caucasian: 24,83, 5.106	African-American: 20.97, 9.029

Table 3
One way ANOVA: Income

Variable	F	df	p-value	Mean, SD high	Mean, SD low
Subjective norms					
Norms: people approval	4.317	6,332	<.001	$75K-$100k: 5.32, .832	<$25k: 4.52, 1.283
				$75K-$100k: 5.32, .832	>$150k: 4.21, 1.956
				$100k-$150k: 5.31, .850	<$25k: 4.52, 1.283
				$100k-$150k: 5.45, .736	>$150k: 4.21, 1.956
				$50K-$75K: 5.04, .956	>$150k: 4.21, 1.956
Norms: family approval	4.805	6,332	<.001	$35k-$50K: 5.00, .937	>$150k: 4.08, 2.104
				$50k-$75K: 4.98, 1.070	>$150k: 4.08, 2.104
				$75k-$100k: 5.39, .844	<$25k: 4.48, 1.352
				$75k-$100k: 5.39, .844	>$150k: 4.08, 2.104
				$100k-$150k: 5.30, .750	<$25k: 4.48, 1.352
				$100k-$150k: 5.30, .750	>$150k: 4.08, 2.104
Norms: friends' approval	4.721	6,332	<.001	$35k-$50k: 4.91, .960	>S150k: 3.88, 1.985
				$50k-$75k: 4.86, 1.117	>S150k: 3.88, 1.985
				$75k-$100k: 5.19, 1.014	>S150k: 3.88, 1.985
				$100k-$150k: 5.33, .758	<$25k: 4.48, 1.352
				$100k-$150k: 5.33, .758	>S150k: 3.88, 1.985
Norms: PCP approval	3.307	6,332	.004	$75k-$100k: 5.45, .624	<$25k: 4.60, 1.360
				$100k-$150k: 5.30, .750	<$25k: 4.60, 1.360
Intent					
Vaccine intent uptake	3.266	6,332	.004	$75k-$100k: 4.77, 1.175	<$25k: 3.75, 1.627
				$100k-$150k: 4.77, 1.331	<$25k: 3.75, 1.627
				>$150k: 4.79, 2.532	<$25k: 3.75, 1.627
Perceived benefits					
Benefits: less worry	3.080	6,332	.006	$75k-$100k: 5.26, 1.032	<$25k: 4.43, 1.438
Benefits: decrease Zika	2.990	6,332	.007	$100k-$150k: 5.43, .728	<$25k: 4.55, 1.283
				$100k-$150k: 5.43, .728	$25k-$35k: 4.52, 1.502
Perceived barriers					
Barrier: vax expensive	5.615	6,332	<.001	<$25k: 4.40, 1.528	$100k-$150k: 3.40, 1.545
				<$25k: 4.40, 1.528	>$150k: 2.71, 1.574
				$25k-$35k: 4.13, 1.343	>$150k: 2.71, 1.574
				$35k-$50k: 4.31, 1.524	>$150k: 2.71, 1.574
Barrier: where to get vax	3.212	6,332	.004	<$25k: 3.07, 1.449	>$150k: 1.96, 1.268

Variable	F	df	p-value	Mean, SD high	Mean, SD low
Self-efficacy					
Self-efficacy: confidence	7.462	6,332	<.001	$35k-$50k: 5.02, .927	$25k-$35k: 4.35, 1.386
				$50k-$75k: 5.27, .828	<$25k: 4.58, 1.281
				$50k-$75k: 5.27, .828	$25k-$35k: 4.35, 1.386
				$75k-$100k: 5.35, .608	<$25k: 4.58, 1.281
				$75k-$100k: 5.35, .608	$25k-$35k: 4.35, 1.386
				$100k-$150k: 5.27, .868	<$25k: 4.58, 1.281
				$100k-$150k: 5.27, .868	$25k-$35k: 4.35, 1.386
				>$150k: 5.46, 1.021	<$25k: 4.58, 1.281
				>$150k: 5.46, 1.021	$25k-$35k: 4.35, 1.386
Self-efficacy: certainty	4.828	6,332	<.001	$50k-$75k: 4.88, 1.029	<$25k: 4.30, 1.425
				$50k-$75k: 4.88, 1.029	$25k-$35k: 4.24, 1.286
				$75k-$100k: 5.10, .746	<$25k: 4.30, 1.425
				$75k-$100k: 5.10, .746	$25k-$35k: 4.24, 1.286
				>150k: 5.25, 1.152	<$25k: 4.30, 1.425
				>150k: 5.25, 1.152	$25k-$35k: 4.24, 1.286
Perceived susceptibility					
Susc.: infection risk mosquitoes	2.444	6,332	.025	$50k-$75k: 4.95, 1.710	>$150k: 3.71, 2.386
Perceived severity					
Severity: serious complications	2.682	6,332	.015	<$25k: 5.87, 1.140	>$150k: 4.83, 2.408
				$35k-$50k: 5.88, 1.365	>$150k: 4.83, 2.408
				$50k-$75k: 5.83, 1.238	>$150k: 4.83, 2.408
Severity: pregnant women/fetus	3.306	6,332	.004	<$25k: 6.45, .974	>$150k: 5.58, 2.302
				$35k-$50k: 6.62, .952	>$150k: 5.58, 2.302
				$50k-$75k: 6.55, .927	>$150k: 5.58, 2.302
				$75k-$100k: 6.71, .824	>$150k: 5.58, 2.302
				$100k-$150k: 6.57, 1.165	>$150k: 5.58, 2.302
Composite constructs					
Subjective norm	4.178	6,332	<.001	$75k-$100k: 26.03, 3.799	<$25k: 22.01, 6.036
				$75k-$100k: 26.03, 3.799	>$150k: 21.75, 6.661
				$100k-$150k: 26.07, 3.279	<$25k: 22.01, 6.036
				$100k-$150k: 26.07, 3.279	>$150k: 21.75, 6.661
Benefits	3.383	6,332	.003	$75k-$100k: 10.52, 1.823	<$25k: 8.99, 2.514
				$100k-$150k: 10.67, 1.626	<$25k: 8.99, 2.514

Variable	F	df	p-value	Mean, SD high	Mean, SD low
Barriers Zika vaccine	4.756	6,332	<.001	<$25k: 16.96, 4.656	$75k-$100k: 13.74, 4.305
				<$25k: 16.96, 4.656	>$150k: 12.17, 4.887
				$25k-$35k: 16.28, 4.236	>$150k: 12.17, 4.887
				$35K-$50k: 16.64, 5.492	>$150k: 12.17, 4.887
				$75k-$100k: 13.74, 4.305	<$25k: 16.96, 4.656
Self-efficacy	6.781	6,332	<.001	$50k-$75k: 10.14, 1.705	<$25k: 8.88, 2.579
				$50k-$75k: 10.14, 1.705	$25k-$35k: 8.59, 2.473
				$75k-$100k: 10.45, 1.287	<$25k: 8.88, 2.579
				$75k-$100k: 10.45, 1.287	$25k-$35k: 8.59, 2.473
				$100k-$150k: 10.27, 1.680	<$25k: 8.88, 2.579
				$100k-$150k: 10.27, 1.680	$25k-$35k: 8.59, 2.473
				>$150k: 10.71, 2.095	<$25k: 8.88, 2.579
				>$150k: 10.71, 2.095	$25k-$35k: 8.59, 2.473

Table 4
Independent sample T-tests: Previous flu vaccine uptake

Variable	T	df	p-value	Mean, SD (flu vax yes)	Mean, SD (flu vax no)
Attitudes					
Attitude: foolish-wise	5.57	231.909	<.001	4.6, .67	4.0, 1.27
Attitude: harmful-beneficial	5.66	246.797	<.001	4.6, .76	4.0, 1.31
Attitude: worthless-valuable	5.04	266.395	<.001	4.6, .85	3.9, 1.31
Attitude: bad-good	5.81	264.047	<.001	5.6, .90	4.8, 1.40
Attitude: negative-positive	5.25	265.608	<.001	4.6, .84	4.0, 1.29
Perceived Behavioral Control					
PBC: outside my control	-2.70	337	.007	2.3, 1.41	2.7, 1.39
Subjective norms					
Norms: people approval	4.71	337	<.001	5.2, 1.13	4.6, 1.23
Norms: family approval	4.81	316.828	<.001	5.2, 1.13	4.5, 1.28
Norms: friend approval	4.60	321.149	<.001	5.1, 1.16	4.5, 1.28
Norms: PCP approval	5.38	284.789	<.001	5.3, .88	4.7, 1.21
Norms: please important people	6.12	337	<.001	4.8, 1.27	3.9, 1.48
Intent					
Vaccine uptake intent	7.90	311.945	<.001	4.9, 1.26	3.7, 1.48
Perceived benefits					
Benefits: less worry	7.12	278.901	<.001	5.3, .97	4.4, 1.38
Benefits: decrease chance at Zika	5.00	303.207	<.001	5.1, 1.08	4.5, 1.34
Perceived barriers					
Barriers: vaccine interferes with activities	-3.23	336.945	.001	3.3, 1.61	3.9, 1.44
Barriers: fear of needles	-2.11	337	.035	2.7, 1.72	3.1, 1.88
Barriers: inconvenience	-3.26	337	.001	2.2, 1.29	2.7, 1.32
Emotion re. vaccine: fear	-3.74	337	<.001	2.5, 1.59	3.2, 1.59
Emotion re. vaccine: worry	-3.90	337	<.001	3.0, 1.64	3.7, 1.64
Emotion re. vaccine: confusion	-3.03	337	<.001	2.4, 1.41	2.9, 1.52
Emotion re. vaccine: anger	-2.80	337	<.001	1.8, 1.10	2.2, 1.25
Emotion re. vaccine: cynicism	-4.01	337	<.001	2.5, 1.52	3.2, 1.43
Self-efficacy					
Self-efficacy: confidence	5.44	272.218	<.001	5.3, .84	4.7, 1.24
Self-efficacy: certainty	5.27	293.034	<.001	5.0, .98	4.4, 1.29

Variable	T	df	p-value	Mean, SD (flu vax yes)	Mean, SD (flu vax no)
Perceived susceptibility					
Susc.: infection risk high	3.35	335.442	.001	2.9, 1.75	2.4, 1.45
Susc.: infection risk possible	2.58	337	.010	3.4, 1.76	2.9, 1.61
Susc.: worry about likelihood infection	4.52	336.888	<.001	3.8, 1.94	2.9, 1.68
Susc.: infection risk mosquitoes	2.82	337	.005	4.9, 1.79	4.4, 1.70
Perceived severity					
Severity: serious complications	3.28	337	.001	5.9, 1.39	5.4, 1.39
Severity: very sick with Zika	2.64	337	.009	5.1, 1.76	4.7, 1.60
Severity: afraid of getting Zika	4.55	337	<.001	5.0, 1.81	4.0, 1.94
Severity: pregnant women/fetus	1.94	309.346	.053	6.6, 1.08	6.3, 1.30
Severity: afraid to get pregnant	4.24	337.000	<.001	3.5, 2.06	2.6, 1.82
Composite constructs					
Attitude	5.84	241.579	<.001	4.783, .706	4.125, 1.259
Subjective norm	6.12	299.702	<.001	5.093, .886	4.415, 1.122
Benefits	6.60	278.825	<.001	5.217, .897	4.415, 1.278
Barriers	-3.22	337	.001	2.920, 1.032	3.269, .953
Barriers: emotion virus	2.26	336.926	.025	1.686, .663	1.531, .594
Self-efficacy	5.70	268.141	<.001	5.150, .808	4.500, 1.224
Susceptibility	4.03	337	<.001	3.750, 1.465	3.129, 1.361
Severity	4.98	337	<.001	5.211, 1.162	4.600, 1.086

Table 5
Independent sample T-tests: PCP

Variable	T	df	p-value	Mean, SD (flu vax yes)	Mean, SD Flu (vax no)
Attitudes					
Attitude: foolish-wise	2.14	332	.033	4.3, 1.00	4.0, 1.22
Perceived behavioral control					
PBC: own my control	2.70	66.346	.009	5.4, .87	4.9, 1.33
Subjective norms					
Norms: friend approval	2.17	332	.031	4.9, 1.20	4.5, 1.45
Norms: PCP approval	2.22	66.770	.030	5.1, .99	4.7, 1.47
Norms: please important people	2.49	332	.013	4.4, 1.39	3.9, 1.66
Intent					
Vaccine uptake intent	2.46	332	.015	4.4, 1.45	3.9, 1.64
Perceived benefits					
Benefits: less worry	2.44	70.363	.017	5.0, 1.19	4.4, 1.55
Perceived barriers					
Barriers: fear of needles	-2.06	332	.041	2.7, 1.77	3.3, 1.93
Barriers: inconvenience	-2.09	73.704	.040	2.4, 1.27	2.8, 1.49
Barriers: expensive	-2.92	332	.004	3.8, 1.55	4.5, 1.50
Emotion re. vaccine: fear	-2.09	332	.037	2.7, 1.61	3.2, 1.65
Emotion re. vaccine: confusion	-3.36	332	.001	2.5, 1.41	3.2, 1.63
Emotion re. vaccine: cynicism	-2.00	332	.047	2.7, 1.50	3.2, 1.55
Self-efficacy					
Self-efficacy: confidence	3.18	72.128	.002	5.1, 1.04	4.5, 1.27
Self-efficacy: certainty	3.50	332	.001	4.8, 1.13	4.2, 1.33
Composite constructs					
Subjective norm	2.25	67.977	.028	4.847, .9718	4.418, 1.3739
Barriers	-3.10	332	.002	3.017, .9960	3.463, .9726
Self-efficacy	3.26	71.131	.002	4.942, 1.0056	4.360, 1.2704

Table 6
Hierarchical multiple regression predicting future Zika vaccine uptake intent

	Model 1					Model 2					Model 3				
Variable	B	**SE**	(t)	p-value	95% CI	B	**SE**	(t)	p-value	95% CI	B	**SE**	(t)	p-value	95% CI
Constant	3.785	.222	17.02	<.001	3.4, 4.3	3.442	.244	14.08	<.001	3.0, 4.0	-1.818	.532	-3.42	.001	-2.9, -.8
Race: Black	.221	.294	.75	.452	-.4, .8	-.040	.275	-.15	.885	-.6, .5	.377	.185	2.04	.042*	.0, .7
Race: Hispanic	.300	.296	1.01	.312	-.3, .9	.204	.275	.74	.458	-.3, .8	.169	.182	.93	.351	-.2, .5
Income: 25-35k	.473	.289	1.64	.103	-.1, 1.0	.355	.273	1.30	.194	-.2, .9	.430	.182	2.36	.019*	.1, .8
Income: 35-50k	.552	.269	2.05	.041*	-.0, 1.1	.499	.258	1.93	.054	-.0, 1.0	.116	.170	.68	.494	-.2, .5
Income: 50-75k	.714	.250	2.86	.005*	.2, 1.2	.542	.240	2.26	.025*	.1, 1.0	.266	.159	1.68	.095	-.1, .6
Income: 75-100k	1.041	.331	3.15	.002*	.4, 1.7	.844	.318	2.66	.008*	.2, 1.5	.204	.212	.96	336	-.2, .6
Income: 100-150k	1.039	.342	3.04	.003*	.4, 1.7	.848	.325	2.61	.010*	.2, 1.5	.316	.217	1.46	.146	-.1, .7
Income: >150k	1.006	.375	2.68	.008*	.3, 1.7	.749	.357	2.10	.037*	.1, 1.5	.475	.244	1.95	.053	.0, 1.0
Education: some college	-.119	.221	-.54	.591	-.6, .3	-.185	.206	-.90	.370	-.6, .2	-.114	.134	-.85	.398	-.4, .2
Education: 2yr degree	-.234	.295	-.79	.428	-.8, .4	-.246	.274	-.90	.370	-.8, .3	-.092	.181	-.51	.612	-.5, .3
Education: 4yr degree	-.171	.247	-.69	.490	-.7, .3	-.278	.230	-1.21	.228	-.7, .2	-.170	.152	-1.12	.263	-.5, .1
Education: grad degree	-.010	.341	-.03	.977	-.7, .7	-.305	.320	-.95	.341	-.9, .3	-.359	.208	-1.72	.086	-.8, .1
Flu vaccine						1.145	.160	7.16	<.001	.8, 1.5	.204	.115	1.78	.077	-.0, .4
PCP						-.047	.217	-.22	.828	-.5, .4	-.080	.142	-.57	.571	-.4, .2
Attitude											.452	.074	6.12	<.001*	.3, .6
PBC											-.006	.077	-.08	.936	-.2, .2
Norms											.251	.079	3.17	.002*	.1, .4
Benefits											.247	.073	3.38	.001*	.1, .4
Barriers											-.117	.064	-1.83	.068	-.2, .0
Barriers + emotions											.136	.082	1.66	.099	.0, .3
Emotions re. virus											.198	.106	1.88	.061	-.0, .4
Self-efficacy											.131	.060	2.16	.031*	.0, .3
Severity											.019	.063	.30	.764	-.1, .4
Susceptibility											.090	.041	2.18	.030*	.0, .2
PCP ask about Zika											.415	.177	2.35	.020*	.1, .8

* $p<.05$

Discussion

This study investigated the predictive effects of women of reproductive age's attitudes, emotional responses, behavioral intentions, and other behavioral constructs as well as demographic and healthcare-related variables on intent to get the future Zika vaccine. Three quarters of the respondents signaled agreement with intentions to get the Zika vaccine, while approximately one quarter reported some level of disagreement. This is encouraging because 76.9% agreed to some level while few promotion efforts so far have taken place since the vaccine is not available yet. At the same time, it is also discouraging because Zika as a disease and the devastating consequence of babies born with microcephaly have been widely publicized, and yet almost a quarter of study participants report they are not likely to get the vaccine once it becomes available.

The responses to the study's open-ended question (i.e., why a respondent would not get the future Zika vaccine) mention not trusting vaccine safety in general and fear of perceived toxic ingredients of vaccines, which are familiar themes of vaccine hesitancy and anti-vaccine sentiment. This indicates that vaccine hesitancy is an issue of concern not just when dealing with well-known childhood vaccines like the MMR vaccine, but also with a yet-to-be-released vaccine. However, the responses also show that many respondents are convinced they do not need the Zika vaccine—e.g., because they are not planning to or cannot have (more) children, or because they abstain from sexual intercourse or are in a monogamous relationship—and thus underestimate their risk for contracting Zika. This may in part be due to a priming effect of available Zika media images, which often focused on the risk of birth defects for pregnant women. Public health professionals should consider this when developing future Zika vaccination campaigns.

In a hierarchical model controlling for all other respective variables, attitude, subjective norms, perceived benefits of a future vaccine, perceived susceptibility, and self-efficacy all were unique predictors of future Zika vaccine uptake intent. In addition, being African-American (compared to being Caucasian), making between $25,000 and $34,999 compared to making less than $25,000 per year, and having a healthcare provider talk to you about the Zika virus and possible Zika preventive measures were also unique predictors of future Zika vaccine uptake intent.

When attitudes, norms, susceptibility, severity, and self-efficacy increase, vaccine uptake intent increases as well—in other words, most HBM and TPB constructs function as predictors of Zika vaccine uptake intent, an indication that the theories work as designed in this situation. Public health practitioners and health communication professionals should be mindful to continue using health behavior theories when designing campaigns for the Zika vaccine. Both the HBM and the TPB are strong theoretical choices for designing for future Zika vaccine campaigns. Specifically, the HBM and TPB constructs that predicted vaccine uptake intent in this study should be emphasized over other, less predictive constructs in campaigns promoting the Zika vaccine in this target audience.

Despite being significant in a one-way ANOVA, neither having a regular healthcare provider nor getting a seasonal flu vaccine in a previous season were significant predictors for Zika vaccine uptake in the multiple hierarchical regression model. Once the psychosocial variables were included in the hierarchical model they explained the variance in future Zika vaccine uptake intent beyond the simple healthcare behaviors of previous flu vaccine uptake and having a regular healthcare provider. However, considering the strong links in the available literature connecting both having a regular healthcare provider and getting the seasonal flu

vaccine with uptake intent for other vaccines, these two variables should continue to receive consideration when designing future Zika vaccine communication campaigns. In addition, having a healthcare provider address the Zika virus and possible Zika preventive measures with patients was a predictor in the model, and yet fewer than 10% of survey respondents reported that their healthcare provider had brought up the issue. This reaffirms the significance of healthcare providers making communication about the Zika virus and the Zika vaccine a priority to address with their patients.

In a complete regression model, and in contrast to other vaccine-related studies, being African-American was predictive of a higher intent to get a future Zika vaccine compared to Caucasians. Studies have suggested that race could be a proxy for other, unidentified or unmeasured, constructs, such as socio-economic status (Egede & Zheng, 2003). In addition, O'Keefe and Nan (2012) argue there may be differences in how people perceive a vaccine from one type of vaccination to another, depending either on the nature of the vaccine or on the condition the vaccine is supposed to prevent. Moreover, cultural/contextual factors could play a role in this dynamic, for example: while infant mortality rates have decreased more for African-American women than for Hispanic and Caucasian women, their infant mortality rate is still high (MacDorman, Hoyert, & Mathews, 2013). In other words, the perceived risk to their infants may be a part of African Americans' higher reported future Zika vaccine uptake. Nevertheless, African-Americans' higher reported intent to get the Zika vaccine is an unexpected finding, and future research should investigate whether the relationships seen here are due to the unique characteristics of the Zika virus/future Zika vaccine or better explained by other race-related constructs. Whatever the cause, this result deserves further attention.

While future Zika vaccine uptake intent is the construct of primary interest as it is most closely related to the eventual behavior of actual vaccine uptake, other constructs can function as intermediate outcomes, potentially leading to vaccine uptake intent or directly to the desired health behavior. These constructs, based on the TPB and the HBM, are attitude toward the vaccine, perceived behavioral control, subjective norms, perceived severity, perceived susceptibility, self-efficacy, and cues to action. Comparing these intermediate outcomes by ethnicity, income, education, having a regular health care provider, and previous flu vaccine uptake provided several other results of interest.

Respondents with a higher education overall reported a higher perceived severity of Zika, as well as higher subjective norms relating to getting the Zika vaccine and a higher likelihood to travel to areas infected with Zika. Those with a lower completed education reported higher barriers to the Zika vaccine and a higher level of cynicism related to the Zika vaccine. This is an indication that in the case of the future Zika vaccine, a higher level of education is associated with higher levels of several of the constructs that can predict intent to vaccinate.

Consistent with the field literature, African-Americans reported significantly lower results for virtually all psychosocial constructs with the potential to predict uptake intent: e.g., attitude, subjective norm, perceived severity and susceptibility, and self-efficacy. The only construct where African Americans scored higher was reported emotion toward the vaccine: fear, confusion, and cynicism were all areas where African-Americans reported higher levels than Caucasians and Hispanics.

When evaluating the association of income with psychosocial constructs related to future Zika vaccine uptake, three results stand out: first, those reporting lower income mention lower self-efficacy to get the vaccine, and second, those making more than $75,000 report significantly

higher intent to get the vaccine compared to those making less than $75,000. While this appears to contradict some of the more recent findings that those with higher incomes are more likely to be vaccine-hesitant than those with lower incomes (Stockwell et al., 2011), it confirms other findings that point to lower education as a barrier to vaccine uptake intent (Larson et al., 2014). Third and finally, both those in the lowest and highest income categories—making either less than $25,000 or more than $150,000—reported a lower mean subjective norm, seemingly at least in part confirming the conflicting results from the literature, where income is found both as a barrier as well as a facilitator for vaccine uptake (Wei et al., 2009).

Both seasonal flu vaccine uptake history and having a regular health care provider were associated with most of the intermediate psychosocial constructs (except with perceived barriers, where high perceived barriers were associated with respondents reporting that they did not get the seasonal flu vaccine the previous season). The first outcome indicates a relationship—confirmed, again, by much of the current literature—between the most common vaccine for adults and the likelihood someone will decide to get the Zika vaccine; convincing people to take one vaccine can help encourage them to get other vaccines, as well. The second outcome points to the importance of having a regular healthcare provider when considering these intermediate outcomes. However, only 9.7% of respondents in this study report that their healthcare provider has addressed Zika and possible preventive actions during a visit. This affirms the importance of both having a regular healthcare provider, as well as those healthcare providers diligently addressing the Zika virus and preventive actions associated with the virus with their female patients of reproductive age. This has implications for audience segmentation when designing future Zika vaccine messaging campaigns.

Strengths and Limitations

A major limitation of this study is that the Zika vaccine is not available yet—so any questions about its uptake are addressing a hypothetical future situation at best. Because of this, there may well be discrepancies between intent and behavior, and constructs like perceived barriers to the vaccine may be different once the vaccine is available. In addition, while the HBM and TPB appear to be good fits for communication about the Zika vaccine, there are other health behavior theories that could be lend additional insights, such as the Extended Parallel Processing Model (EPPM) which focuses more explicitly on the role of threat and efficacy in message design (Witte, 1992). Finally, the one-way ANOVA results should be interpreted with caution as the analyses did not correct for potential family-wise errors.

This study has several strengths, despite its limitations. It takes a proactive approach in studying which psychosocial variables might be most important to target for future Zika vaccine messaging, allowing for results to be implemented as the vaccine becomes available. In addition, this study used a nationally representative sample of women of reproductive age, focusing on one of the groups most vulnerable to devastating Zika consequences. Finally, this study investigated theoretically driven predictors of behavior, adding to the rigor of the design and the applicability.

Conclusion and Future Directions

In summary, the future Zika vaccine does not seem to follow other available vaccines when considering the predictive potential of demographic variables (i.e., race) as well as healthcare-related factors (i.e., having a regular healthcare provider and getting the seasonal flu vaccine). Most importantly, this study provides an indication that African-Americans, who tend to have a lower vaccine uptake level with other, more established vaccines, may be more

inclined to get the future Zika vaccine, a finding that will require further investigation. If this is a replicable finding, it has the potential to increase our understanding of vaccine-related communications, which is significant because of the increasing prevalence of anti-vaccine sentiments.

Finally, both health behavior theories that were the focus of this study, the HBM and the TPB, look to be useful to inform Zika vaccine uptake campaigns, which provides helpful guidance for public health professionals who will be focusing on these campaigns. The Zika virus may not be designated as a global health emergency at this point, but it is an ongoing threat and it is of great importance that the future Zika vaccine will be accepted quickly. Understanding the most effective audience segmentation strategies and psychosocial constructs for targeted messaging promoting the new Zika vaccine will be of critical importance for vaccine uptake to happen.

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CHAPTER 5

CONCLUSION

In a series of three papers, this dissertation examined the conversation about Zika on the social media platform Instagram, tested message characteristics proposed to increase future Zika vaccine uptake intent, and explored the extent to which several demographic, healthcare and psychosocial variables predicted future Zika vaccine uptake. The three papers are interrelated: The first paper studied how Instagram users discuss the Zika virus on the platform, and how other users respond to these posts. The second paper then tested if specific types of future Zika vaccine messages, designed to look like Instagram posts, affect Zika vaccine uptake intent as well as intermediate psychosocial variables. Finally, the third paper examined the extent to which demographics, healthcare, and psychosocial variables predicted intent to get the Zika vaccine. Results of this dissertation inform public health communication related to both using visual social media as a communication medium, and crafting effective vaccine-promoting messages. These issues will continue to increase in importance as the use of visual social media further develops and as new emerging infectious diseases outbreaks arise.

The first paper used a quantitative content analysis of 1,000 randomly selected Zika-focused Instagram posts. This study explored what Instagram users were saying about Zika on the visual social media platform and what psychosocial constructs were represented in these posts. Results showed that most Instagram posts mentioned the perceived threat of Zika, either through referring to Zika's perceived severity or through perceived susceptibility to the virus. Posts referring to perceived severity elicited significantly lower engagement, possibly a sign of maladaptive disengagement as a response to a threat that is perceived as too intense to respond. In addition, images frequently focused on mosquitoes and mosquito repellent instead of on pregnant women and their risk associated with Zika. This is not surprising, however, since

approximately 30% of the sample posts originated with commercial entities, most of which specifically promoted mosquito repellents. Few of the posts were published by any type of public health organization or other health-related entity.

The second paper was based on a 2 x 2 online survey experiment among 339 U.S. women of reproductive age, testing the effect of message framing and visual type on reported intent to get a future Zika vaccine. Results indicated that neither framing nor visual type had an effect on vaccine uptake intent, but when testing the effect on intermediate psychosocial constructs that in turn can lead to intent, gain-framed messages seemed to be associated with an increase in subjective norm, perceived benefits, and self-efficacy related to getting the Zika vaccine.

The third paper, using the same survey dataset as the second paper, identified several predictors of Zika vaccine uptake intent. A majority of psychosocial constructs (i.e., attitude toward the new vaccine, subjective norm related to the vaccine, perceived benefits of the vaccine, perceived susceptibility to Zika, self-efficacy related to the new vaccine), as well as being African-American (compare to Caucasian), and having a healthcare provider speak with you about Zika prevention all functioned as predictors of reported intent to get a future Zika vaccine.

These findings point to several important conclusions. First, Instagram users express a high perceived threat as it relates to the Zika virus, which will then be available for those searching for Zika-related information on the platform. This focus on the threat of Zika is particularly concerning given the lack of public health-based Instagram Zika posts, which means Instagram lacks one of the most reliable sources for outbreak-related information (Blair, 2014; Firger, 2014; Househ, 2016; Towers et al., 2015). Second, on Instagram little attention is paid to the most devastating consequence of Zika: microcephaly among babies born to mothers infected

with Zika during pregnancy (Mlakar et al., 2016). This points to a continued need for trustworthy information on social media focused on Zika and its potential adverse effects, particularly when the summer and mosquito season nears north of the equator, since studies continue to show an increasing percentage of people searching for health-related information online (Moorhead et al., 2013; Sharma, Yadav, Yadav, & Ferdinand, 2017). Finally, 10% of Instagram posts in the study sample mentioned conspiracy theories related to the Zika virus – for example that the virus was designed by either a specific government or pharmaceutical company and then released to increase pharmaceutical sales. In addition, these conspiracy theory messages were more likely to elicit engagement. Considering the presence of anti-vaccine conversations on social media—conversations that often mention similar conspiracy theories—this is a concerning result, and one that can have far-reaching consequences once a Zika vaccine is released and promoted (Dredze, Broniatowski, & Hilyard, 2016; Kata, 2012).

Because experimental results indicated a lack of main effects of framing and visual type on Zika vaccine uptake intent, further studies are needed to determine whether these results hold once the vaccine is available as well as during peak mosquito season. In addition, future studies should focus on other types of visual social media messaging that would be effective in promoting vaccine uptake. A main effect was present for three of the intermediate psychosocial variables, subjective norms, perceived benefits, and self-efficacy. Intriguingly, in contrast with much of the existing literature, gain-framed messages appeared to be more effective than loss-framed messages to increase these constructs, which all are theoretically linked to vaccine behavior. This is a novel finding since the literature shows that, while generally gain-framed messages promote preventive behaviors, when relating to vaccines the opposite tends to be true: loss-framed messages are more beneficial to the uptake of other vaccines (Chien, 2011; Gerend,

Shepherd, & Monday, 2008; Nan, Xie, & Madden, 2012). Women may be more likely to accept the perceived risk of a vaccine that will in turn protect their future children, perhaps similar to some pregnant women's willingness to respond to prenatal smoking cessation interventions (Bell et al, 2017; Coleman, Chamberlain, Davy, Cooper, & Leonardi-Bee, 2012). Another possible reason for the finding that gain-framed messages seem to be more effective than loss-framed messages in promoting Zika vaccine uptake intent could be that the Zika vaccine has not been released yet, and therefore (perceived) adversary effects are not reported yet. However, the vaccine not being available could also cause people to be uneasy because of a shortage of information. Regardless, the results of the intermediate psychosocial outcomes warrant further attention.

One of the most fascinating results of the online survey was that African-Americans, compared to Caucasians, were more likely to report a willingness to get a future Zika vaccine, contrary to findings related to other vaccines reported in existing literature (Englund, 2003; Fisher et al., 2011). While this could be a spurious finding, there may be important reasons why African-Americans report this results for this specific vaccine, and further research is warranted here as well. In addition to replicating the current study, qualitative research in the form of in-depth interviews and focus group would provide valuable information on whether this is a lasting result. Perhaps even more importantly, it will be crucial to further study which messages work for specific groups of people, since these characteristics may differ markedly between groups.

Finally, the theoretical framework for this dissertation consisted of the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB). Many of the psychosocial constructs from these models were significant individual predictors for a future Zika vaccine uptake. This is an encouraging result, because it affirms the usefulness of these theoretical models for health

communication messaging related to epidemics. Moreover, this finding adds to the consensus that these health behavior theories should inform health communication messages, including those that are broadcast online (Rothman, Bartels, Wlaschin, & Salovey, 2006; Webb, Joseph, Yardley, & Michie, 2010).

Strengths and Limitations

Before discussing the implications for practice as well as future research, the study limitations, as described in each separate paper, should be noted again. The first paper's main limitation was that its data were limited to Instagram, not including other popular social media platforms like Facebook, Twitter, Pinterest, and Snapchat. While Instagram is one of the more popular platforms for women of reproductive age, the focus of this dissertation, it is nowhere near the only one (Pew Research Center, 2016), and similar content analyses should be carried out for other platforms. In addition, future studies should consider using other health behavior theories, such as the Extended Parallel Processing Model and Social Cognitive Theory. Despite these limitations, this study had significant strengths. The content analysis relied on random sampling, which increases the generalizability of that study. In addition, both the codebook and experimental stimuli were driven by health behavior theory which adds rigor, replicability, and the ability to add to future meta-analyses.

One of the main limitations of both studies two and three is the use of a nonrandom sample, which limits the generalizability of the findings. However, it was a nationwide sample that was regionally balanced, making it more generalizable than many studies utilizing nonrandom sampling methods. Another limitation of the sample used in studies two and three is the focus on women of reproductive age. While this group of the population is of profound importance to the fight against the Zika virus because of the risk of microcephaly for babies born

to mothers who were pregnant when they were infected with Zika, other population segments are at risk as well. In addition, while the CDC and the WHO use the age range of 18-49 for women of reproductive age, those on the higher end of that spectrum are generally less likely to be considering having children, and future studies should consider additional segmentation in these age groups.

The timing of the survey is also a potential limitation. The survey was in the field in early March of 2017, shortly after the World Health Organization announced Zika was no longer a Public Health Emergency of International Concern, but rather an ongoing threat that will need long-term public health attention (McNeil Jr., 2016), and before the summer of 2017 mosquito season would start again. This may have decreased the salience of the Zika outbreak for the survey respondents.

The survey lost 313 participants to the applied attention checks. While there were no differences between those who finished the survey and those who failed the attention checks in terms of intent to get the Zika vaccine, they could have varied on other important measures. These results, therefore, should be interpreted with caution.

A final limitation is that both these studies took place with the Zika vaccine not yet available. Social media posts; attitudes, beliefs, and barriers related to the vaccine; and intent to get the vaccine will likely all change to some extent once the Zika vaccine is available to the public. Despite these limitations, the proactive approach taken in these studies lends important insights into likely predictors of future Zika vaccine uptake and lays an important foundation for developing future public health communication efforts.

Implications for Research and Practice

Implications for future research are plentiful. Future research should focus on monitoring Zika- and Zika-vaccine-related conversations on Instagram as well as other popular social media platforms for attitudes toward Zika and the vaccine, and in particular for misinformation regarding both. In addition, studies should focus on designing and testing messages for both future interventions on these platforms as well as responses to public conversations and questions. Social media research is a field in infancy, and there is a need for increasingly interdisciplinary research, as effective public health communication via social media involves the application of health behavior theories, risk communication principles, and digital media design and implementation skills.

The online experiment should be replicated, ensuring sufficient power for the three main ethnicity groups: Caucasian, African-American, and Hispanic women of reproductive age. The dosage of the intervention should be adjusted, either by introducing repeated exposures, longer exposure, or both. Some of the more unexpected findings from the studies presented here could likely be better understood using qualitative approaches, segmenting participants by ethnicity or other demographic variables. . For example, focus groups and/or in-depth interviews could be used to better understand attitudes toward and beliefs about the vaccine as well as ways to remove barriers to obtaining the vaccine.

One of the main implications for public health and health communications practice is that public health practitioners and health communication professionals need to increase their Instagram activity—both by posting and replying to the public's posts—to be ready for the increase in online conversations when the vaccine becomes available. The conversation on Instagram will likely change once the Zika vaccine is available, and will likely be affected by the

already existing anti-vaccine conversations on social media (Betsch et al., 2012; Dredze et al., 2016; Jacobson, Sauver, & Rutten, 2015; Jarrett, Wilson, O'Leary, Eckersberger, & Larson, 2015; Kata, 2012). This reaffirms the importance of providing accurate information on Instagram, and the need to counter misinformation about Zika before the vaccine is available.

Another implication is that public health practitioners as well as healthcare providers need to find a way to communicate quickly with the public once the vaccine is released for use. Almost one quarter of the survey respondents (all women of reproductive age) reported not planning to get the future Zika vaccine, which is troubling considering the potentially devastating adverse consequences of Zika infection during pregnancy.

Two of this dissertation's results—that African-American women of reproductive age may be more likely to express intent to get the Zika vaccine and that gain-framed messages may be somewhat more effective than loss-framed messages in promoting subjective norms, perceived benefits, and self-efficacy as related to the vaccine—were particularly surprising because the existing literature has long reported the opposite in both cases. One possible reason for the unexpected findings could be that the Zika vaccine is unique in the ways in which it incorporates both threat to self (woman) and other (potential offspring) in the population studied here. Future research should investigate whether these findings are replicated among other populations where the threat to other may not be relevant. While both these results could be spurious and need to be confirmed by repeated testing, they at least deserve consideration when focusing on message design and targeting for the upcoming vaccine. If these results are reproducible, they could add to our understanding of vaccine-related communication, particularly with those who are vaccine-hesitant.

Conclusion

This dissertation presents findings related to communication about the Zika virus and the future Zika vaccine on the visual social media platform Instagram. While the WHO ended Zika's status as a Public Health Emergency of International Concern, it emphasized that the disease is an ongoing threat that warrants long-term public health attention. With visual social media playing an increasing role in people's health information seeking behaviors and a growing number of anti-vaccine conversations, Zika and Zika-vaccine-focused messaging on these platforms will be of continued importance.

In addition, communication recommending Zika vaccine uptake will need to be a matter of continued focus. Zika may be, in many cases, a mild disease, but its potential adverse effects for pregnant women and their fetuses are devastating and the impact of a vaccine that will be able to protect these women and their fetuses will depend on the extent to which women of reproductive age decide to actually get the vaccine.

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Appendix 1: coding variables and operationalizations

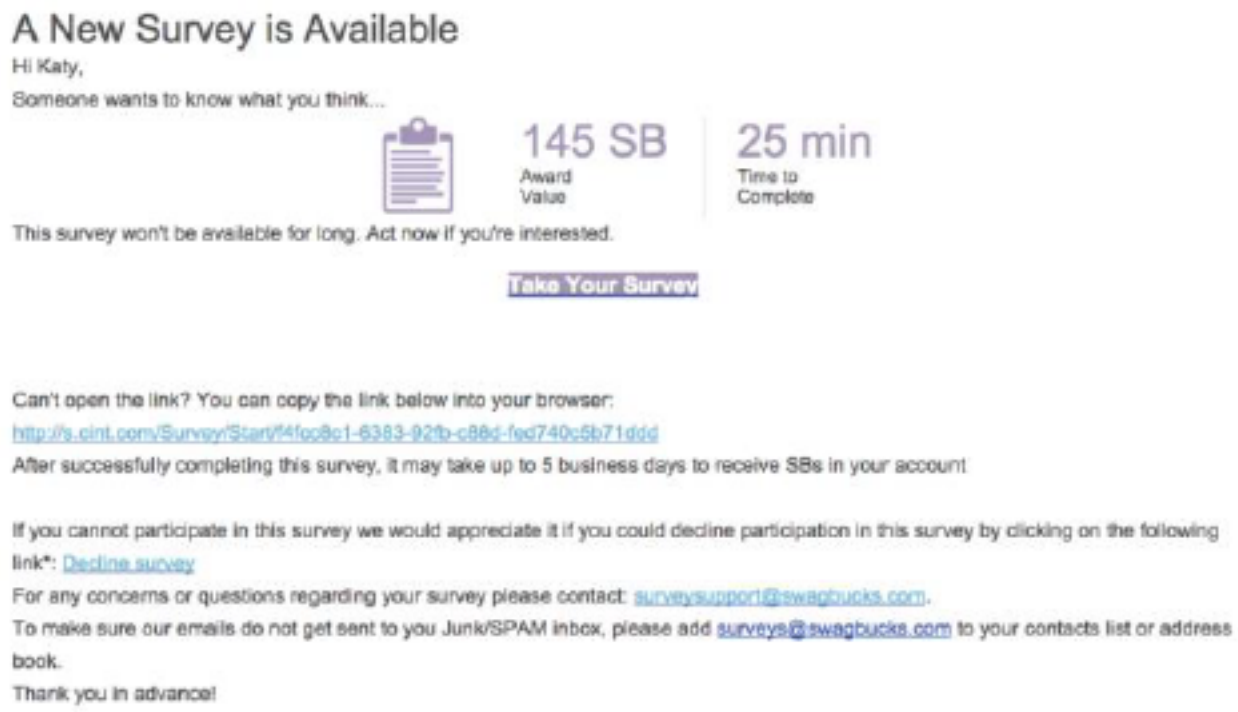
Variable	Operationalization
Hashtag frequency	Number of hashtags included in the post
Mention frequency	Number of mentions included in the post
Like frequency	Number of times the post was liked
Comment frequency	Number of comments the post received
Language	Language of the post
Hyperlink	Did the post contain a hyperlink?
Hyperlink type	Type of hyperlink: 1. Blog 2. Social media 3. Government 4. Official medical (CDC, WHO, etc.) 5. Other health-focused 6. News 7. Commercial 8. Other 9. None 10. Broken link
Source type	Type of source: 1. Individual 2. Commercial 3. Public health/NGO 4. News organization 5. Other 6. Cannot tell 7. Medical professional
Mention topics	
Mosquitoes	Did the post mention mosquitoes?
Microcephaly	Did the post mention microcephaly?
Travel restrictions	Did the post mention travel restrictions?
Future Zika vaccine	Did the post mention a future Zika vaccine?
Zika symptoms	Did the post mention Zika symptoms?
Sexual transmission	Did the post mention sexual Zika transmission?
Primary Care Provider (PCP)	Did the post mention a PCP?
Civil liberties	Did the post mention civil liberties as related to Zika (e.g., being forced to get a future Zika vaccine)?
Current Zika patient	Did the post mention a current Zika patient?
Health Belief Model	
Perceived severity	How serious is Zika?
Perceived susceptibility	How likely is someone to get Zika?
Perceived benefits	Benefits of Zika prevention (e.g., I will not get Zika)

Variable	Operationalization
Perceived barriers	Barriers to Zika prevention (e.g., expense, hassle, don't trust it works)
Self-efficacy	How confident is someone they can protect themselves against Zika?
Cues to action	Reminders to carry out Zika preventive measures (e.g., put on mosquito repellent)
Emotion	
Fear	Use of the words (or derivatives): fear, afraid, terror, scared, terrified
Anger	Use of the words (or derivatives): anger, furious, upset
Confusion	Use of the words (or derivatives): confused, do not understand, baffled, puzzled, perplexed
Cynicism	Use of the words (or derivatives): cynical, mocking, skeptical, sarcastic
Conspiracy theories	
Government conspiracy theory	Belief that the government is responsible for creating Zika
Pharmaceutical conspiracy theory	Belief that the pharmaceutical industry is responsible for creating Zika
Medical conspiracy theory	Belief that the medical establishment is responsible for creating Zika
Visuals	
Visual type	Type of visual: 1. Primarily image 2. Primarily text 3. Mix of image and text 4. Infographic 5. Drawing 6. Video 7. Other
Fear image	Does the image contain a mosquito, a baby with microcephaly, people in hazmat suits, threatening words (e.g., Zika will kill us all)
Visual: mosquito	Does the image show a mosquito?
Visual: pregnant woman	Does the image show pregnant woman?
Visual: microcephaly	Does the image show a baby with microcephaly?
Visual: show person	Does the image show a person or persons?
Visual: Caucasian	Does the image show a Caucasian person?
Visual: Black	Does the image show a Black person?
Visual: Hispanic	Does the image show a Hispanic person?
Visual: Asian	Does the image show an Asian person?
Visual: Male	Does the image show a male person?
Visual: Female	Does the image show a female person?

Appendix 2: Scott's pi coefficient values

Variable	Scott's pi
Hyperlink type	.73
Source type	.71
Mention topics	
Mosquitoes	.74
Microcephaly	.97
Travel restrictions	.90
Future Zika vaccine	.84
Zika symptoms	.84
Sexual transmission	.88
Primary Care Provider (PCP)	.90
Civil liberties	.80
Current Zika patient	.82
Health Belief Model	
Perceived severity	.76
Perceived susceptibility	.73
Perceived benefits	.75
Perceived barriers	.78
Self-efficacy	.72
Cues to action	.82
Emotion	
Fear	.78
Anger	.74
Confusion	.78
Cynicism	.77
Conspiracy theories	
Government conspiracy theory	.91
Pharmaceutical conspiracy theory	.96
Medical conspiracy theory	.82
Visuals	
Visual type	.81
Fear image	.82
Visual: mosquito	.81
Visual: pregnant woman	.96
Visual: microcephaly	.88
Visual: show person	.89
Visual: Caucasian	.86
Visual: Black	.82
Visual: Hispanic	.78
Visual: Asian	.74
Visual: Male	.90
Visual: Female	.86

Appendix 3: Qualtrics recruiting email



A New Survey is Available

Hi Katy,

Someone wants to know what you think...

145 SB
Award Value

25 min
Time to Complete

This survey won't be available for long. Act now if you're interested.

Take Your Survey

Can't open the link? You can copy the link below into your browser:
http://s.cint.com/Survey/Start/f4fcc8c1-6383-92fb-c88d-fed740c5b71ddd
After successfully completing this survey, it may take up to 5 business days to receive SBs in your account

If you cannot participate in this survey we would appreciate it if you could decline participation in this survey by clicking on the following link*: Decline survey
For any concerns or questions regarding your survey please contact: surveysupport@swagbucks.com.
To make sure our emails do not get sent to you Junk/SPAM inbox, please add surveys@swagbucks.com to your contacts list or address book.
Thank you in advance!

Appendix 4: Qualtrics survey instrument

Q1 RESEARCH PARTICIPANT INFORMATION AND CONSENT FORM

TITLE: Preventive Behaviors among Women of Reproductive Age

VCU IRB PROTOCOL NUMBER: HM20009221

INVESTIGATOR: Kellie Carlyle, PhD, MPH

If any information contained in this consent form is not clear, please contact the study staff to explain any information that you do not fully understand.

PURPOSE OF THE STUDY
The purpose of this research study is to find out more about the types of messages and other factors that influence people's willingness to get a future Zika vaccine, and how these factors relate to other vaccination and preventive behaviors. You are being asked to participate in this study because you are female, between 18-49 years of age, and a current resident of the United States.

DESCRIPTION OF THE STUDY AND YOUR INVOLVEMENT
This is a survey study. If you decide to be in this research study, you will be asked to click on the "agree" button to electronically consent after you have had all your questions answered and understand what will happen to you.

If you agree to participate, you will be randomly assigned to one of six groups. Each group will view a different Instagram-style message. After viewing the message, everyone in each group will complete the same set of survey questions, which will take approximately 30 minutes to complete. The survey questions ask your opinions about a future Zika vaccine, as well as other vaccinations and related preventive health behaviors, and demographic questions.

RISKS AND DISCOMFORTS
We do not foresee any significant risks or discomfort to your participation. However, it is possible that questions relating to sensitive subject matter could be distressing to some people. If you choose to participate in this study, please keep in mind that you may stop at any time if you become uncomfortable and you may skip any questions you do not wish to answer.

BENEFITS TO YOU AND OTHERS
You may not receive any direct benefits by participating in this research, but you may get the opportunity and satisfaction of learning more about and contributing to research in this

field. You will also have the opportunity to contact the principal investigator at the conclusion of the study for a copy of the results.

COSTS
There are no costs for participating in this study other than the time you will spend filling out the online survey.

PAYMENT FOR PARTICIPATION
Qualtrics respondents will receive an incentive based on the length of the survey, their specific panelist profile and target acquisition difficulty. You will receive the agreed upon incentive from the sample source.

ALTERNATIVES
There are no alternatives forms of participation available for this study.

CONFIDENTIALITY
The surveys will be administered online via Qualtrics. Data collected in the survey is completely anonymous, meaning that there is no way to connect your identity to your responses. The study PI (Dr. Kellie Carlyle) will maintain raw survey data on her HIPAA secured computer and drive in her office; no identifying information or keys will be included. The results of this study may be used in reports, presentations, or publications, but your name will not be used.

VOLUNTARY PARTICIPATION AND WITHDRAWAL
Your participation is voluntary. You may decide not to participate in this study. Your decision not to take part will involve no penalty or loss of benefits to which you are otherwise entitled. If you choose to participate, you may stop at any time without any penalty. You may also choose not to answer particular questions that are asked in the study.

QUESTIONS
If you have any questions, complaints, or concerns about your participation in this research, contact the Principal Investigator:

Kellie E. Carlyle, PhD, MPH at Kellie.Carlyle@vcuhealth.org or 804.628.4623.

The researcher named above is the best person(s) to call for questions about your participation in this study.

If you have any general questions about your rights as a participant in this or any other research, you may contact:

Office of Research
Virginia Commonwealth University
800 East Leigh Street, Suite 3000
P.O. Box 980568
Richmond, VA 23298
Telephone: (804) 827-2157

Contact this number for general questions, concerns or complaints about research. You may also call this number if you cannot reach the research team or if you wish to talk with someone else. General information about participation in research studies can also be found at http://www.research.vcu.edu/irb/volunteers.htm.

CONSENT
I have been provided with an opportunity to read this consent form carefully. All of the questions that I wish to raise concerning this study have been answered.

By clicking the "I consent" button, I have not waived any of the legal rights or benefits, to which I otherwise would be entitled. My clicking indicates that I freely consent to participate in this research study.

Q2
- ❍ I consent (1)
- ❍ I do not consent (2)

Condition: I do not consent Is Selected. Skip To: End of Block.

Q3 What is your age?
- ❍ Under 18 (1)
- ❍ 18 - 49 (2)
- ❍ 50 or older (3)

Condition: 18 - 49 Is Not Selected. Skip To: End of Block.

Q4 What is your gender?
- ❍ Male (1)
- ❍ Female (2)
- ❍ Transgender (3)
- ❍ Other (4)

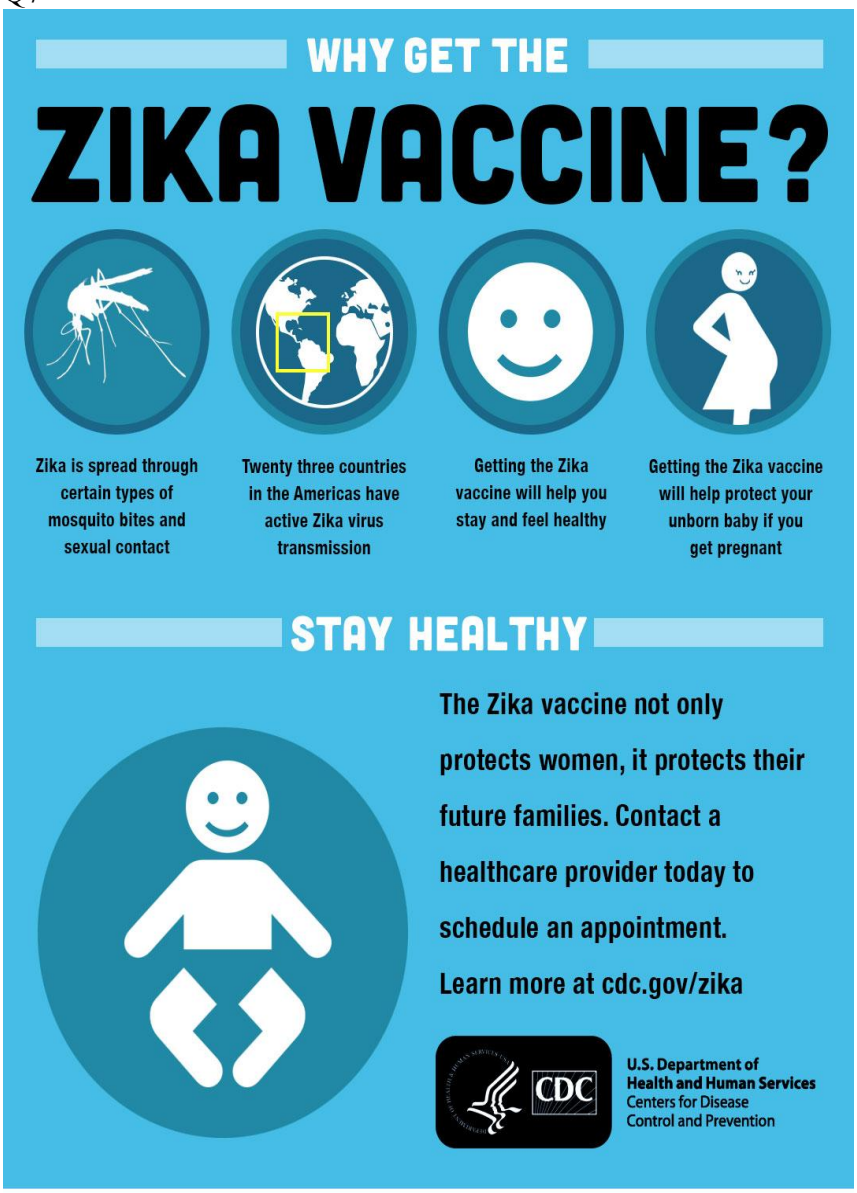
Condition: Female Is Not Selected. Skip To: End of Block.

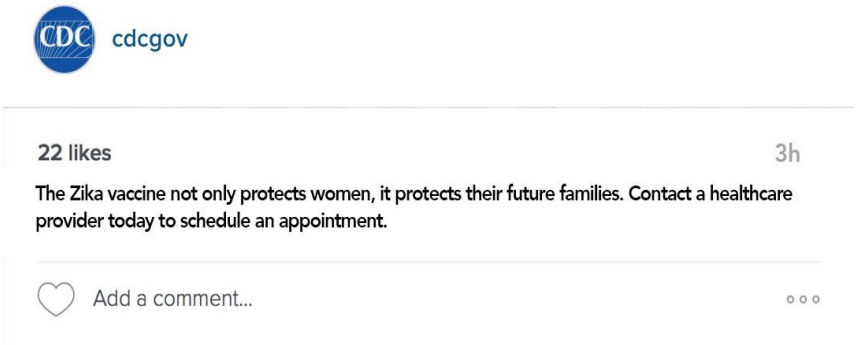
Q5 In which region do you live?

- ❍ Northeast (CT, MA, ME, NH, NJ, NY, PA, RI, VT) (1)
- ❍ Midwest (IA, IL, IN, KA, MI, MN, MO, ND, NE, OH, SD, WI) (2)
- ❍ South (AL, AR, DC, DE, FL, GA, KY, LA, MD, MS, NS, OK, SC, TN, TX, VA, WV) (3)
- ❍ West (AK, AZ, CA, CO, HI, ID, MT, NM, NV, OR, UT, WA, WY) (4)

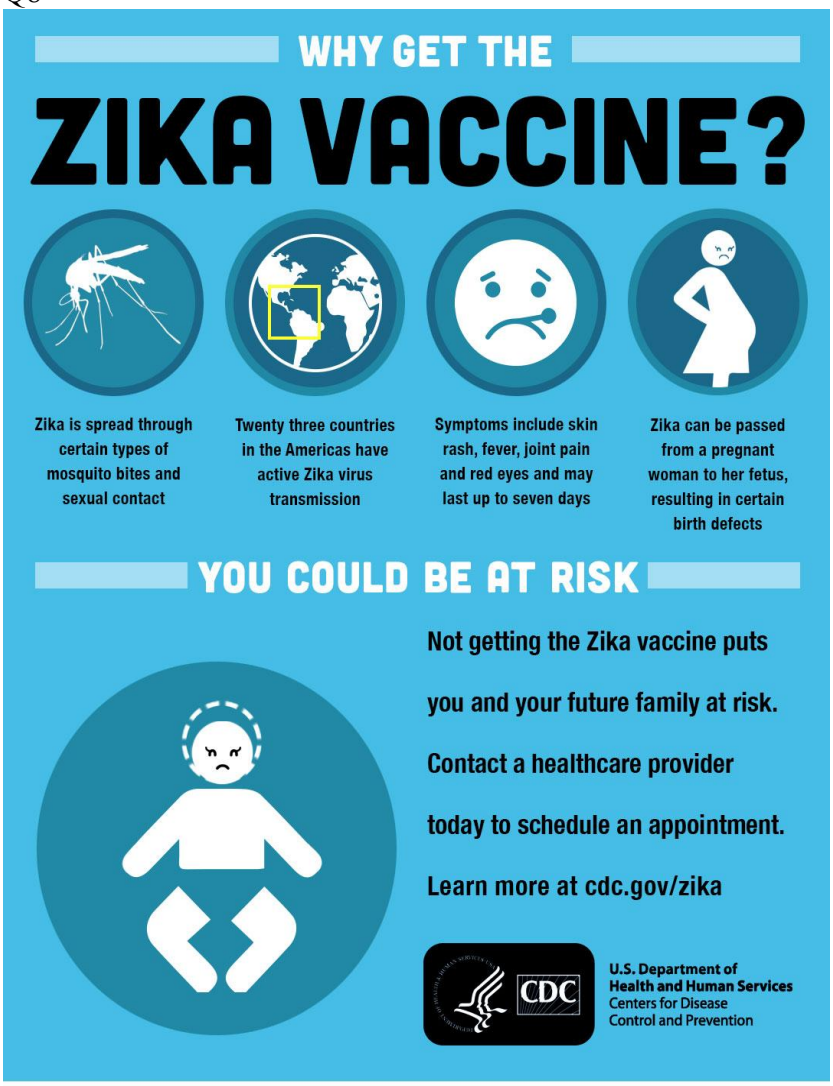
Q6 The Zika virus (Zika) can be spread through mosquitos, through sexual transmission, and from a pregnant woman to her fetus. Most of the symptoms of Zika are mild, but the Zika infection during pregnancy can cause fetuses to have a serious birth defect of the brain called microcephaly – a medical condition in which the brain does not develop normally. Currently, no vaccine or treatment is available for Zika, but several versions of a vaccine are under development and could be available as early as sometime in 2017.On the next page, you will be presented with a message regarding a future Zika vaccine. Afterwards, you will be presented with the survey questions.

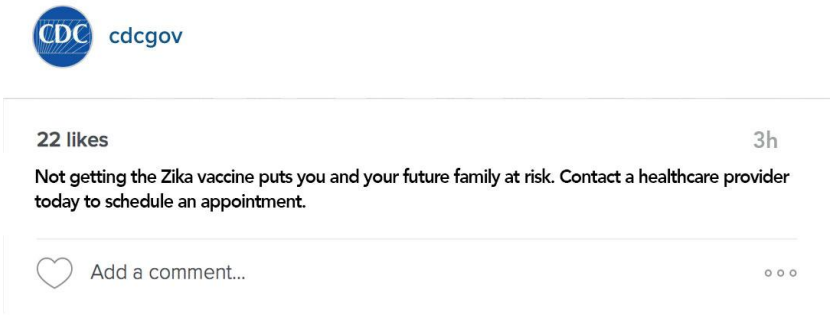
Q7


WHY GET THE
ZIKA VACCINE?
Zika is spread through certain types of mosquito bites and sexual contact
Twenty three countries in the Americas have active Zika virus transmission
Getting the Zika vaccine will help you stay and feel healthy
Getting the Zika vaccine will help protect your unborn baby if you get pregnant
STAY HEALTHY
The Zika vaccine not only protects women, it protects their future families. Contact a healthcare provider today to schedule an appointment.
Learn more at cdc.gov/zika
CDC
U.S. Department of Health and Human Services
Centers for Disease Control and Prevention


cdcgov
22 likes
3h
The Zika vaccine not only protects women, it protects their future families. Contact a healthcare provider today to schedule an appointment.
Add a comment...

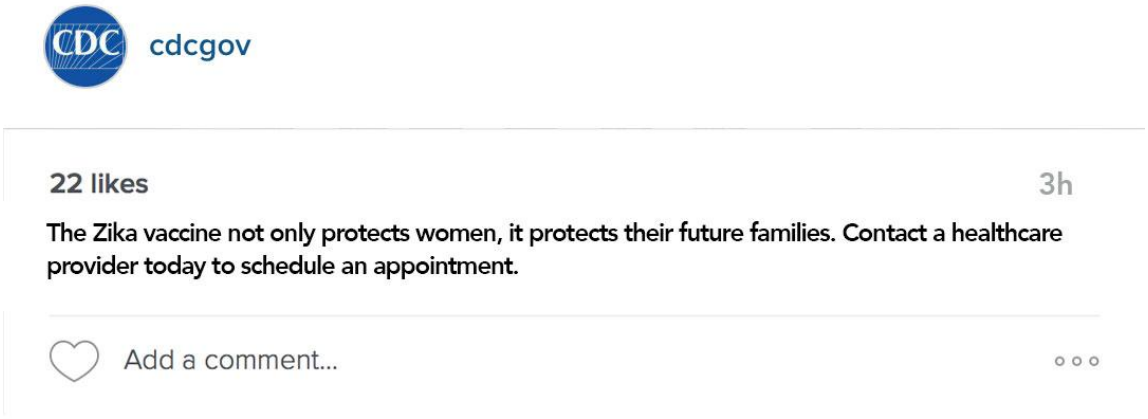
Q8


WHY GET THE
ZIKA VACCINE?
Zika is spread through certain types of mosquito bites and sexual contact
Twenty three countries in the Americas have active Zika virus transmission
Symptoms include skin rash, fever, joint pain and red eyes and may last up to seven days
Zika can be passed from a pregnant woman to her fetus, resulting in certain birth defects
YOU COULD BE AT RISK
Not getting the Zika vaccine puts you and your future family at risk. Contact a healthcare provider today to schedule an appointment. Learn more at cdc.gov/zika
CDC
U.S. Department of Health and Human Services
Centers for Disease Control and Prevention


cdcgov
22 likes
3h
Not getting the Zika vaccine puts you and your future family at risk. Contact a healthcare provider today to schedule an appointment.
Add a comment...

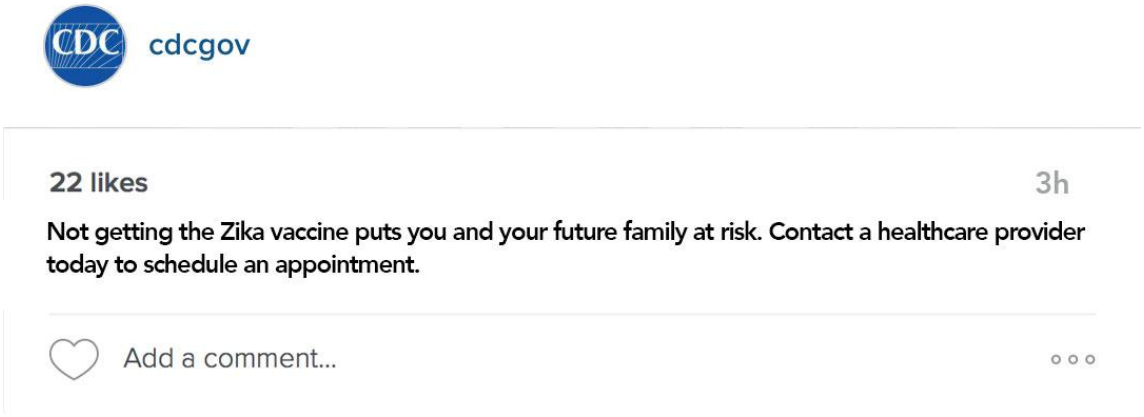
Q9


WHY GET THE
ZIKA VACCINE?
YOU CAN STAY HEALTHY.
The Zika virus is transmitted through certain types of mosquito bites and sexual contact and has spread through 23 countries in the Americas. Zika can be passed from a pregnant woman to her fetus, resulting in certain birth defects.
The Zika vaccine not only protects women, it protects their future families. Contact a healthcare provider today to schedule an appointment.
Learn more at cdc.gov/zika
CDC
U.S. Department of Health and Human Services
Centers for Disease Control and Prevention


CDC
cdcgov
22 likes
3h
The Zika vaccine not only protects women, it protects their future families. Contact a healthcare provider today to schedule an appointment.
Add a comment...

Q10


WHY GET THE
ZIKA VACCINE?
YOU COULD BE AT RISK.
The Zika virus is transmitted through certain types of mosquito bites and sexual contact and has spread through 23 countries in the Americas. Zika can be passed from a pregnant woman to her fetus, resulting in certain birth defects.
Not getting the Zika vaccine puts you and your future family at risk. Contact a healthcare provider today to schedule an appointment.
Learn more at cdc.gov/zika
CDC
U.S. Department of Health and Human Services
Centers for Disease Control and Prevention


CDC
cdcgov
22 likes
3h
Not getting the Zika vaccine puts you and your future family at risk. Contact a healthcare provider today to schedule an appointment.
Add a comment...

Q13 The following questions ask about your opinions on getting a future Zika vaccination.

	Wise (1)	(2)	(3)	(4)	(5)	Foolish (6)
Getting a future recommended Zika vaccination would be: (1)	❍	❍	❍	❍	❍	❍

Q14

	Beneficial (1)	(2)	(3)	(4)	(5)	Harmful (6)
Getting a future recommended Zika vaccination would be: (1)	❍	❍	❍	❍	❍	❍

Q15

	Valuable (1)	(2)	(3)	(4)	(5)	Worthless (6)
Getting a future recommended Zika vaccination would be: (1)	❍	❍	❍	❍	❍	❍

Q16

	Bad (1)	(2)	(3)	(4)	(5)	Good (6)
Getting a future recommended Zika vaccination would be: (1)	❍	❍	❍	❍	❍	❍

Q17

	Positive (1)	(2)	(3)	(4)	(5)	Negative (6)
Getting a future recommended Zika vaccination would be: (1)	❍	❍	❍	❍	❍	❍

Q18

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Somewhat agree (4)	Agree (5)	Strongly agree (6)
There will be several things outside my control that would prevent me from getting a future Zika vaccination. (1)	❍	❍	❍	❍	❍	❍
It will be mostly up to me whether or not I get a future Zika vaccination. (2)	❍	❍	❍	❍	❍	❍
I will have very little control over whether I do or do not get a future Zika vaccination (3)	❍	❍	❍	❍	❍	❍

Q19

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Somewhat agree (4)	Agree (5)	Strongly agree (6)
People who are important to me would approve of me getting a future Zika vaccination. (1)	❍	❍	❍	❍	❍	❍
My family would approve of me getting a future Zika vaccination. (2)	❍	❍	❍	❍	❍	❍
My friends would approve of me getting a future Zika vaccination. (3)	❍	❍	❍	❍	❍	❍
My primary care provider would approve of me getting a future Zika vaccination. (4)	❍	❍	❍	❍	❍	❍
I want to do what people important to me think is best regarding getting a future Zika vaccine. (5)	❍	❍	❍	❍	❍	❍

Q20

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Somewhat agree (4)	Agree (5)	Strongly agree (6)
I intend to get a future Zika vaccine when it becomes available. (1)	❍	❍	❍	❍	❍	❍

Q21 If you do NOT intend to get the future Zika vaccine, why?

Q22 The following questions ask you your opinions about getting a future Zika vaccine.

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Somewhat agree (4)	Agree (5)	Strongly agree (6)
A future Zika vaccination will help me feel less worried about getting Zika. (1)	❍	❍	❍	❍	❍	❍
A future Zika vaccination will decrease my chance of getting Zika or its complications. (2)	❍	❍	❍	❍	❍	❍
I am concerned that the side effects of a future Zika vaccination will interfere with my usual activities. (3)	❍	❍	❍	❍	❍	❍
I am afraid of needles. (4)	❍	❍	❍	❍	❍	❍
I am concerned it will be inconvenient for me to get a future Zika vaccination. (5)	❍	❍	❍	❍	❍	❍
To confirm your responses are valid, please select strongly agree for this question. (8)	❍	❍	❍	❍	❍	❍
I am concerned that a future Zika vaccine will be expensive. (6)	❍	❍	❍	❍	❍	❍
I am concerned I won't know where to get a future Zika vaccine when it becomes available. (7)	❍	❍	❍	❍	❍	❍

Condition: To confirm your responses a... Is Not Selected. Skip To: End of Block.

Q23 Please indicate how likely you would be to feel each of the following emotions by clicking the statement that best indicates intensity of your feelings about a future Zika VACCINE:

	Extremely unlikely (6)	Moderately unlikely (5)	Slightly unlikely (4)	Slightly likely (2)	Moderately likely (1)	Extremely likely (8)
Scared, fearful, afraid (of the future Zika vaccine) (1)	❍	❍	❍	❍	❍	❍
Nervous, anxious, worried (about what could happen when getting the future Zika vaccine) (2)	❍	❍	❍	❍	❍	❍
Confused (by the information about the future Zika vaccine) (3)	❍	❍	❍	❍	❍	❍
Angry, frustrated (because of information about the future Zika vaccine) (4)	❍	❍	❍	❍	❍	❍
Cynical, skeptical (because of information about the future Zika vaccine) (5)	❍	❍	❍	❍	❍	❍

Q24 The following two questions ask you about your ability to get a future Zika vaccine.

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Somewhat agree (4)	Agree (5)	Strongly agree (6)
If I wanted to, I am confident that I could get the future Zika vaccination. (1)	❍	❍	❍	❍	❍	❍

Q25

	Very uncertain (1)	Uncertain (2)	Somewhat uncertain (3)	Somewhat certain (4)	Certain (5)	Very certain (6)
How certain are you that you could get the future Zika vaccination? (1)	❍	❍	❍	❍	❍	❍

Q26 Has a physician, healthcare provider, or clinician spoken to you about Zika and Zika prevention?

❍ Yes (1)

❍ No (2)

Q27 The following questions ask you about your current feelings about Zika.

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly agree (7)
My chance of getting infected with the Zika virus in the next few months is high. (1)	❍	❍	❍	❍	❍	❍	❍
Getting infected with Zika is currently a possibility for me. (2)	❍	❍	❍	❍	❍	❍	❍
I am worried about the likelihood of getting Zika in the near future. (3)	❍	❍	❍	❍	❍	❍	❍
My chances of getting Zika are high when I'm in an area with a lot of mosquitoes. (4)	❍	❍	❍	❍	❍	❍	❍
Complications of Zika are serious. (5)	❍	❍	❍	❍	❍	❍	❍
I will be very sick if I get Zika. (6)	❍	❍	❍	❍	❍	❍	❍
I am afraid of getting Zika. (7)	❍	❍	❍	❍	❍	❍	❍
Complications of Zika for a pregnant woman and her fetus are serious. (8)	❍	❍	❍	❍	❍	❍	❍
I am afraid to get pregnant because of Zika. (9)	❍	❍	❍	❍	❍	❍	❍

Q28 Please indicate how likely you would be to feel each of the following emotions by clicking the statement that best indicates how you feel about the Zika VIRUS:

	Extremely unlikely (1)	Moderately unlikely (2)	Slightly unlikely (3)	Slightly likely (4)	Moderately likely (5)	Extremely likely (6)
Scared, fearful, afraid (1)	❍	❍	❍	❍	❍	❍
Nervous, anxious, worried (2)	❍	❍	❍	❍	❍	❍
Confused (3)	❍	❍	❍	❍	❍	❍
Angry, frustrated (4)	❍	❍	❍	❍	❍	❍
Cynical, skeptical (5)	❍	❍	❍	❍	❍	❍

Q29 The following questions ask about places where Zika may be more likely to be present.

	Strongly disagree (1)	disagree (2)	Somewhat disagree (3)	Somewhat agree (4)	Agree (5)	Strongly agree (6)
I am likely to travel to an area with ongoing Zika transmission within the next 12 months. (1)	❍	❍	❍	❍	❍	❍
I live in an area with ongoing Zika transmission. (2)	❍	❍	❍	❍	❍	❍
I live in an area with a lot of mosquitoes. (3)	❍	❍	❍	❍	❍	❍

Q30 The following question is about actions you could take to prevent Zika. How likely would you be to undertake these actions?

	Very unlikely (1)	Unlikely (2)	Somewhat unlikely (3)	Somewhat likely (4)	Likely (5)	Very likely (6)
Refrain from traveling to areas affected by Zika. (1)	❍	❍	❍	❍	❍	❍
Postpone travel plans to Zika-infected areas. (2)	❍	❍	❍	❍	❍	❍
Wear long-sleeved shirts and long pants when it is hot outside. (3)	❍	❍	❍	❍	❍	❍
Use mosquito repellent. (4)	❍	❍	❍	❍	❍	❍
Use condoms when having sex. (5)	❍	❍	❍	❍	❍	❍

Q31 Have you gotten the seasonal flu vaccine this season (2016-2017)?
- ❍ Yes (1)
- ❍ No (2)

Display This Question:
If: Have you gotten the seasonal flu vaccine this season (2016-2017)? No is selected

Q32 If not, do you intend to get the seasonal flu vaccine this season?
- ❍ Yes (1)
- ❍ No (2)
- ❍ Not sure (3)

Q33 Did you get the seasonal flu vaccine last season?
- ❍ Yes (1)
- ❍ No (2)

Q100 In closing, please answer the following demographic questions. What is your age?

Q101 What is your highest level of education reached?
- ❍ Less than high school (1)
- ❍ High school graduate (2)
- ❍ Some college (3)
- ❍ 2 year degree (4)
- ❍ 4 year degree (5)
- ❍ Graduate degree (6)

Q102 What is your ethnicity?
- ❍ African-American (1)
- ❍ American Indian or Alaska native (2)
- ❍ Asian (3)
- ❍ Hispanic (4)
- ❍ Native Hawaiian or Pacific Islander (5)
- ❍ White (6)
- ❍ Other (7)

Q103 What was your total household income before taxes during the past 12 months?

- ❍ Less than $25,000 (1)
- ❍ $25,000 to $34,999 (2)
- ❍ $35,000 to $49,999 (3)
- ❍ $50,000 to $74,999 (4)
- ❍ $75,000 to $99,999 (5)
- ❍ $100,000 to $149,999 (6)
- ❍ $150,000 or more (7)

Q104 Are you pregnant?

- ❍ I am currently pregnant (1)
- ❍ I am not pregnant but am planning to get pregnant within the next 12 months (2)
- ❍ I am not pregnant and not planning to get pregnant within the next 1-2 years (3)

Vita

Jeanine Patricia Drost Guidry was born on July 12, 1967, in Amsterdam, the Netherlands, and is a dual Dutch/U.S. citizen. She received her Master of Science in Health Sciences from Maastricht University, Maastricht, the Netherlands in 1990, and subsequently moved to the United States to work with nonprofit organizations in Denver, Colorado and Richmond, Virginia. She received a Master of Professional Studies from the George Washington University in Washington, D.C. in 2013. She joined the doctoral program in Social and Behavioral Sciences at the Department of Health Behavior and Policy at Virginia Commonwealth University in 2014. During the program, she published twelve manuscripts, and presented her research at numerous national and international conferences. She received a number of awards, including the national first-place award in the Best Practices in Teaching Competition of AEJMC for the "Global Health and Social Media" open online course in 2015 and the AEJMC ComSHER Lori Eason Award in 2014.

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