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Determinants of Parental Acceptance of the H1N1 Vaccine

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Introduction

Children were among several high-risk groups who received priority vaccinations during the 2009–2010 H1N1 pandemic, but as a group, their rates of vaccination in the U.S. during H1N1 barely hovered above 40% (CDC, 2011). While these rates are much greater than the typical 27% vaccination rate for children during seasonal flu, the rate is low for a group designated high risk. In past flu seasons, traditional "high risk" groups such as senior citizens have been vaccinated at rates of nearly 70% (MMWR, 2010). Given the heavy media coverage of H1N1, the increased risk children faced from the disease, their designated priority status, the availability of free H1N1 vaccine at most health departments, and the emphasis by federal flu planners on children as potential vectors of disease in a pandemic, the low rate of vaccination among children is alarming and deserves special scrutiny.

Parents ultimately determine whether children will receive a flu vaccination. To better understand parental decision-making about vaccines and effectively utilize the lessons of H1N1 in future, more serious pandemics, we conducted a nationwide survey of 684 parents at the height of the H1N1 pandemic. Here we report factors that influenced parental acceptance of the H1N1 vaccine and discuss implications for improving vaccine uptake for children in the future.

Research on parental acceptance of vaccines has focused on three primary issues and/or types of vaccines: 1) childhood immunizations, especially perceived vaccine risks, such as parental concerns about autism; 2) vaccination against human papillomavirus (HPV); and 3) influenza vaccinations, both seasonal – and in a handful of studies – H1N1. Although each vaccine issue has accompanying complications that do not permit exact comparisons (e.g. school mandates regarding routine MMR immunization or parental attitudes about sexual activity and the HPV vaccine), each of these studies offers clues related to parental vaccine decision-making.

In their review article advising physicians how to communicate with vaccine-hesitant parents, Healy and Pickering (2011) report that at least 28% of parents have been hesitant to vaccinate at some time. They cite three consistent reasons for vaccine refusal: fears about vaccine safety, concerns that vaccines may transmit the disease they are intended to immunize against, and the idea that contracting a disease and building “natural” immunity is preferable. Bhat-Schelbert et al. (2012) found in a series of focus groups with families and healthcare providers that fear, misinformation and mistrust, amplified by the media, were significant reasons for not vaccinating. However, they also found vaccination was more readily accepted if the disease was better understood, if a trusted person recommended vaccination, or if barriers such as inconvenience could be overcome. In qualitative studies in the UK, Leask et al. (2006) and Poltorak et al. (2005) found factors such as attitudes toward government and the pharmaceutical industry, past personal experiences, and trust in healthcare providers to be as important as the individual child’s health in determining parental acceptance of vaccine. Poltorak described a complex web of personal, social and media influences. Hobson-West (2003) argued that benefits and risks to the community, rather than to the individual child, would be most effective in persuading parents to vaccinate. Spier’s historical review (2001) of the anti-vaccination movement cited a primal human aversion to disturbing the status quo, which heightens the perceived risk of introducing a vaccine into a child’s body versus the risk of doing nothing (i.e. the risk of the disease).

Frew et al. (2011) surveyed 223 African American and Hispanic parents during H1N1 and found 41% had already vaccinated their children for seasonal flu, or intended to, and 36% for H1N1. Factors most associated with acceptance of the vaccine were perceived susceptibility of the child to H1N1, concern about the impact of H1N1 in the community, concern about H1N1 relative to other diseases, perception that vaccination was more effective than other methods of mitigation such as hand-washing, and finally, lack of insurance. The authors did not find demographic factors such as race, income and education level to be significant, and while perceived concern about vaccine safety was negatively associated with vaccine acceptance, safety concerns were not a significant reason for vaccine refusal in the sample.

Our study extends these findings about parental vaccine acceptance by examining the issue during the more urgent environment of a pandemic, and evaluating them through the lens of the Health Belief Model, or HBM (Janz & Becker, 1984; Mattson, 1999). For more than 60 years the HBM has been successfully used to examine factors explaining why individuals might decline preventive public health care or screenings, especially when offered at no monetary cost. The HBM considers how individual behavior is affected by the following variables: demographics, perceived risk of disease (severity and susceptibility), perceived benefits of mitigating behaviors versus perceived barriers or costs, perceived self-efficacy (ability to perform or access mitigation steps), and cues to action, which might include environmental prompts such as media messages, observation of role models, conversations with friends or family, reminders from healthcare providers, etc.

Our research questions looked separately at each variable in the HBM to ask: “Is this individual variable a significant predictor of a parent’s behavioral intention to vaccinate a child?” Our final research question was “What is the relationship or interaction between all of the variables in the model in predicting a parent’s behavioral intention to vaccinate a child?”

We confirm some associations found in previous studies, but also add a detailed examination of “cues to action” as a key determinant in behavioral intention. Using the HBM framework, we propose a model to explain parental decision-making related to the H1N1 vaccine and offer suggestions for practical application of the results.

Methods

From January 22, 2010 to February 1, 2010, we surveyed a nationally representative, random sample of 2,042 adults in the US, including oversamples of African Americans and Hispanics. About 40% of respondents were White Non-Hispanic with remaining sample evenly split between Black Non-Hispanics and Hispanics. There were roughly equal number of males and females (47%, 53%, respectively). The respondents were between 18 and 95 years old. The survey was approved by the researchers’ Institutional Review Boards (IRBs) and conducted online by Knowledge Networks. The sample was drawn from its panel of approximately 40,000 individuals recruited by random-digit-dialing, and included households without traditional Internet access. All analyses were weighted to be demographically representative of the US population as reported by the January 2010 Current Population Survey (CPS). Of this sample, 684 were parents of children under 18 years old.

In examining vaccine behavior and behavioral intention to get vaccinated, we divided respondents into two groups: those who vaccinated at least one of their children, and those who vaccinated none.

The survey instrument was designed by nationally recognized experts in health communication and vaccine behavior on the research team, and pilot tested by Knowledge Networks before deployment. The survey described H1N1 as “the current influenza outbreak” and used the term “swine flu” rather than H1N1, indicating they were in fact interchangeable terms. The survey included 80 questions and 350 individual items covering a variety of issues important to public health practitioners responding in real time to the unfolding pandemic. Of these survey items, 26 corresponded to elements of the Health Belief Model (HBM), including perceived susceptibility to H1N1 (“How likely do you think it is that one of your children under 18 will become ill with swine flu?”); perceived severity of H1N (“If one of your children under 18 became ill with swine flu, how severe do you think the illness will be?”); perceived costs and benefits of receiving the H1N1 vaccine (including monetary costs; inconvenience; concerns about vaccine risks and side effects; and efficacy of vaccine versus other mitigations, (see Table 2 for complete list); and perceived self-efficacy (confidence they could get the H1N1 vaccine). Cues to action included levels of worry; perception (whether accurate or not) of being in a vaccine priority group; influence of friends, family, media coverage, and public health communication (e.g. “How influential was [your best friend/your doctor/TV news] to your decision about the swine flu vaccine?”); and influence of President Obama’s decision to vaccinate his daughters (e.g.

"Knowing the President had his daughters vaccinated would increase my willingness to have my children vaccinated"). The first stage of our analysis examined descriptive statistics to look for differences between groups. The second step of analysis was a k-cluster analysis of the 12-item list of possible costs and benefits associated with the H1N1 vaccine, to identify homogeneous groups of respondents. The number of clusters was chosen based on interpretability and differences among the clusters and three clusters emerged (Kaufman & Rousseeuw, 1990). Missing data for these variables ranged from 2% to 3% and were imputed using the Expectation- Maximization Algorithm (Dempster, Laird, & Rubin, 1977).

The third and final stage of our analysis tested the Health Belief Model using structural equation modeling (SEM), controlling for demographics such as race, gender, age, income, education and health insurance coverage (see, Figure 2). The model was estimated using mean- and variance-adjusted weighted least squares (WLSMV), which does not assume normality. Since the model χ^2 is sensitive to the sample size in SEM, three fit indexes were used: 1) the comparative fit index, or CFI (Bentler, 1990); 2) the root mean square error of approximation, or RMSEA (Steiger & Lind, 1980); and 3) weighted root mean square residual or WRMR ((Muthén & Muthén, 2010). A model is considered good if CFI ≥ 0.95, RMSEA ≤ 0.06, and WRMR ≤ 0.90.

Results

Overall in our sample of parents with children under age 18 (n=684), 62% vaccinated none of their children, 31% vaccinated all, and 7% vaccinated some. Parents of children with unspecified "underlying health conditions" were more likely to get some or all of their children vaccinated (49% versus 35% of those whose children had no health conditions, p = .009).

Some of our data confirmed trends seen in earlier studies of vaccine behavior (see e.g. Bhat-Schelbert et al., 2012; Leask et al., 2006; Poltorak et al., 2005, and Frew et al., 2011). In descriptive analysis, there was no significant difference between people with and without insurance in accepting vaccines for their children (42% vs. 37%, p = .293). Additionally, there were strong relationships between uptake and knowledge, and between uptake and media consumption about H1N1; medical practitioners were influential, particularly to younger parents. Across the entire sample, parents' education levels were important: participants with less than a high school education were significantly more likely to vaccinate some or all children than participants with some college or more education (47% vs. 29%, p < .001).

Within the framework of the Health Belief Model (HBM), we used structural equation modeling to examine the following predictors: demographics, perceived susceptibility to H1N1 and perceived severity of the virus, perceived costs and benefits of vaccination, cues to action, and self-efficacy. There was a significant difference between the observed and the model covariance matrices, χ^2 (55) = 175.52. However, there was a "good" fit, CFI = .950, RMSEA = .057, WRMR = .832 (Figure 2). The factor loadings of cues to action ranged from .49 to .77. The HBM explained 38% of the variability in parental acceptance of the H1N1 vaccine, with "cues to action" being the most significant predictor associated with parental acceptance, and two other HBM variables, costs & benefits and self-efficacy, also playing a role. There was moderate correlation among perceived susceptibility, perceived severity, and cues to action (.28 to .33). However, the correlations of these variables to costs and benefits were low (.01 to .11).

Because race was significant in overall rates of parental acceptance, we singled it out for special consideration as a predictor of response to other variables (Kumar, Quinn, Kim, Daniel, & Freimuth, 2012). After adjusting for other demographic variables in the SEM analysis, there were significant differences in perceived susceptibility, perceived severity, and cues-to-action items among races: Hispanics had the highest perceived susceptibility, perceived severity, and stronger responses to all cues-to-action items ($\beta = .36$) compared to Whites. African Americans were significantly more likely than Whites to be affected by cues to action ($\beta = .13$). There was no significant difference between African Americans and Whites in perceived susceptibility and severity regarding H1N1, but Hispanics had higher perceptions of both perceived severity and susceptibility compared to Whites. Only about 8% of perceived susceptibility was explained by race and demographic variables, while nearly 20% of perceived severity was explained by the same variables. However, in the overall model, these measures of perceived risk were not significant predictors of vaccine acceptance.

Moving to perceived costs and benefits of the H1N1 vaccine, our analysis found African Americans and Hispanics were about 1.2 times more concerned than Whites about both vaccine risks and about adverse effects of the H1N1 virus (e.g. including missing work and spreading the disease to others). In general, the greater the perceived "cost" of the H1N1 vaccine (including perceived vaccine risks, perceived limited efficacy, or financial cost), the less likely parents were to vaccinate any of their children; as perceived costs outweighed benefits, parents were only 77% as likely to get their kids vaccinated.

In some health behaviors, perceived costs and benefits may be unambiguous, (for example, smoking cessation). However, the perceived costs and benefits of accepting a vaccine are somewhat more nuanced and conflicting because of widespread concerns about vaccine safety that compete with concerns about disease. To capture this complexity within our path model, we conducted a cluster analysis of the cost-benefit items, discovering three distinct cost-benefit clusters, which we then used in the path model: the "Worried" (worried about H1N1, worried about the vaccine – "high") comprised 41% of participants; the "Unconcerned" (worried about neither disease nor vaccine – "low") represented 28%; and the "Vaccine-Averse" (worried about the vaccine but not about the disease – "medium") made up 31%. We expected to see a fourth group, worried about the risk of H1N1 but not worried about the risk of the vaccine, however, there was no cluster of respondents matching this profile. There were significant differences between the clusters on all the cost-benefit items, and most of the differences had a large effect size (Table 2 & Figure 1). Cluster groups were significantly likely to predict vaccine uptake, with the Worried 73% more likely to get their child vaccinated.

Cues to action (including worry; perceived membership in a vaccine priority group; and the influence of friends, family, media coverage, public health communication, and President

Obama's decision to vaccinate his daughters) were significant predictors of vaccine uptake, even when controlled for demographics and political affiliation. The factor loadings of cues to action ranged from .48 to .75. Respondents got children vaccinated at a 1.4 times higher rate for every standard deviation increase in the level of impact of cues to action.

The costs-and-benefits cluster and cues to action explained about 30% of variability in self-efficacy. There was a significant positive prediction of self-efficacy by cues to action, and a significant negative prediction of self-efficacy by those in the "Worried" cost-benefit cluster. Parents were 1.3 times more likely than others to get their children vaccinated for every standard deviation increase in self-efficacy.

Discussion

Our survey was created rapidly, in response to the information needs of public health practitioners during the unfolding H1N1 pandemic, rather than as a purely theoretic test of the Health Belief Model. Although our measures are typical of those often used in the HBM (for examples, see Brewer et al., 2007; Brewer & Fazekas, 2007; Janz & Becker, 1984; McCaul, Branstetter, Schroeder, & Glasgow, 1996; Rimal, 2001; Witte & Allen, 2000), some measures are less robust than others, and our analysis does not attempt to add to the literature on the HBM. Rather, we use it as a framework that may possibly explain parental behavior, and could be used to help public health officials more effectively segment and communicate with this audience.

When our initial analysis of data revealed, somewhat counter-intuitively, that higher levels of risk perception about H1N1 were not associated with increased parental acceptance of the vaccine, we searched for clues that could predict what separated parents who opted for the vaccine from those who did not. A conceptualization of the HBM in which cues to action take a central role proved to be a very good fit, explaining much of the difference between the two groups.

Our key finding was that cues to action at all levels, from intrapersonal all the way to mass media, may be far more important in vaccine decision-making than perceived risk. In practice, this means scary messages about the impact of H1N1 may be ineffective in motivating people to action. What we found instead (and other recent studies have confirmed, see for example, Mileti, et al., 2011), was the significant effect of affirming messages and role models, either within an individual's social network or in a position of authority or celebrity, such as the Obamas' modeling of vaccine acceptance for their daughters. This indicates an important role for social media; for news coverage that may include personal testimonials, especially from community opinion leaders; or perhaps visuals depicting the accessibility and popularity of flu clinics. It also may inform practitioner-patient communication by focusing the conversation away from persuading parents of the dangers of a disease and focusing instead on social norms related to vaccination, and possibly even on the doctor's own decision-making process with regard to child vaccination.

Perceived risk as measured by traditional items asking about susceptibility and severity was not significant, but risk did appear to matter as measured indirectly in the cost-benefit index (where one perceived vaccination “benefit” -- not missing work because of a sick child -- may reflect perceived “risk” of the disease’s consequences). The index, of course, contained items not just dealing with the risk of H1N1, but perceived risk of vaccine acceptance; it was the perception that disease risk outweighed vaccine risk that was significant. This indicates traditional measures of risk may not be capturing the cost-benefit analysis inherent in vaccine decision making; when parents perceive risks of both the disease and the vaccine, the decision-making process is no doubt different than for a risk perceived as unambiguous. (Indeed, we initially planned to subtract perceived costs from perceived benefits, as is customary in the HBM, until our examination of the data indicated that for many respondents, the calculation was not as straightforward as it might be for other health issues. We ultimately chose to create an index as a more robust way of capturing this complexity, then used cluster analysis to identify patterns among respondents).

One possible approach suggested by our findings is that rather than simply emphasizing the risk of the disease, communicators may need to acknowledge potential perceived risks of the vaccine and emphasize the greater comparative risk of the disease itself. Alternatively, perceived risk of the disease may be unimportant as a motivator; rather, the important thing may be overcoming perceived risk of vaccine. It is also possible risk issues should take a backseat to stronger, better motivators – as indicated by our overall findings about the effects of cues to action.

The importance of emphasizing these relative risks may also depend on the target group. The cluster analysis provides important insight into the psychology behind vaccine decision-making. Not surprisingly, the Worried are most likely to accept the vaccine for their child. Our data showed they worried about both the disease and the vaccine, but it appears as if the vaccine was ultimately favored in the Worried’s cost-benefit analysis. Exactly what led to that decision is not apparent in the data, however, cues to action appear to have been an important prompt for this group, indicating that someone ambivalent about relative risks and benefits can be influenced by cues from the media and important others. Personal testimonials and social media, in addition to mass media, may be an important channel for these cues.

The Unconcerned may not be influenced by the same cues to action; they are not worried and do not need reassurance. It is unclear from our results whether it would be possible to increase risk perception of the disease among this group, and whether increased disease risk perception alone would be effective in achieving vaccine acceptance, given that our model showed risk perception alone was not significantly associated with uptake. Future research should investigate other potential cues to action for this group, including the influence of friends, family, health professionals and the media.

Those who we classified as Vaccine-Averse might be responsive to risk information on either side of the cost-benefit equation. On the other hand, such information might require them to admit they had been wrong about vaccines, or could potentially cause them to become more entrenched in their views. Although this group of parents is a critical one to reach, it may make sense for communicators and public health officials to focus on the more winnable battle of persuading approximately two-thirds of people who are either Worried or Unconcerned to choose vaccination for their children. Such a strategy would help establish parental acceptance of vaccine as a social norm in the wider community, perhaps leading to more success when focusing in the future on the Vaccine-Averse.

Self-efficacy, or the confidence an individual had that they could get the H1N1 vaccine, appeared to work in our model. However, as a single item measure it provides little data for interpretation and may be confounded by concerns about availability or even attitudes toward the vaccine. Greater understanding of the components of this variable is needed to help understand why it boosted vaccine rates so significantly.

Initial descriptive data showed some significant demographic differences, and some of them were, indeed, puzzling, such as the higher vaccination rates among parents with high school education only versus those with some college. However, when examining each demographic individually (while controlling for others), none of the demographics, including race or education, continued to play a large role. This should come as good news to practitioners in the field, since demographics cannot be altered and the behaviors and traits associated with them can be extremely difficult to change. However, messages, cues and perceptions are all imminently changeable with the right approach, and may still need to be tailored to the racial, ethnic or cultural norms of those groups practitioners are trying to reach.

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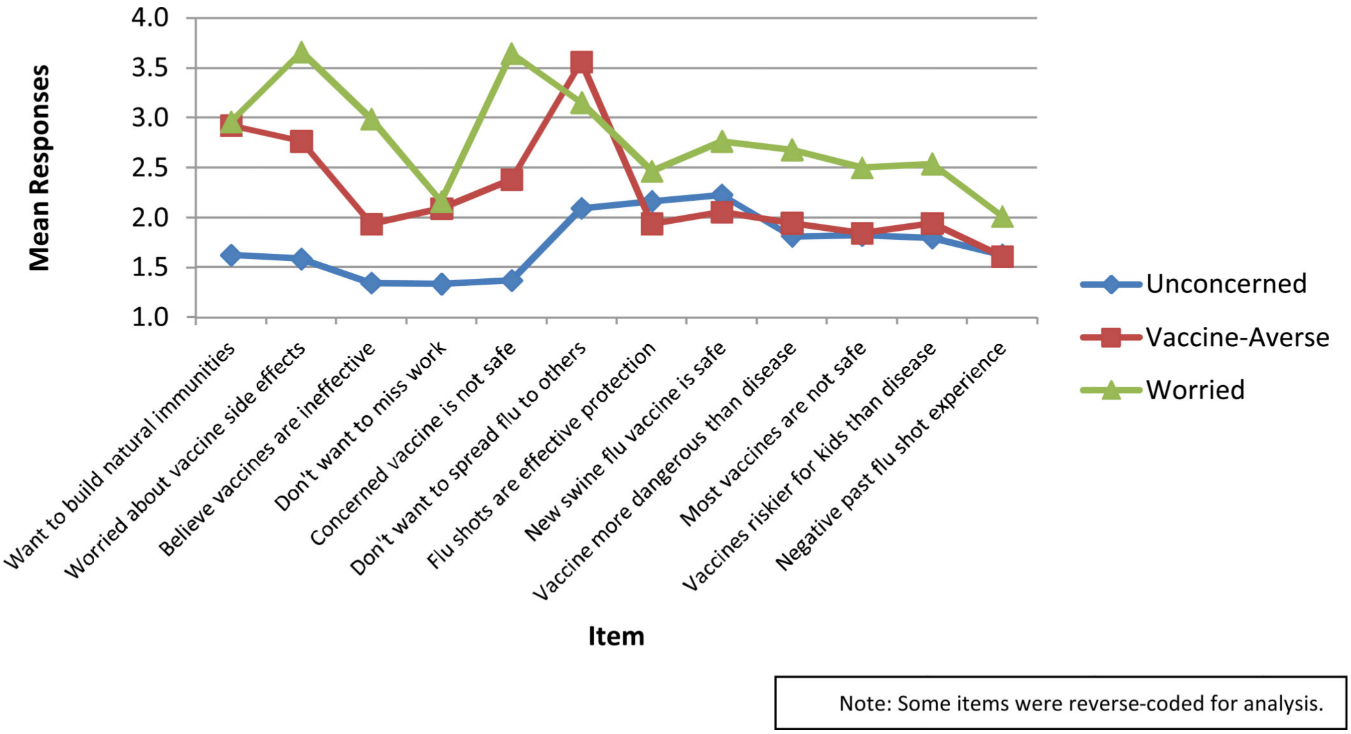

Figure 1.

Cluster analysis of cost- benefit items

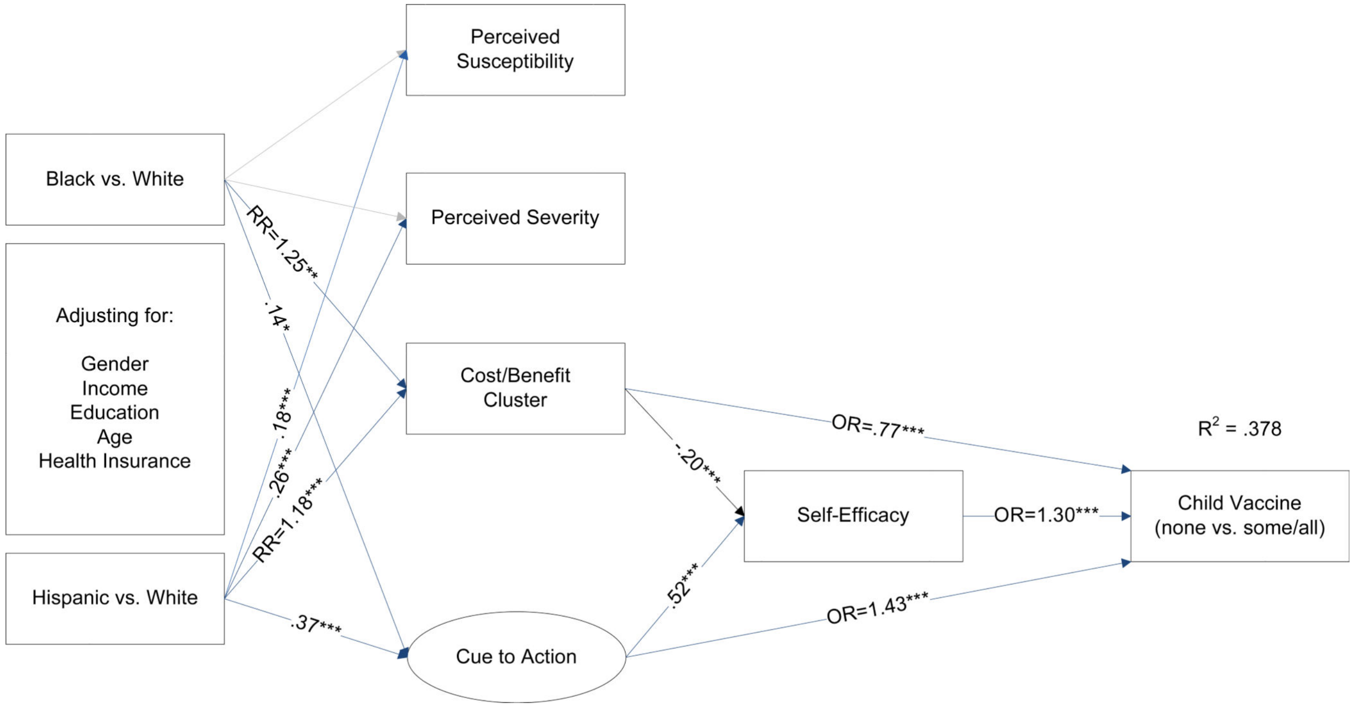

Figure 2.
Health Belief Model of Child Vaccination of H1N1 influenza

Table 1

HBM variables by race.

	White (N = 179)	Black (N = 174)	Hispanics (N = 320)	p	Cramer's V
Child Vaccination	32.6%	32.7%	43.0%	.027	.106
Education (some college or more)	74.3%	54.0%	25.3%	<.001	.418
Income (≥ $25,000)	90.5%	67.2%	64.7%	<.001	.247
Gender (male)	49.2%	42.0%	41.6%	.225	.067
Cost/Benefit cluster				<.001	.147
"Unconcerned"	43.0%	21.8%	23.4%		
"Vaccine-Averse"	23.5%	30.5%	35.9%		
"Worried"	33.5%	47.7%	40.6%		
					η^2
Age	40.2 (9.58)	42.3 (11.90)	37.5 (11.94)	<.001	.030
Perceived Susceptibility	2.14 (.71)	2.01 (.72)	2.48 (.77)	<.001	.074
Perceived Severity	1.98 (.70)	2.08 (.86)	2.70 (.98)	<.001	.129
Self-efficacy	2.49 (1.10)	2.67 (1.16)	3.18 (1.01)	<.001	.077
Cues to Action					
Concern	2.03 (.74)	2.10 (.88)	2.77 (.97)	<.001	.134
Obama Daughters	2.23 (.83)	2.52 (.97)	2.67 (.97)	<.001	.037
Friends/family want you to get	1.77 (.99)	2.09 (1.16)	2.64 (1.17)	<.001	.100
vaccine Importance of friends/family influence	−.23 (1.46)	.05 (1.56)	.85 (1.90)	<.001	.074

Table 2

Mean of the cost- benefit items by cluster (large effect, $\eta^2 > .14$).

	Unconcerned (N = 192)	Vaccine-Averse (N = 215)	Worried (N = 277)	η^2
Want to build natural immunities	1.63 (.77)	2.92 (.89)	2.96 (1.02)	.30
I am worried about side effects of the vaccine	1.59 (.75)	2.76 (.91)	3.66 (.63)	.55
I believe the vaccine is ineffective	1.35 (.61)	1.93 (.80)	2.99 (.87)	.44
I don’t want to miss work	1.33 (.68)	2.09 (1.09)	2.16 (1.18)	.11
I am concerned vaccine is not safe	1.37 (.56)	2.38 (.91)	3.64 (.64)	.63
I don’t want to spread the flu to others	2.09 (1.10)	3.56 (.68)	3.15 (1.02)	.27
Flu shots are effective (reverse coded)	2.16 (.80)	1.94 (.58)	2.47 (.81)	.08
Newly developed flu vaccine is safe (reverse coded)	2.23 (.75)	2.06 (.57)	2.77 (.76)	.17
Vaccine is riskier than disease itself	1.81 (.68)	1.94 (.65)	2.68 (.78)	.24
Most vaccines are not safe	1.82 (.67)	1.84 (.54)	2.50 (.75)	.19
Children are at greater risk from vaccine than disease	1.80 (.65)	1.94 (.65)	2.54 (.77)	.18
I will never get another flu shot because of previous negative experience	1.64 (.69)	1.61 (.69)	2.01 (.90)	.06
Mean	1.73 (.29)	2.25 (.24)	2.79 (.31)	.70