RESEARCH NOTE

REVISED Flu vaccine experiences and beliefs influence vaccination decision making more than knowledge [version 2; peer review: 1 approved]

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Abstract

Mass immunization programs have proven to be a primary preventive measure to limit the spread of many infectious diseases worldwide. Nurses are trained to be leaders in preventing potential global health problems, but they are one of the groups with the lowest rates of compliancy in receiving influenza vaccination. Since nursing faculty are important role models in molding attitudes and behaviors of future nurses (their students), we set out to explore the knowledge, attitudes and beliefs of the nursing faculty and their students regarding influenza vaccine decision making. Our study included an assessment of the knowledge, attitudes and beliefs (KABs) of the nursing faculty and students related to influenza vaccination and whether their KABs influence the decision to receive or decline the vaccination. A cross-sectional survey was conducted using an anonymous questionnaire and our study indicated that personal experiences—either positive or negative—had a direct effect on influenza vaccine decision-making. Additionally, personal experiences influenced beliefs, and beliefs were shown to influence decision-making regarding vaccination. While beliefs and personal experiences had a direct effect on vaccine decision-making, knowledge had only an indirect effect through beliefs. Our study demonstrated that even though nursing practice is supposed to be driven by evidence-based medical practices, personal practices by nurses may be more influenced by personal beliefs than medical knowledge.

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Any reports and responses or comments on the article can be found at the end of the article.

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REVISED Amendments from Version 1

This manuscript was revised to include the *Data Predicting Flu Vaccine Based on Experiences and Beliefs* dataset. Version 1 was published without it in error - the Publisher acknowledges responsibility for this.

See referee reports

Introduction

The influenza virus is a well-known infectious pathogen that causes annual epidemics and pandemics occurring at 10 to 50 year intervals¹. The spread of influenza could be ameliorated or diminished with an appropriate level of herd immunity^{2,3}, however, individual attitudes and beliefs are known to influence a healthcare worker's decision to receive an influenza vaccination⁴. Although nurses are trained to be leaders in preventing potential global health problems, research has shown that they are one of the patient-exposed groups with the lowest rates of compliance in receiving influenza vaccination⁵. Nursing faculty are important role models in molding attitudes and behaviors of future nurses (their students) but there is a paucity of research exploring the knowledge, attitudes, and beliefs of nursing faculty members and their students regarding influenza immunization and compliance practices.

An appropriate theoretical framework to examine nurses' decisions to receive the influenza vaccination was the Health Belief Model⁶. The framework was used due to its ability to predict health behaviors based on the theory that an individual's willingness to change behaviors and follow health recommendations is determined by personal beliefs or perceptions about a disease⁷. In the context of this study, the theoretical framework helped to explain the relationship of nursing faculty and students' perceptions and health behavior practices relative to influenza vaccination. This model has been cited in numerous studies related to the adoption of health care practices.

Bond and Nolan used the Health Belief Model to make sense of perceptions about disease severity and susceptibility risks related to the decision of parents to vaccinate their children⁸. The researchers indicated that the degree of familiarity with a disease (or lack of) and the characteristics related to the disease prompted preventive action. Similarly Toronto and Mullaney found that Registered Nurses (RNs) acknowledged fear of adverse reactions and uncertainty of efficacy of the current vaccine as primary barriers for being vaccinated⁹.

A cross sectional survey explored the rate of influenza immunizations among health-care workers in a Saudi hospital and identified reasons for electing or declining the flu immunization¹⁰, and the most common reason for not being vaccinated was a belief that the vaccine was not effective in preventing the disease. Hunt reported that nursing students participated in H1N1 and seasonal vaccination based on their risk perception and history of previous illness as motivators for immunization while those who abstained perceived the vaccine as not being necessary¹¹. Another cross sectional study of nursing students reported that only 43% had been vaccinated¹² because the student nurses did not believe the seriousness and facts regarding the H1N1 influenza outbreak.

Other researchers reported that nurses who had a better understanding of the risk of flu infection, who had knowledge of the disease, and who had been previously vaccinated were found to be more inclined to be vaccinated yearly¹³.

A cross-sectional mail survey revealed that the most common reason for being vaccinated was the belief of self-protection and the most common reason for not being vaccinated was concern about adverse reactions¹⁴. Similarly, in the United Kingdom, general practitioners and practice nurses found that confidence in the efficacy of the vaccine along with the conviction of the severity of the influenza were predictors to the acceptance of the vaccine¹⁵.

In an urban community teaching medical center, health care workers were surveyed on their participation in influenza vaccination¹⁶. The main study findings were that (a) a higher knowledge score of influenza, and (b) the belief that the vaccine was to protect patients, were both correlated with increased health-care worker vaccination rates. Group identification, professional responsibility and patient protection were also identified in another study¹⁷. The researchers identified in their study of 531 nurses in Switzerland that rejection of the flu vaccine occurred secondary to knowledge of the flu and the vaccine. Yet, in another study, only 64% of the 513 nurses surveyed intended to receive the influenza vaccination despite being exposed to educational bulletins and receiving information about influenza severity¹⁸.

By using the Health Belief Model to assess the knowledge, attitudes and beliefs (KABs) of the nursing faculty, students and public relative to influenza vaccination, we have concluded that experiences and beliefs influence vaccination decision making more than knowledge.

Methods

A cross-sectional survey was conducted using an anonymous questionnaire, and population samples of nursing faculty, nursing students and health-fair attendees were surveyed with questions related to their attitudes and beliefs surrounding yearly vaccination against seasonal influenza, and answers were documented in a paper format. The participants for this research project were recruited from three sources.

The first source was nursing faculty and students attending an annual research conference in March, 2011. The sponsoring organization, agreed to allow the recruitment of participants at this conference. A convenience sampling method was used to ask nursing faculty members, students, and nursing community members present at the conference to complete a survey related to their attitudes towards and beliefs surrounding yearly vaccination against seasonal influenza. An announcement was made at the opening of the conference explaining the purposes of this study and asking for participation by completing an anonymous survey. The survey instrument used was developed by researchers at the University of Michigan and modified, with permission from the authors, to address the research questions and population of interest for this study. The 24-item survey included demographic information and 22 closed-ended and 2 open-ended questions. The survey instrument was designed to measure knowledge, attitudes and beliefs (KABs) regarding the

seasonal influenza vaccine. Practices related to influenza vaccination, receipt and recommendations were also measured. A blank copy of the survey and an attached cover letter describing the study and requesting participation was distributed to all attendees during the opening session of the conference. The surveys were distributed during the opening session of the conference and took approximately 30 minutes to complete based on observation. A total of 1,000 surveys were distributed to nursing faculty and nursing students and 226 surveys were collected. The completed surveys were placed in sealed boxes by the responders.

A second source of sampling came from nursing students and community members attending a health fair in South Florida. Nursing students and community members were surveyed and data were collected and compiled for statistical analysis.

Community members not attending the health-fair were also surveyed and all documented data were collected and compiled for statistical analysis. Community members were chosen randomly in order to provide a comparison of medically educated professionals—nursing and faculty—to the general public.

The conceptual framework for the statistical analysis was classical test theory¹⁹. The disease detection model was used to evaluate the predictive success of the model, and logistic regression was the statistical method used to estimate the probability of receiving the vaccine, based on predictors (knowledge, beliefs and the influence of personal experiences). Logistic regression was better suited than linear regression because the dependent variable is dichotomous.

A logistic regression model was evaluated in three steps. First, the extent to which the model fits the observed data was evaluated. Next, the statistical significance and effect size of individual predictors was evaluated. Since the scales for the knowledge index and the beliefs index have no natural interpretation like weight or temperature scales, the variables were standardized in order to make the scale of the variables more comparable. A standardized variable is transformed so its mean is zero and its standard deviation is one regardless of the units in which it was measured. In the third step, a classification table was generated that compares predicted outcomes to observed outcomes. Sensitivity and selectivity were calculated from the classification table.

Results

The descriptive statistics for the study are summarized in Table 1. 29 nursing faculty, 197 nursing students and 152 community members residing in Broward and Miami-Dade counties in South Florida represented the study with ages ranging from 19 to over 65 with White non-Hispanics representing only 25% of the surveyed population. 37% described their ethnicity as Hispanic and 17% described their ethnicity as Black. The largest age group at 42% was 19–29 year olds and 60% of the total population was 40 years and younger.

169 individuals received the vaccine and 209 did not. Based on a crosstabulation analysis, the proportion of nursing faculty (62%) receiving the vaccine was not significantly greater than the proportion of community members (49%) receiving the vaccine, $X^2=1.746$, $p=0.19$; however, the faculty proportion was significantly greater than the proportion of nursing students (39%) receiving the vaccine,

Table 1. Descriptive statistics of nursing faculty, nursing students and community members in Broward and Miami-Dade counties of South Florida.

		Count	Percent
Cohort	Nursing Faculty	29	8%
	Nursing Student	197	52%
	Community Member	152	40%
	Total	378	100%
Age	19–29 years	158	42%
	30–40 years	68	18%
	41–51 years	52	14%
	52–64 years	60	16%
	65 years or older	39	10%
	Total	377	100%
Ethnicity	Hispanic	138	37%
	White non-Hispanic	94	25%
	Black	65	17%
	Other	62	16%
	No Response	19	5%
	Total	378	100%

$X^2=5.480$, $p=0.02$. Note that the achieved power of the analysis was only .63 due to the small number of nursing faculty in the sample.

According to the health benefits model, a person's decision to participate in influenza vaccination is influenced by knowledge, beliefs and personal experiences⁶. As measured by Cronbach's alpha, the reliability of the beliefs index was good, $\alpha=0.82$, but the reliability of the knowledge index was poor, $\alpha=0.52$. Furthermore, the knowledge index was highly correlated with the beliefs index, $r=0.54$. The poor reliability of the knowledge index reduced its power in the analysis. The collinearity with beliefs and the low power made it less likely that the knowledge index would be a statistically significant predictor of receiving the flu vaccine.

Logistic regression was conducted to determine the extent to which the independent variables (influential personal experiences, vaccine beliefs index, and vaccine knowledge index) were predictors of receiving the flu vaccine. Personal positive or negative experiences were dichotomous depending on whether the respondent reported being influenced by positive or negative experiences. The knowledge scale had six items and the belief scale had four items. The belief and knowledge indexes were based on the sum of items on a 5-point Likert agreement scale. Data screening identified no outliers. Model fit statistics revealed that the model fitted the data since the Hosmer-Lemeshow Goodness-of-Fit test was not significant ($-2 \text{ Log Likelihood} = 371.427$ and Hosmer-Lemeshow Goodness-of-Fit = 9.646, $p=0.29$). The Omnibus Test of Model Coefficients showed that the generated model was significantly different from the constant-only model, $X^2(4) = 136$, $p<0.001$. In other words, compared to the prediction that everyone does not receive the vaccine (the most frequent outcome), the predictors improved the prediction. Wald statistics indicated that the knowledge index was not

a significant predictor of the decision to vaccinate, Wald = 0.075, $p=0.78$. Consequently, the knowledge index was dropped as a predictor in a revised, more parsimonious model.

For the revised model, (excluding knowledge index), the proportion correctly predicted went from 55.3% with the constant only model to 77.0%. The specificity (probability of true negative) is 80%, 95% CI [74%, 85%] and the sensitivity (probability of true positive) is 73%, 95% CI [66%, 80%], see **Figure 1**. Note in **Figure 1** the left bar represents all respondents who actually received the vaccine and the right bar represents all who did not. The shading of the bars indicates whether the respondent was predicted to receive the vaccine (dark shading) or was predicted not to receive the vaccine (light shading). Regression coefficients are presented in **Table 2**. Wald statistics indicated that influential personal experiences and the beliefs index significantly predict receiving the flu vaccination. The odds ratio for influential positive experiences, OR = 4.49, 95% CI [2.71, 7.45], indicated a moderate effect size while the odds ratio for influential negative experiences, OR = 0.381, 95% CI [0.163, 0.892], indicated a smaller but still moderate effect size. The odds ratio for the beliefs index standardized, OR = 2.86, 95% CI [2.08, 3.94], indicated a moderate effect size similar to the effect size for influential negative experiences.

Figure 1. Classification success for personal experiences and beliefs predicting receiving the flu vaccine.

Table 2. Logistic regression analysis summary for predictors of receiving flu vaccination.

Variables	Coefficient	Standard Error of Coefficient	Wald	Odds Ratio
Positive experiences	1.502	0.258	33.858	4.49
Negative experiences	-0.965	0.434	4.941	0.38
Beliefs index standardized	1.052	0.162	42.047	2.86
Constant	-0.866	0.175	24.450	

Note. -2 Log Likelihood = 377.960, $\chi^2(3) = 141.818$, $p < 0.001$. ($N = 378$).

Respondents were nearly three times more likely to report they were influenced by positive experiences ($n=153$) as opposed to negative experiences ($n=52$).

A 2×2 factorial ANOVA was conducted to evaluate the relationship between influential personal experiences with the flu vaccine and beliefs about receiving the flu vaccine. The independent variables, positive experiences and negative experiences, were dichotomous. The dependent variable was the standardized beliefs index. A preliminary analysis evaluating the homogeneity of variances assumption, using Levene's test, indicated no significant difference in variances among groups, $F(3,374) = 1.74$, $p = 0.16$. The ANCOVA indicated no significant interaction between positive experiences and negative experiences, $F(1,374) = 0.060$, $p = 0.81$. There was a significant effect for influential positive experiences, $F(1,375) = 51.2$, $p < 0.001$, and a significant effect for influential negative experiences, $F(1,375) = 8.51$, $p = 0.004$, see **Table 3**. Having an influential positive experience improves the belief index by two thirds of a standard deviation, $d = 0.68$, 95% CI (0.49, 0.86), indicating a large effect size. Having an influential negative experience reduces the belief index by approximately one third of a standard deviation, $d = 0.40$, 95% CI [0.13, 0.66], indicating a moderate effect size.

The results of this study were combined to establish a working model (**Figure 2**) that illustrated the variables and their influence on vaccine

Table 3. One-way analysis of variance summary for effect of personal experiences on the decision to receive the flu vaccine.

Source	df	SS	MS	F	η^2
Positive experiences***	1	40.433	40.433	51.22	.12
Negative experiences**	1	6.716	6.716	8.51	.02
Error	375	296.040	.789		
Total	378	352.268			

** $p < 0.01$ *** $p < 0.001$

Note. df=degrees of freedom, SS=sum of squares, MS=mean square, F=value of F-statistic, and η^2 =eta squared

Figure 2. Flu vaccine model that indicates that personal experiences can directly influence vaccination decisions and personal experiences also influence beliefs.

decision making. Our study indicated that personal experiences—either positive or negative—had a direct effect on whether or not a person received the influenza vaccination. Additionally, personal experiences influenced beliefs, and beliefs were shown to influence decision making regarding vaccination. Knowledge did not have a direct effect on the decision making process. However, knowledge is correlated with beliefs, $r=.58$, $p<.001$. The research design does not identify whether beliefs influence knowledge or knowledge influences beliefs.

Data Predicting Flu Vaccine Based on Experiences and Beliefs

2 Data Files

<http://dx.doi.org/10.6084/m9.figshare.1098705>

Discussion

According to our study and model, knowledge about the influenza vaccine was not a reliable predictor as to whether or not a person would actually participate in vaccination. In fact, it is likely that knowledge about influenza vaccination is mentally processed through a person's belief system as a heuristic filter as indicated by other reports²⁰. It is well-known that heuristics (mental short cuts or rules of thumb) can lead to erroneous decision-making even to the point where a person may later be embarrassed by his or her decision²¹. Many of the decisions to vaccinate, therefore, are not based on evidence-based science.

In a 2007 study, "Gaps between knowing and doing" a systematic review of English language studies involving human subjects, the researchers found that there was a significant gap between routine clinical practices and scientifically established clinical practice guidelines²². That finding was consistent with our study where we identified that beliefs influence vaccine decision making (Figure 2).

Personal experiences, on the other hand, were significant in our study to the point where a positive or negative experience influenced their decision to receive the vaccine, and the personal experiences also affected their belief. In the sample 95 respondents reported being influenced by a positive experience and 13 reported being influenced by a negative experience. A positive experience increased the odds of receiving the flu vaccination by 4.5 times, whereas, a negative experience decreased the odds of receiving the flu vaccine by only 0.38 times. It is possible that the positive experience confirmed the person's knowledge that receiving the flu shot was important and helped alleviate any hesitation of receiving the flu shot due a preconceived fear of a negative outcome. Accordingly, it would be pertinent for the promotion of vaccination to focus only on positive personal experiences and spend less time on alleviating the fear of negative outcomes, those that are real or that are perceived as real. A focus group study on Human papillomavirus (HPV) vaccination among girls in Australia identified that social capital, peer acceptance and trust in authority were not only related to the likelihood of receiving the vaccine but could be influenced through social marketing campaigns²³. Additionally, it is

well known in marketing that an emphasis on timing is relevant to positive outcomes²⁴.

The limitations of our study include a small sample size for the faculty and one that is localized to a nursing school in South Florida. The population of South Florida is one of cultural diversity and is quite distinct from other regions of the United States. The participants in our study reflected that distinctness with 54% of the respondents describing their ethnicity as either Black or Hispanic with another 16% describing themselves as "other". Only 25% indicated that their ethnic background was White. The ethnic composition of the study is significant when understanding that a person's belief is influenced by "repeated articulations" of life and culture²⁵. Investigating cultural contributions to our model is an area for future research.

Most campaigns to increase immunization rates among nurses are knowledge-based, but the lack of focus on attitudes and beliefs could contribute to the failure of such campaigns. The nursing practice is increasingly being driven by medical evidence but personal practices by those in the profession may not follow the same path. Utilizing a multidirectional approach addressing other domains of learning to influence vaccine decision-making may be more effective than traditional knowledge-based programs. Perhaps, an application component—such as the measuring of antibody titers—could be implemented in vaccination training to complement the knowledge component. A rise in antibody titers (levels) demonstrates the effectiveness of a vaccine, and the measurement of a rise in levels of antibodies would provide positive feedback to the trainee.

Relative to our study in South Florida, we would recommend a social marketing campaign targeting the public, a campaign organized by the nursing faculty and one that would involve nursing students who would encounter positive experiences and a lack of negative experiences. The campaign would also focus on community support and trust among respected leaders in the community—including parents, healthcare workers, clergy, *etc*—with a positive emphasis on a call to action in a timely manner. An emphasis on positive experiences could have a dual objective: an increase in vaccination rates and a change in beliefs.

Data availability

figshare: Data Predicting Flu Vaccine Based on Experiences and Beliefs, <http://dx.doi.org/10.6084/m9.figshare.1098705>²⁶

Author contributions

DW, DM, FM, LS, VH and JC collaborated and conceptualized the study. DW, FM, LS and VH surveyed and collected data from the nursing school, and JC surveyed and collected data from the public. DM statistically analyzed the data and JC wrote the article.

Competing interests

No conflicting interests were disclosed.

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An interesting finding that even nurses are guided more by personal beliefs than medical knowledge in their personal health practices.

- Influenza virus contributes to morbidity and mortality via annual epidemics, and pandemics every 10-50 years.
- These epidemics can be moderated by mass vaccination and herd immunity.
- Nursing faculty are role models for their students, who are future nurses, as well as their patients.
- The authors used a cross-sectional survey based on the Health Belief Model to assess knowledge, attitudes and beliefs (KABs) on annual influenza vaccination of nursing faculty members, nursing students, and members of the public.
- The sample was recruited from three sources: 1) convenience sampling method of nursing faculty and students attending an annual research conference (226 surveys collected of 1000 distributed; 23%); 2) nursing students and faculty attending a health fair; 3) Community members chosen randomly.
- Logistic regression was performed to assess the extent to which influential personal experiences, vaccine beliefs index and vaccine knowledge index were predictive of flu vaccine receipt.
- Interestingly, positive experiences had a greater effect on influencing behavior than

negative experiences.

- Response rate was low (23%) or not reported, and there was a small sample size: 29 nursing faculty, 197 nursing students, 152 community members. Therefore, the power of the analysis was low (0.63). It was also not clear how the community members were recruited.
- Due to the small sample size, and selection bias issues in the convenience sampling method, the generalizability of the study is limited and should be interpreted with caution. It is also not clear how the recommendations in the Discussion (e.g. social marketing campaign) were decided upon, as the effectiveness of such an approach is not clear, especially in comparison to other potential approaches.
- Overall, the underlying premise and theory is interesting and merits further study.

Competing Interests: No competing interests were disclosed.

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