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Attitudes toward vaccination in the event of an influenza pandemic and the characteristics of those likely to decline vaccination

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Attitudes toward vaccination in the event of an influenza pandemic and the characteristics of those likely to decline vaccination

Abstract of a thesis presented
to the Faculty of the University at Albany,
State University of New York in partial fulfillment
of the requirements for the degree of
Master of Science

School of Public Health
Department of Epidemiology and Biostatistics

Michelle Cummings

2011
ABSTRACT

BACKGROUND: In addition to conscientious hygiene and limiting exposure, vaccination is an important public health intervention to limit influenza infection among high risk groups. However, limited research has been conducted among the general population to measure vaccine acceptance against a pandemic strain of influenza, and which specific concerns might hinder acceptance. Because this study was conducted prior to the H1N1 pandemic of 2009, it serves as a baseline measure of the population’s perspectives on influenza vaccination. Subsequent studies will shed light on the degree to which a pandemic heightens acceptance.

PURPOSE: Assess individual’s willingness to be vaccinated against pandemic influenza if such a vaccine were to become available and to identify specific participant characteristics which may influence a person’s unwillingness to be vaccinated.

METHODS: We conducted a telephone-based health survey of 456 Albany county residents using a modified version of Respondent-Driven Sampling (RDS). The survey covered several domains, including demographic characteristics, vaccination history, vaccination intention in the event of a pandemic, and rationale for such intention. Univariate, bivariate and multivariate regression analyses were conducted using SAS.
RESULTS: About 10% of participants claimed they would refuse influenza vaccine if one became available during the next pandemic. The best predictor for likelihood of declining vaccination was lack of routine influenza vaccination the previous year. Other characteristics found to have bivariate association with vaccine refusal include non-white race, age <65, less than 13 years of education, self-reported health status less than “very good” and last routine check-up more than 24 months prior. Among those who were not vaccinated for seasonal influenza in the past year, significant predictors of vaccine refusal were non-white race and lower education. Self-reported rationale for refusal included: “didn’t think I would need it” or “I don’t get vaccines” (50.9%), followed by concern about side effects, e.g. “seasonal influenza shot can make you sick” (22.6%).

CONCLUSION: Although public health messages emphasize the high risk groups by age and health status, these two factors were not associated with a respondent’s decision regarding vaccination in our study due primarily to vaccine history. We confirmed that beliefs and behaviors are strongly tied to the vaccination decision, and that setting up a habit of vaccination (or refusal) is key to determining likelihood of future vaccination, such as in a pandemic. While 90% of our respondents claimed they would be vaccinated for pandemic influenza, NYS only vaccinated 10-20% of residents 18 years of age and older against the H1N1 pandemic in 2009. The disconnect between our participants’ hypothetical response and true vaccine coverage may reflect mild symptoms and delays in vaccine production that occurred during the 2009 pandemic.
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1. BACKGROUND

1.1. Influenza Virus

1.1.1. Significance

The influenza virus causes a contagious respiratory illness affecting 10-20% of the global population each year\(^1\). Those most at risk of becoming infected and developing complications to seasonal influenza are people 65 years of age or older, infants, and persons who are immunocompromised. In addition to conscientious hand washing and limiting exposure, one way to reduce the likelihood of influenza infection is vaccination. The strategy of developing herd immunity is particularly important for protecting those who will not develop sufficient antibody response to the vaccine, such as the elderly or immunocompromised. Despite widespread public health education and intervention to prevent infection, more people die from this virus than any other vaccine-preventable disease in the United States\(^2\).

Influenza also presents a host of morbidity-related factors. Every year in the United States, the indirect effects of seasonal influenza infection take a huge financial toll on society. For example, absenteeism costs close to $77 billion and direct medical costs can reach or exceed $10 billion, yet with adequate vaccination coverage these costs could be significantly reduced\(^3\).

Every few decades, a novel, easily transmissible influenza virus is introduced to the human population. The result is a pandemic, or worldwide outbreak of influenza which is capable of causing millions of deaths in addition to widespread social and economic disaster. Estimates of the direct and indirect costs of a pandemic suggest an economic impact as high as $166 billion, most of which can be attributed to mortality\(^4\).
Thus, preventing infection is essential for limiting extensive social and economic disruption during a pandemic. In addition to sensible precautions against exposure (such as voluntary isolation among the ill), widespread vaccination against a novel virus may limit morbidity and mortality among vulnerable groups. On the other hand, poor hygiene, poor health status, influenza vaccination refusal and drug resistance are viewed as major barriers to influenza prevention\(^5\).

1.1.2. Viral Structure and Mutation

The influenza virus belongs to the *Orthomyxoviridae* family, which is comprised of enveloped single stranded RNA viruses with a diameter ranging from 80-120 nanometers. The genome consists of eight different gene segments, each coding for different viral proteins\(^6\). Two important surface glycoproteins of the influenza virus are hemagglutinin (H) and neuraminidase (N) that project from the viral envelope and aid in attachment to the host cells during infection and during release of the progeny after replication. It is these features of the virus that become targeted by the host’s immune system\(^7\).

The influenza virus can be classified into three types at the genus level: Influenzavirus A, Influenzavirus B, and Influenzavirus C\(^8\). The different subtypes of influenza type A are classified according to the 16 possible H proteins and 9 possible N proteins found on the surface of the virus. For example, a virus with the H1 and N1 surface glycoproteins is called H1N1.

Through a process called antigenic drift, small changes in the H and N surface proteins are continuously occurring in both type A and B viruses. This enables the virus
to avoid recognition by the host immune system\textsuperscript{9}. Since new viral strains form within each subtype frequently, a new influenza vaccine needs to be manufactured each season.

Large changes, such as the complete replacement of either the H or N protein, do not happen as often as the smaller mutations. They do occasionally occur in type A viruses and can result in a new viral subtype to which there is no immunity\textsuperscript{10}. This process of antigenic shift usually occurs through reassortment with another influenza virus, setting the stage for a pandemic to occur.

Influenza viruses are almost universally species-specific, which means that the H surface protein preferentially binds receptors of only one species preventing the virus from infecting multiple hosts. However, pigs can be infected by multiple influenza viruses simultaneously because they have avian, human and swine receptors. Because the genome of the virus is in multiple segments, such an environment is favorable for reassortment if two viruses are coinfecting one host. For example, if an avian virus in a coinfection were to acquire the potential to bind human receptors, the reassortment could result in a pandemic since human immune systems would have no prior immunity to this avian virus.

\subsection*{1.1.3. Human Transmission}

The most common mode of transmission among humans is through the inhalation of respiratory droplets expelled from the coughs or sneezes of infected persons\textsuperscript{11}. The influenza virus is short-lived on surfaces, but touching a contaminated surface and then touching the nose, mouth or eyes is another possible mode of transmission.

Interspecies transmission is uncommon but does occur and can be devastating. The outbreak of the avian influenza virus H5N1 is a good example of the potentially...
devastating effect of interspecies transmission – because the virus was never present among humans, reassortment to enable human transmission conferred a high mortality rate. If the virus then gained the ability to be easily transmitted between humans, a severe pandemic would most likely have occurred. Such a pandemic is still possible and H5N1 is carefully monitored by the World Health Organization (WHO).

1.2. Past Influenza Pandemics

1.2.1. Epidemics vs. Pandemics

An influenza epidemic occurs when the number of influenza cases in a given region substantially increases above endemic levels. For example, during the colder months in each hemisphere the predicted outbreaks of influenza are considered epidemics because the number of cases is elevated compared to the warmer months of the year.

A pandemic is a widespread epidemic that is typically caused by a novel influenza virus that has the potential to spread easily and rapidly among humans. Such a pandemic doesn’t necessarily follow any seasonal pattern. Predicting when a pandemic will occur is nearly impossible, but trends suggest that at least one happens every forty years. One of the earliest pandemics documented occurred in 1510 in Africa and followed the trade routes into Europe. Pandemics continued to occur throughout the 18th, 19th and 20th centuries. The 20th century had three documented pandemics (1918-19, 1957, 1968), and this century has experienced one in 2009.

1.2.2. Spanish Influenza of 1918

The Spanish Flu of 1918 (H1N1) was the worst pandemic in recorded history. It has been estimated that over one-third of the global population was infected and up to 100 million people died as a result of this influenza virus. Unlike seasonal influenza
epidemics, young adults were the primary victims of the Spanish Flu, with almost half of all the deaths occurring among persons between 20 – 40 years of age\textsuperscript{17}.

The first of three waves of the pandemic began in the spring of 1918 and the mortality rate was relatively moderate compared to the second wave that occurred the following autumn\textsuperscript{16}. During the second wave, case fatality rates varied based on location, but some estimate an overall rate of 2.5% which greatly exceeds the 0.1% of contemporary seasonal epidemics\textsuperscript{18}. By 1920, the virus settled into a seasonal pattern until the next pandemic surfaced in 1957, which marked the disappearance of the H1N1 virus for 20 years. Today, the 1918 H1N1 virus still circulates in humans and in swine and continues to contribute to newly emerging epidemics.

\textbf{1.2.3. Asian Influenza of 1957 and Hong Kong Influenza of 1968}

The Asian Flu of 1957 (H2N2) and the Hong Kong Flu of 1968 (H3N2) were possible descendents of the H1N1 pandemic virus of 1918\textsuperscript{18}. Both viruses resulted from a reassortment between human and avian strains originating in China\textsuperscript{19}. Similar to seasonal epidemics, mortality mainly occurred among the very young and the elderly.

\textbf{1.2.4. Current Influenza Pandemic – H1N1}

On June 11, 2009 the World Health Organization declared an influenza virus of swine origin, H1N1, to be the cause of the first pandemic of the 21\textsuperscript{st} century\textsuperscript{20}. The virus was first reported in Mexico in April 2009 and by August 2010 it had spread rapidly to 214 countries, killing over 18,000 people\textsuperscript{21}. Most cases of H1N1 were mild, with a significantly higher number of young adults falling victim to infection, similar to the Spanish Flu of 1918. Serious illness and death were higher among children, pregnant women and the immunocompromised compared to seasonal influenza.
1.3. Prevention Measures

There are many preventative measures for influenza, including frequent hand washing, proper respiratory hygiene (i.e., covering mouth when coughing or sneezing) and vaccination. The first two strategies listed have been recommended for prevention of respiratory illnesses for many decades and have been shown to be reasonably effective in numerous settings, such as in hospitals and schools\textsuperscript{22,23}. Although these strategies are still highly recommended, vaccination has been shown to be the most effective method of preventing infection with the influenza virus as well as reducing the severity of the symptoms if infection does occur\textsuperscript{24}.

1.3.1. Seasonal Influenza Vaccination

Influenza vaccination induces immunity by triggering the development of antibodies against the virus which prevent the virus from attaching to and infecting host cells. The efficacy and effectiveness of the influenza vaccine is dependent upon how close the vaccine matches the viruses in circulation as well as the age and health status of the individual receiving the vaccine\textsuperscript{24}.

The vaccine contains the hemagglutinin antigen, which is the same antigen for the three subtypes of influenza that have been circulating globally for decades (Influenza A (H1N1), Influenza A (H3N2) and an influenza B virus), but due to the constant antigenic drift of the influenza A viruses, new strains emerge every year making it necessary to produce a new vaccine. The hemagglutinin on the surface of the influenza virus is primarily responsible for the initial infection of host cells, so it is immunity to this surface antigen that reduces the chances of a host becoming infected\textsuperscript{25}.
The production of the vaccine takes from 4 to 6 months to complete, and is typically initiated between January-March to prepare for influenza season. Distribution begins in August and continues throughout the flu season. Immunizations usually begin in October and continue until about March. The composition of the influenza vaccine is based on yearly virus surveillance data of the circulating strains by a network of National Influenza Centers and WHO laboratories across 83 countries. The Food and Drug Administration (FDA) makes a prediction regarding which viruses are going to be predominant in the upcoming flu season and the vaccine is created accordingly.

The influenza vaccine is manufactured through an egg-based technique and requires many steps. There are two different types of influenza vaccines available, both contain the same components, but elicit immunity in different ways. Trivalent inactivated influenza vaccine (TIV) is given intramuscularly and is made with noninfectious viruses that were heat killed, making the vaccine appropriate for most persons over the age of six months. The other type, a live attenuated influenza vaccine (LAIV), contains live virus so it is not recommended for people at high risk for influenza-related complications or contacts to high risk persons since there is a chance of developing mild flu symptoms. Only non-pregnant persons between the ages of two to 49 are approved for LAIV usage.

**1.3.2. Pandemic Influenza Vaccine**

Because a pandemic influenza virus is a novel virus that has not previously, or recently, circulated among humans, a seasonal influenza vaccine will not provide adequate immunity to protect against infection. Thus, high-risk populations who are recommended for vaccination should have both the seasonal vaccine as well as the
pandemic vaccine to ensure coverage. If both vaccines are TIV, they can be given at the same time.

Once a pandemic virus strain is isolated, vaccine production can begin and will follow the same requirements as the seasonal vaccine. The vaccine will be available 4 to 6 months after manufacturing begins. Advances in vaccine development to an adenovirus vector-mediated system will speed the manufacturing process in the future.

1.4. Purposes of the study

Assess individual’s willingness to be vaccinated against pandemic influenza if such a vaccine were to become available and identify specific participant characteristics which may influence a person’s unwillingness to be vaccinated.
2. METHODS

2.1. Sample Site

Located on the eastern border of New York State and approximately 135 miles north of New York City, Albany County is home to the state capital and the city of Albany. The county has a population of about 300,000 people\textsuperscript{28}, about 100,000 of whom live within the city limits. Covering 540 square miles, the county is geographically diverse encompassing urban, suburban and rural areas. The county contains a mix of 83\% White and 11\% Black, with 3\% reporting Hispanic ethnicity. The race/ethnic diversity occurs primarily in the city whereas suburbs and rural areas are predominately White. Within the city limits, approximately 28\% report Black race, 63\% White, and 6\% Hispanic. Median household income for Albany County is $43,000 which is substantially higher than the median household income for the city of Albany ($30,000).

2.2. Sampling Methods

The study employs cross-sectional design. Subjects were recruited using a modified version of Respondent-Driven Sampling (RDS). Respondent-Driven Sampling is a form of chain referral sampling but is unique in that it uses statistical adjustments to produce representative estimates of the target population\textsuperscript{29, 30, 31, 32}.

Like chain referral sampling, in an RDS study participants are responsible for recruitment of additional members of the sample population from within their social network, theoretically at random\textsuperscript{29, 31}. Thus each participant’s social network defines the sampling frame.
2.3. Recruitment

Recruitment took place from May 2007 through November 2008. Initial study participants or “seeds” were chosen based on geographic location within Albany County as well as demographic characteristics, such as age, gender and race/ethnicity. The seeds were selected from work or neighborhood acquaintances of the study staff or through visits to neighborhood gathering places (e.g. gas stations, hair salons).

2.4. Measures

Outcome of interest. The main outcome in the study was to measure the participant’s perceived desire to be vaccinated in the event of an influenza pandemic and why he/she would or would not choose to be vaccinated. The following question was asked: “A few times each century a worldwide influenza pandemic happens. Around 1918, the Spanish flu killed about 100 million people worldwide. In 1968 the Hong Kong flu killed about seven million people. No vaccines were available in the past, but when the next pandemic influenza happens, it is very likely a vaccine will become available. How likely is it that you will choose to get this vaccine? The following response options were then read out loud to the participant Very likely, somewhat likely or not at all likely?” Although the response option “unsure” was not read out loud, a response of “I’m not sure” was accepted and recorded as “unsure.” Each participant was then asked, “Why is it that you are [very likely, somewhat likely, not at all likely, unsure] to choose to get this vaccine?” This open-ended question design ensured that the data would capture a broad representation of all viewpoints. The responses were later categorized and coded.

Other factors. In addition, we collected demographic characteristics of the participants, data on general health status, and whether they received a seasonal influenza
shot in the past year. We also asked how long it has been since they had a routine check-up to determine if any of the above factors influenced the likelihood of getting the pandemic flu shot if one were to become available (Appendix B).

Age was measured by asking the participants their current age. If this question was uncomfortable to answer, a set of age ranges was provided for selection. Gender was only asked if it was not obvious by the sound of the participant’s voice and name. Hispanic ethnicity (yes/no) and race (White, Black or African American, Asian, Native Hawaiian or Other Pacific Islander, American Indian or Alaska Native or Other) were ascertained separately. Multiple responses to race were recorded when provided. To measure the level of education, the participants were asked to identify the highest level of education they had received (none, grades 1-8, grades 9-11, high school graduate or GED, 1-3 years of college or college graduate and higher).

The general health information was obtained using questions from the Behavioral Risk Factor Surveillance Survey (BRFSS). Information regarding the participant’s general health was measured by directly asking about perception of health status (excellent, very good, good, fair, poor). Access to medical care was based on the time since the participant saw a health care provider (within 1 year, 1 to 2 years, 2 – 5 years, over 5 years, or never).

Seasonal influenza vaccination history was captured with a question from the BRFSS (During the past 12 months, have you had a flu shot?). This was followed up by asking the participants why they decided to get the vaccine or not get the vaccine, which was asked as an open-ended question and later categorized.
2.5. Data Collection and Storage

Data from the health interviews were recorded on paper and kept in accordance with the Federal Privacy Act of 1974. The paper records were kept locked in an office, out of sight and reach of unauthorized persons. Personal identifiers were kept separate from the information to maintain confidentiality.

2.6. Data Management

All of the information from the study was entered into Epi Info (CDC, 2004). Every third record was re-entered to ensure data accuracy. After completion of data entry, the information was imported and analyzed in SAS (Version 9.1, SAS Institute, Cary, NC).

Responses to open-ended questions were reviewed for similar themes and grouped together in Microsoft Excel. The groups were later imported into SAS to be analyzed with the rest of the data.

For the purpose of this study, data analysis was restricted to include only participants who successfully provided an appropriate response to the questions pertinent to our outcome of interest. Persons who reported ‘unsure’ or refused to answer where not included in the analyses.

2.7. Univariate and Bivariate Analyses

Univariate analyses of the demographic characteristics of the study sample were performed using SAS (Univariate procedure and FREQ procedure). Bivariate analyses were conducted to compare the characteristics of the participants who reported they were not likely to seek vaccination in the event of the next pandemic to those participants who reported to be very likely or somewhat likely to be vaccinated. Prevalence ratios and 95%
confidence intervals were generated using SAS. Gender, age and race were then compared to the 2000 Decennial Census for Albany county\textsuperscript{28} to assess how representative our sample was of the source population.

2.8. Multivariate Analyses

Logistic analyses, Poisson regression and log binomial regression were performed using SAS (GENMOD procedure) in order to determine which method best represented the data and allowed for the most accurate calculation of our desired measure of effect, which was the prevalence ratio. Since the main outcome was not rare, the odds ratios calculated with logistic regression were not good estimators for prevalence ratios. Potential models with all predictors included and models with all potential predictors except vaccine history were assessed. Prevalence ratios and 95% confidence intervals were generated using SAS.
3. Results

3.1. Sample Demographics

Of the 589 people approached for the study, 17 (2.9%) were not eligible, 55 (9.3%) refused to participate and 48 (8.1%) were never reached. One (0.2%) person stopped participating before answering questions pertinent to this analysis, 3 (0.5%) refused to provide a response to the necessary questions, and 9 others were unsure how they felt, which was a response not included in the analysis. A total of 456 (79.7%) people successfully completed the survey and were included in the analyses.

Age of the sample population ranged from 18 to 91 years of age, with a mean of 49 years. Over half of the participants were between the ages of 35 and 64 (N = 266, 58.7%), female (N = 315, 69.1%) and White (N = 408, 89.9%) (Table 1). Sample demographics were comparable to the 2000 Decennial Census\textsuperscript{28}, except females were over-sampled (Table 2).

Most respondents had received a routine check-up by a doctor in the last two years (N = 419, 92.3%), and health status was generally very good to excellent (N = 332, 72.8%) (Table 1). Influenza vaccination history was divided, with about half reporting they did not get the seasonal influenza vaccine in the prior year (N = 235, 51.7%).

3.2. Bivariate Analyses

Overall, 43 participants (9.4%) stated they were not likely to seek vaccination during the next pandemic. The greatest predictor for being unlikely to get vaccinated was not having received the influenza vaccine in the past year (PR = 19.2, 95% CI: (4.70, 78.4)) (Table 3). Also predictive of unwillingness to be vaccinated was not having a health check-up in the past two years (PR = 2.33, 95% CI: (1.12, 4.84)).
Participants of non-White race were about three times as likely as their counterparts to respond negatively toward pandemic vaccination (PR = 3.13, 95% CI: 1.35, 7.23) (Table 3). The younger participants, in age groups 18 to 34 and 35 to 64 years old, were twice as likely as the elderly (65+ years old) to state they were unlikely to get the pandemic influenza vaccine. A second set of bivariate analyses were conducted to combine those reporting they would not get vaccinated with those who were unsure to determine if an ‘unsure’ response would provide different results; results were similar (Appendix C).

3.3. Multivariate analyses

Compared to Poisson regression, log binomial regression produced more stable estimates of the Deviance and Pearson chi square statistic. These two statistics were, in turn, closer in value to one another, and their ratio to the degrees of freedom was closer to 1.0. Thus, log binomial regression was selected for multivariate analysis. When all factors were considered for the full model, seasonal vaccination history was such a strong predictor of pandemic vaccination that other factors were not significantly influential. To determine which factors were important among those who were not vaccinated the previous year, the dataset was restricted to this group and variables were eliminated in a stepwise manner based on the significance of likelihood ratio tests. Pearson and Deviance goodness of fit statistics were used to assess the quality of fit for the final model.

Among those who did not get a vaccine for seasonal influenza in the prior year, lower education (PR = 1.85, 95% CI: 1.05, 3.26) and non-White race (PR = 2.08, 95% CI 1.16, 3.72) were significantly predictive of unwillingness to be vaccinated for pandemic
flu in our sample. The prevalence ratio for education was similar to that found in the bivariate analyses whereas the prevalence ratio for non-White race was much lower. Results from logistic, log binomial and Poisson regression are also provided for comparison (Table 5). The adjusted odds ratios overestimate the adjusted prevalence ratios and are shown only for comparison purposes.

Due to the small sample size no interactions were found to be statistically significant. Compared to the full model with all the factors present, the parameter estimates for education and race were not significantly different in the final model suggesting that no confounding from other factors originally included in the model occurred.

3.4. Explanations for responses

Out of the 43 participants who reported to be unlikely to seek vaccination, 41 (95.3%) provided a reason for their perspective. One person was unable to provide an explanation and one refused to elaborate. Because the question was open-ended, participants were able to give more than one answer creating a dataset of 53 responses. Overall, the most common explanation stated by respondents was that they felt they would not need the vaccine (N=14, 26.4%) followed by stating that they don’t normally get vaccines (N=13, 24.5%). Other common responses were concern about side effects, including the belief that the seasonal influenza shot can make you sick (N = 6, 11.3%) (Table 6).
4. Discussion

Our study of Albany county residents conducted between May 2007 and November 2008, prior to the start of the 2009-2010 H1N1 pandemic, found that about 10 percent reported it was unlikely they would seek vaccination during an influenza pandemic. The H1N1 vaccine became available to the public in October of 2009 and although a large majority of the participants in our study claimed they would accept a pandemic influenza vaccine, recent estimates have claimed that NYS as a whole only achieved 10-20% coverage for people 18 years of age and older. The mild nature of the pandemic and delays in the availability of the vaccine to the general public most likely contributed to the low coverage rate observed. Common misconceptions still exist surrounding influenza vaccination, minimizing the likelihood of vaccine acceptance should a pandemic necessitate an immediate response.

The greatest predictor of refusing a pandemic vaccine in our sample was the absence of recent seasonal influenza vaccination. These findings are well supported by the literature: multiple studies have demonstrated a strong link between annual influenza vaccination and future vaccination.

White race and higher education have been found highly correlated with obtaining vaccination. Consistent with prior research, this study found non-white race and lower education to be predictive of not getting vaccinated. Racial disparities continue to be documented in healthcare access and utilization studies. Even after controlling for other possible determining factors (perceived health, access to healthcare, and recommendation by primary doctor) whites are still significantly more likely than African Americans to receive the seasonal influenza vaccine. Due to the high correlation
between seasonal vaccination and vaccination for a pandemic, it is possible that the factors predictive of seasonable vaccination are similarly predictive for a pandemic vaccination.

Surprisingly, multivariate analysis results found age and health status were not significant predictors of self-reported vaccination likelihood. Other studies have found these factors to be important proxies for decisions regarding vaccine uptake. Small sample size, and the correlation of these factors with vaccine history, may be an important limitation in our study.

The most common explanation mentioned for not wanting a pandemic vaccine was lack of perceived need. These findings are supported by many other studies which have investigated reasons for not getting the seasonal influenza vaccine. Prior to The CDC’s Advisory Committee on Immunization Practices (ACIP) change in recommendations for 2010, healthy adults were excluded from those recommended for routine vaccination due to vaccine availability issues and the circulation of well-established influenza strains. This older policy could play a large role in establishing perceived risk levels surrounding influenza.

In addition to the recommendations that were in practice, refusing a pandemic vaccination because it wouldn’t be necessary or because they “don’t get vaccines” could also be related to how they interpreted their experience with the previous 2006-2007 influenza season, which was considered mild, and a decent match between the vaccine and the circulating viruses existed, limiting widespread transmission. According to the BRFSS, vaccination levels were significantly higher compared to the previous 2005-2006 influenza season, with approximately 72% of all adults age 65 and older being
vaccinated. Higher coverage levels and a mild season could temporarily mask the impact influenza can have on a population. This may lead to false assumptions regarding the potentially severe personal health implications an influenza pandemic can bring as well as the importance of vaccination. Good or bad experiences with influenza or the influenza vaccine, whether personal or anecdotal, are highly associated with future vaccine uptake.

There were several limitations to our study. The questions used to obtain the data for our outcome were unique to this study, and validity and reliability were not previously established. It is likely that the validity would be reasonable for a pandemic with serious morbidity. Clearly it is not valid for a pandemic with a virus that primarily produces more mild flu symptoms as occurred in 2009-2010. The entire survey was not designed specifically for this study, so other factors that have been found to be associated with vaccination rates such as existing marital status, health insurance, income, chronic diseases, and knowledge level regarding influenza and the influenza vaccine were not included in our survey. Inclusion of these factors could have provided more insight into the characteristics that may predispose people to refuse vaccination during a pandemic. Aside from variables not considered, our sample size may have been too small to identify other significant relationships as well. Lastly, RDS sampling is unique in its theoretic ability to produce a representative population estimate through statistical adjustments; however, this requires measurement of social connections and the application of sampling weights to adjust for lingering selection bias. While these indicators were measured, they were not used in this analysis. Thus our results may not be representative of the target population.
Changes in seasonal influenza vaccination may have an important, positive impact on accepting vaccination in future pandemics. History of influenza vaccination in the prior year remains the best predictor of likely future vaccination. Thus, continued efforts to reinforce the importance of universal influenza vaccination to protect against seasonal influenza may provide important behavioral conditioning for accepting the vaccination during the next pandemic.
5. Bibliography


Appendix A. RDS Health Interview Informed Consent Script

HEALTH INTERVIEW INFORMED CONSENT SCRIPT
HELLO, I’m calling from the University at Albany. ________ referred you to us as someone who may be willing to participate in a 10 minute research interview on health and health policies. My name is ____________.

There are two main purposes to the study. The first is to measure the general health status of Albany county residents and opinions about new health policies. The second is to try a new way of enrolling people into a health study.

We are only asking people to join the study if they are referred by a friend or family member.

The survey has questions on your general health, who you are such as your age, and your thoughts on health practices and recommendations. There are also some questions on types of equipment some people have in their home in case of an emergency.

Afterwards I will ask you to refer 2 other friends or family members to participate.

The survey will take about 15 minutes. Participation is voluntary.

There is minimal risk because some questions might make you feel uncomfortable. You don’t have to answer any question you don’t want to, and you can end the interview at any time.

Your name will be kept until we are done enrolling people to make sure that you are not called again. Afterwards your name will be discarded. All information obtained in this study will be used for research purposes only and is strictly confidential unless disclosure is required by law.

Now I want to give you some telephone numbers. If you have questions about the study you can call Dr. McNutt, at 518-402-0403.

If you have any questions about your rights as a research participant or if you have complaints about the study, you may call the University at Albany Office of Research Compliance at 518-437-4569 or orc@uamail.albany.edu.

Do you have any questions about the study?
1 NO
2 YES - RESPONDENT UNCLEAR - ASK HOW YOU CAN CLARIFY THE SITUATION FOR THE RESPONDENT

Do you agree to participate in this study?
1 YES
2 NO - ATTEMPT TO SET AN APPOINTMENT DATE AND TIME FOR FUTURE CALL
Appendix B. Demographics

Indicate sex of respondent. [Ask only if necessary.]
1. Male
2. Female

What is your age?

_____ CODE AGE IN YEARS
777. DON’T KNOW/NOT SURE
99. REFUSED

If Refused,

---------------------------------------------------------------------------------
I understand that you may not want to tell me your age. However older and
younger people have very different lifestyles and health conditions. So would
you mind telling which age group you fall into?
1. 18 - 23
2. 24 - 34
3. 35 - 44
4. 45 - 54
5. 55 - 64
6. 65 +
77. DON’T KNOW/NOT SURE
99. REFUSED

Which one or more of the following would you say is your race? Would you say: White,
Black or African American, Asian, Native Hawaiian or Other Pacific Islander, American
Indian or Alaska Native, or Other?

INTERVIEWER: Mark all that apply
1. White
2. Black or African American
3. Asian
4. Native Hawaiian or Other Pacific Islander
5. American Indian, Alaska Native
6. Other [specify]
77. DON’T KNOW/NOT SURE
99. REFUSED

What is the highest grade or year of school that you have completed?
INTERVIEWER: READ ONLY IF NECESSARY
1. Never attended school or only attended kindergarten
2. Grades 1 through 8 (Elementary)
3. Grades 9 through 11 (Some high school)
4. Grade 12 or GED (High school graduate)
5. College 1 year to 3 years (Some college or technical school)
6. College 4 years or more (College graduate)
77. DON'T KNOW/NOT SURE
99. REFUSED

Would you say that in general your health is excellent, very good, good, fair, or poor?
1. Excellent
2. Very good
3. Good
4. Fair
5. Poor
77. DON’T KNOW/NOT SURE
99. REFUSED

About how long has it been since you last visited a doctor for a routine checkup?
*Interviewer Note: A routine checkup is a general physical exam, not an exam for a specific injury, illness or condition. READ ONLY IF NECESSARY*
1. Within the past year (1 to 12 months ago)
2. Within the past 2 years (1 to 2 years ago)
3. Within the past 5 years (2 to 5 years ago)
4. 5 or more years ago
5. Never
77. DON’T KNOW/NOT SURE
99. REFUSED

During the past 12 months, have you had a flu shot?
1. YES
2. NO
77. DON’T KNOW/NOT SURE
99. REFUSED

The following question is on pandemic flu or pandemic influenza.

B3 A few times each century a worldwide influenza pandemic happens. Around 1918, the Spanish flu killed about 100 million people worldwide. In 1968, the Hong Kong flu killed about 7 million people. No vaccines were available in the past, but when the next pandemic influenza happens, it is very likely a vaccine will become available. How likely is it that you will choose to get this vaccine? Would you say...
1. Very likely
2. Somewhat likely
3. Not at all likely
77. DON’T KNOW/NOT SURE
99. REFUSED

B4. Why is it that you are [very likely, somewhat likely, not at all likely, unsure] to choose to get this vaccine?”
Appendix C. Associations between participant characteristics and unwillingness to seek vaccination if a pandemic influenza vaccine were available (Including participants who were unsure), Albany County, NY, 2007-2008a.

<table>
<thead>
<tr>
<th>Participant Characteristics</th>
<th>Likely/Somewhat (N = 413, 88.8%)</th>
<th>Not Likely/Unsure (N = 52, 11.2%)</th>
<th>Prevalence Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>286 (88.8%)</td>
<td>36 (11.2%)</td>
<td>Referent</td>
</tr>
<tr>
<td>Male</td>
<td>127 (88.8%)</td>
<td>16 (11.2%)</td>
<td>1.00 (0.57, 1.74)</td>
</tr>
<tr>
<td>Age Group (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 – 34</td>
<td>93 (87.7%)</td>
<td>13 (12.3%)</td>
<td>Referent</td>
</tr>
<tr>
<td>35 – 64</td>
<td>239 (87.8%)</td>
<td>33 (12.1%)</td>
<td>0.99 (0.54, 1.80)</td>
</tr>
<tr>
<td>65+</td>
<td>79 (94.1%)</td>
<td>5 (5.9%)</td>
<td>0.49 (0.18, 1.31)</td>
</tr>
<tr>
<td>Missing</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>377 (91.3%)</td>
<td>36 (8.7%)</td>
<td>Referent</td>
</tr>
<tr>
<td>Non-White</td>
<td>35 (70.0%)</td>
<td>15 (30.0%)</td>
<td>3.44 (2.03, 5.82)</td>
</tr>
<tr>
<td>Missing</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Education Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some college or higher</td>
<td>341 (90.7%)</td>
<td>35 (9.3%)</td>
<td>Referent</td>
</tr>
<tr>
<td>High school graduate or below</td>
<td>71 (80.7%)</td>
<td>17 (19.3%)</td>
<td>2.08 (1.22, 3.53)</td>
</tr>
<tr>
<td>Missing</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>125 (89.9%)</td>
<td>14 (10.1%)</td>
<td>Referent</td>
</tr>
<tr>
<td>Very good</td>
<td>180 (90.4%)</td>
<td>19 (9.6%)</td>
<td>0.95 (0.49, 1.83)</td>
</tr>
<tr>
<td>Good/Fair/ Poor</td>
<td>108 (85.0%)</td>
<td>19 (15.0%)</td>
<td>1.49 (0.77, 2.84)</td>
</tr>
<tr>
<td>Routine Check-up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within 2 years</td>
<td>383 (89.9%)</td>
<td>43 (10.1%)</td>
<td>Referent</td>
</tr>
<tr>
<td>Greater than 2 years ago</td>
<td>28 (77.8%)</td>
<td>8 (22.2%)</td>
<td>2.20 (1.12, 4.32)</td>
</tr>
<tr>
<td>Missing</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Received Seasonal Influenza Shot</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>218 (98.2%)</td>
<td>4 (1.8%)</td>
<td>Referent</td>
</tr>
<tr>
<td>No</td>
<td>194 (80.2%)</td>
<td>48 (19.8%)</td>
<td>11.00 (4.04, 30.03)</td>
</tr>
<tr>
<td>Missing</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Rounding may result in proportions slightly under or over 100 percent.
Table 1. Demographic characteristics of the study sample, Albany County, NY, 2007-2008.

<table>
<thead>
<tr>
<th>Participant Characteristics</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age Group (years)</strong></td>
<td></td>
</tr>
<tr>
<td>18 – 34</td>
<td>104 (23.0%)</td>
</tr>
<tr>
<td>35 – 64</td>
<td>266 (58.7%)</td>
</tr>
<tr>
<td>65+</td>
<td>83 (18.3%)</td>
</tr>
<tr>
<td>Missing</td>
<td>3</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>315 (69.1%)</td>
</tr>
<tr>
<td>Male</td>
<td>141 (30.9%)</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>408 (89.9%)</td>
</tr>
<tr>
<td>Black</td>
<td>21 ( 4.6%)</td>
</tr>
<tr>
<td>Other</td>
<td>25 ( 5.5%)</td>
</tr>
<tr>
<td>Missing</td>
<td>2</td>
</tr>
<tr>
<td><strong>Education Level</strong></td>
<td></td>
</tr>
<tr>
<td>Some college or higher</td>
<td>371 (81.5%)</td>
</tr>
<tr>
<td>High school graduate and below</td>
<td>84 (18.5%)</td>
</tr>
<tr>
<td>Missing</td>
<td>1</td>
</tr>
<tr>
<td><strong>Routine Check-up</strong></td>
<td></td>
</tr>
<tr>
<td>Within the past 2 years</td>
<td>419 (92.3%)</td>
</tr>
<tr>
<td>More than 2 years ago</td>
<td>35 ( 7.7%)</td>
</tr>
<tr>
<td>Missing</td>
<td>2</td>
</tr>
<tr>
<td><strong>Health Status</strong></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>135 (29.6%)</td>
</tr>
<tr>
<td>Very Good</td>
<td>197 (43.2%)</td>
</tr>
<tr>
<td>Good/Fair/ Poor</td>
<td>124 (27.2%)</td>
</tr>
<tr>
<td><strong>Received Seasonal Influenza Shot</strong></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>220 (48.3%)</td>
</tr>
<tr>
<td>No</td>
<td>235 (51.7%)</td>
</tr>
<tr>
<td>Missing</td>
<td>1</td>
</tr>
<tr>
<td><strong>Pandemic Vaccine</strong></td>
<td></td>
</tr>
<tr>
<td>Likely/Somewhat</td>
<td>413 (90.6%)</td>
</tr>
<tr>
<td>Not Likely</td>
<td>43 ( 9.4%)</td>
</tr>
</tbody>
</table>

*Rounding may result in proportions slightly under or over 100 percent.*
Table 2. Comparison of study participant characteristics to those of the 2000 Decennial Census for Albany County, NY.

<table>
<thead>
<tr>
<th>Participant Characteristics</th>
<th>Study Participants, 2007-2008</th>
<th>2000 U.S. Census</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>69.1</td>
<td>53.2</td>
</tr>
<tr>
<td>Male</td>
<td>30.9</td>
<td>46.8</td>
</tr>
<tr>
<td><strong>Age Group (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 – 34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>23.0</td>
<td>28.5</td>
</tr>
<tr>
<td>35 – 64</td>
<td>58.7</td>
<td>51.9</td>
</tr>
<tr>
<td>65 +</td>
<td>18.3</td>
<td>19.6</td>
</tr>
<tr>
<td>Missing</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Race&lt;sup&gt;b&lt;/sup&gt;</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>89.9</td>
<td>83.2</td>
</tr>
<tr>
<td>Non-White</td>
<td>10.1</td>
<td>16.8</td>
</tr>
<tr>
<td>Missing</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> The U.S. Census data are only available for persons 20 years of age and older.  
<sup>b</sup> U.S. Census reports race for all persons not only persons 18 years of and older.
Table 3. Associations between participant characteristics and unwillingness to seek vaccination if a pandemic influenza vaccine were to become available, Albany County, NY, 2007-2008a.

<table>
<thead>
<tr>
<th>Participant Characteristics</th>
<th>Likely/Somewhat (N = 413, 90.6%)</th>
<th>Not Likely (N = 43, 9.4%)</th>
<th>Prevalence Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Received Seasonal Influenza Shot</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>218 (99.1%)</td>
<td>2 (0.9%)</td>
<td>Referent</td>
</tr>
<tr>
<td>No</td>
<td>194 (82.6%)</td>
<td>41 (17.4%)</td>
<td>19.2 (4.70, 78.40)</td>
</tr>
<tr>
<td>Routine Check-up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within 2 years</td>
<td>383 (91.4%)</td>
<td>36 (8.6%)</td>
<td>Referent</td>
</tr>
<tr>
<td>Greater than 2 years ago</td>
<td>28 (80.0%)</td>
<td>7 (20.0%)</td>
<td>2.33 (1.12, 4.84)</td>
</tr>
<tr>
<td>Health Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>125 (92.6%)</td>
<td>10 (7.4%)</td>
<td>Referent</td>
</tr>
<tr>
<td>Very good</td>
<td>180 (91.4%)</td>
<td>17 (8.63%)</td>
<td>1.17 (0.55, 2.47)</td>
</tr>
<tr>
<td>Good/Fair/ Poor</td>
<td>108 (87.1%)</td>
<td>16 (12.9%)</td>
<td>1.74 (0.82, 3.69)</td>
</tr>
<tr>
<td>Education Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some college or higher</td>
<td>341 (91.9%)</td>
<td>30 (8.1%)</td>
<td>Referent</td>
</tr>
<tr>
<td>High school graduate or below</td>
<td>71 (84.5%)</td>
<td>13 (15.5%)</td>
<td>1.91 (1.04, 3.51)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>286 (90.8%)</td>
<td>29 (9.2%)</td>
<td>Referent</td>
</tr>
<tr>
<td>Male</td>
<td>127 (90.1%)</td>
<td>14 (9.9%)</td>
<td>1.10 (0.59, 1.98)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>377 (92.4%)</td>
<td>31 (7.6%)</td>
<td>Referent</td>
</tr>
<tr>
<td>Non-White</td>
<td>35 (76.1%)</td>
<td>11 (23.9%)</td>
<td>3.15 (1.70, 5.83)</td>
</tr>
<tr>
<td>Age Group (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 – 34</td>
<td>93 (89.4%)</td>
<td>11 (10.6%)</td>
<td>Referent</td>
</tr>
<tr>
<td>35 - 64</td>
<td>239 (89.9%)</td>
<td>27 (10.1%)</td>
<td>0.96 (0.49, 1.86)</td>
</tr>
<tr>
<td>65+</td>
<td>79 (95.2%)</td>
<td>4 (4.8%)</td>
<td>0.46 (0.15, 1.38)</td>
</tr>
</tbody>
</table>

*a Rounding may result in proportions slightly under or over 100 percent.*
Table 4. Pearson Chi Square and Deviance Estimates for log binomial, Poisson and logistic methods of analysis for the model in which having a high school education or lower and being of a non-White race are significantly predictive of unwillingness to be vaccinated for pandemic influenza, Albany County, NY, 2007-2008.

<table>
<thead>
<tr>
<th>Participant Characteristics</th>
<th>Log Linear Binomial Regression</th>
<th>Poisson Regression with a Sandwich Matrix</th>
<th>Logistic Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Value</td>
<td>Value/DF</td>
<td>Value</td>
</tr>
<tr>
<td>Deviance</td>
<td>206.913</td>
<td>0.896</td>
<td>134.384</td>
</tr>
<tr>
<td>Pearson Chi Square</td>
<td>230.257</td>
<td>0.997</td>
<td>190.282</td>
</tr>
</tbody>
</table>

*Sandwich matrix was used to adjust for possible overdispersion and to provide more robust estimators
Table 5. Comparison of log binomial, Poisson and logistic methods of analysis for the final model in which having a high school education or lower and being of a non-White race are significantly predictive of unwillingness to be vaccinated for pandemic influenza, Albany County, NY, 2007-2008.

<table>
<thead>
<tr>
<th>Participant Characteristics</th>
<th>Log- Binomial Regression</th>
<th>Poisson Regression with a Sandwich Matrix*</th>
<th>Logistic Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PR 95% CI</td>
<td>PR 95% CI</td>
<td>PR 95% CI</td>
</tr>
<tr>
<td>Non-White Race</td>
<td>2.08 1.16, 3.72</td>
<td>2.18 1.09, 4.36</td>
<td>2.87 1.24, 6.65</td>
</tr>
<tr>
<td>High School Graduate or Below</td>
<td>1.85 1.05, 3.26</td>
<td>1.94 1.00, 3.76</td>
<td>2.41 1.11, 5.26</td>
</tr>
</tbody>
</table>

PR = Prevalence Ratio  
CI = Confidence Interval  
*Sandwich matrix was used to adjust for possible overdispersion and to provide more robust estimators
Table 6. Participant reasons for being unlikely to be vaccinated during a future pandemic, Albany County, NY, 2007-2008.

<table>
<thead>
<tr>
<th>Explanation</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don't think I will need it</td>
<td>14</td>
</tr>
<tr>
<td>Don't get vaccines</td>
<td>13</td>
</tr>
<tr>
<td>Concerned about side effects</td>
<td>6</td>
</tr>
<tr>
<td>Seasonal influenza shot can make you sick</td>
<td>6</td>
</tr>
<tr>
<td>Religious beliefs</td>
<td>3</td>
</tr>
<tr>
<td>Leave it for those more in need</td>
<td>2</td>
</tr>
<tr>
<td>Don’t have enough information about it</td>
<td>2</td>
</tr>
<tr>
<td>I would be dead by then</td>
<td>1</td>
</tr>
<tr>
<td>Personal reasons</td>
<td>1</td>
</tr>
<tr>
<td>I probably wouldn’t know to get it</td>
<td>1</td>
</tr>
<tr>
<td>Allergic to eggs</td>
<td>1</td>
</tr>
<tr>
<td>Don’t like needles</td>
<td>1</td>
</tr>
<tr>
<td>Depends on the severity</td>
<td>1</td>
</tr>
<tr>
<td>Unsure</td>
<td>1</td>
</tr>
<tr>
<td>Refused</td>
<td>1</td>
</tr>
</tbody>
</table>