Vaccine Epidemiology and Decision-Making:

A Bryant Student Focus

The Honors Program

Senior Capstone Project

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April 2018

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Abstract

The Centers for Disease Control and Prevention estimate that influenza has resulted in between 9.2 and 35.6 million illnesses and between 12,000 and 56,000 deaths annually since 2010 (1). Annual influenza vaccination remains to be the most effective way in controlling the spread and symptom severity of influenza infections (1). Influenza infections are especially virulent on college campuses as a dense population of students interact in close quarters such as shared housing, bathrooms, dining halls, classrooms, and social activities (2). Despite influenza vaccinations being safe, effective, easily accessible to Bryant University students, and free of cost, many students choose not to receive an annual vaccination. A survey and interviews were conducted among Bryant University students to: determine the vaccination rate of students on campus; determine reasons why students did or did not decide to receive this season's flu vaccination; and analyze how the vaccination rates and decision-making of students affect the overall health of the Bryant University campus. Based on the survey data, only 25.15% of Bryant University students participating in the survey had received a vaccination this year, and only a small fraction of these individuals were vaccinated at the Health Services clinics. This incredibly low vaccination rate among the Bryant University student body has severe consequences for the students, University, healthcare system, and even the surrounding communities. This research discusses the importance of vaccination, impact of influenza on Bryant students' health, the reasons for the low vaccination rate on campus, and describes potential ways to enhance student participation in on-campus vaccination clinics.

Literature Review

Introduction. Seasonal influenza is a highly contagious respiratory illness caused by varying strains of the influenza virus. The varying influenza strains range in virulence and symptom severity. Mild cases include fever, cough, sore throat, and other upper respiratory complications, while in severe cases secondary contraction of bacterial pneumonia can lead to hospitalization or even death. The flu virus is primarily spread by airborne droplets of infected body fluids, such as saliva or mucus transmitted while coughing, sneezing, or talking. Flu can also be spread by direct contact with surfaces contaminated with the virus. (1). The average incubation period for influenza ranges from one to four days, while the typical infectious period occurs during incubation and up to seven days after symptoms develop. Anyone is prone to contracting the flu, although some portions of the population are more susceptible to developing serious flu-related complications or even death. Individuals aged sixty-five and older, individuals with chronic medical conditions (such as cancer, immunodeficiency, asthma, diabetes, or heart disease), pregnant women, and young children are at high risk for developing severe symptoms or even death (1).

During the 2018 flu season a total of 151 children have died from influenza complications, and the overall influenza hospitalization rate has reached a cumulative 105.3 people per 100,000 U.S. residents (1). This is a significant increase from last flu season's cumulative hospitalization rate of 4.1 people per 100,000 residents (3). This steep increase is in part due to this season's predominant strain, influenza A-H3N2, which is an especially virulent strain with harsher effects on the respiratory system. Influenza-like illness activity levels during the 2017-2018 season have been the highest observed in the US since the 2009 pandemic. The 2009 H1N1 pandemic resulted in a cumulative hospitalization rate of 29.3 people per 100,000 U.S. residents and was stated to be a global health crisis by the World Health Organization (1). According to estimates published in December 2017, between 291,000 and 649,000 deaths per year occur worldwide from seasonal influenza and influenza-related complications (4).

Influenza virus components and mechanism. All strains of the influenza A virus are comprised of several key components vital to infecting host cells. These viral components

include segmented negative-sense, single-stranded RNA genomes, RNA polymerase of viral origin, a membrane envelope, and surface binding proteins hemagglutinin (H) and neuraminidase (N) (5). Genetic sequencing has confirmed that each strain of the flu virus shares a common genetic ancestor within their virus type, but diversity in strains has occurred from the exchange of viral RNA segments between viruses. The Influenza A virus is characterized by the subtype of their H and N surface glycoproteins. Hemagglutinin serves to bind sialic acid on the surface of host erythrocytes and upper respiratory tract epithelial cells (6). Binding between the virus and host cell enables the engulfment of the virus into the cell through endocytosis. Once inside the cell, transfer of viral RNA into the host cell can occur due to a conformational change occurring in the H receptor of the virus. The differing pH within the host cell environment reorients the virus membrane and H receptor, causing shifts in the viral membrane. These conformational changes allow the viral RNA to release from the virus into the host cell (6).

Binding of the virus to ciliated epithelial cells in the respiratory tract also enables the destruction of these cells by the virus; this can make the infected individual more susceptible to a secondary infection such as pneumonia. When inside the host cell, the viral RNA is first copied and then translated into viral proteins, which are then assembled into virus particles within the host cell. The assembled viruses then escape the host cell through budding, where neuraminidase allows the budding viruses to be released from the host cell membrane (6).

Many viral subtypes exist due to the variety in H and N surface proteins present, otherwise referred to as antigens. Sixteen H subtypes and nine N subtypes can be combined in a variety of ways to form different influenza strains. The recombination of differing hemagglutinin and neuraminidase subtypes is a result of antigenic shift or drift. Antigenic shift is a major and abrupt change in the virus' genes resulting in changed surface glycoproteins. Antigenic shift typically occurs in and emerges from the virus replicating and genetically mutating in an animal population, and the resulting virus is extremely different from the same subtype that exists in the human population. Antigenic drift describes the small changes in the genes of the virus that accumulate over time, resulting in viral strains that are closely related and relatively similar. When antigenic shift or drift

occur and the virus infects the body, the immune system may not be able to recognize the newly mutated viral antigens. This results in an infection and a slower, less effective immune response against the infective virus. Pandemic influenza virus strains arise when antigenic shift generates a virus to which a population is susceptible and immunologically naïve (5).

About the Influenza A-H3N2 vaccine. The flu vaccine is effective when its antigenic components are similar to those of the actual infective virus present in the population. When the flu vaccine is administered, the vaccine's antigens initiate a natural immune response. The body's immune response produces many antibodies against the antigens, which prevents potential infection by the virus or fights existing virus particles circulating in the body much quicker. Individual immunity from a specific viral antigen can be retained for up to two years. Influenza viruses are constantly evolving, meaning that the vaccination's antigenic components need to be revised each year to improve protection against each season's strain (7).

Due to the constant minor changes observed in the viral structure and the possibility for major shifts, health professionals highly recommend getting the annual flu vaccination at the beginning of every flu season. Numerous studies have proven that annual influenza vaccination remains to be the most effective way in controlling the spread and symptom severity of influenza (7). The seasonal influenza vaccine is designed to protect against up to three or four influenza virus strains at a time. These strains are predicted and then selected based upon vast research and surveillance of viral spread across the world. This includes more than 100 national influenza laboratories in over 100 countries that conduct tests upon thousands of influenza virus samples from patients (7).

The viral strains that are predicted to be the most common and prevalent for each flu season are then injected into fertilized chicken eggs for replication. Chicken eggs are used because they provide necessary host cells and nutrients for the virus to infect and replicate within; chicken eggs can also be mass produced and utilized at a low cost. The viruses are then harvested from the eggs and their antigens are purified. These purified antigens are the only viral components used in the flu shot that is currently available to the public. The

entire flu vaccine production process- from the study of global infection patterns, predicting probable viral strains, replicating the virus, purifying antigens, assembling the vaccines, and distributing them to public markets- takes upwards of nine months (7). Unfortunately, this allows ample time for the virus to mutate and evolve within the population, so that when the vaccine is available it is sometimes discovered that the predictions were not quite accurate and the vaccine is not 100% effective. Frequent genetic changes occur at a faster rate in influenza A-H3N2 viruses, therefore when the vaccine for H3N2 was originally prepared for the market this season, it proved only 36% effective against the new, mutated H3N2 virus (8). While vaccine effectiveness can vary based upon whether or not strain predictions match outcomes, recent studies show that flu vaccination still reduces the risk of flu illness on average by between 40-60% among the overall population during the flu season (9).

Importance of herd immunity. Vaccination administration among populations plays a very crucial role in preventing influenza pandemics, resulting in public health crises. Increased vaccination rates among a population can decrease or eliminate the exponential spread of the flu. Health crises related to influenza pandemics can potentially lead to an exhaustion of medical facilities, treatment options, and in extreme cases can result in numerous deaths. In the United States alone, the total economic burden of annual influenza epidemics has been evaluated to be $87.1 billion dollars. This takes into account an average of 610,660 life-years lost, 3.1 million hospitalized days, and 31.4 million outpatient visits (10). All of these consequences of a pandemic could potentially be prevented or reduced through increased vaccination rates. Increased vaccination rates within a population can lead to herd immunity.

Herd immunity can be defined as a population's immunity from a disease that prevents the exponential spread of the disease throughout the population. The vaccination rate in a population needed to achieve herd immunity is referred to as the herd immunity threshold (HIT). A population will experience lower occurrences of influenza infection if more individuals are immunized and this can be done through increased vaccination. Widespread vaccination can greatly help reduce the basic reproduction numbers of influenza. The basic reproduction number of an influenza virus (R_0), is defined as the

average number of secondary cases generated per infected individual in a susceptible population; this is an important factor in predicting outbreak severity and transmissibility of seasonal strains of influenza (11).

A value of R_0 greater than one indicates that the infection will exponentially grow and persist in a population, while an R_0 value less than one indicates that the transmission of infection will decline over time within the population. Historically, R_0 values have been calculated by utilizing many different methods; the majority have been derived by using the growth rate of the specific epidemic or by observing the disease transmission from one generation to the next (11). The basic reproduction number determines the outcome of total infected individuals and the herd immunity threshold (11). The magnitude of the basic reproduction number plays a pivotal role in the rate of infection, and what healthcare measures need to be taken to prevent severe illness or even death due to influenza. During the 2009 H1N1 influenza pandemic in the United States, a basic reproduction number for the virus ranged from 1.3-3.3 (11). The lower R_0 values were calculated among populations in communities, while R_0 values as high as 3.30 were calculated within a school setting. Higher basic reproduction numbers occur within populations that live within close quarters, as more people have a higher chance of coming into contact with more viral transmitters (11). Once enough individuals are vaccinated, the R_0 value can be reduced to one or less and exponential spread of disease is eradicated; quite simply put, when more individuals are vaccinated it decreases the spread of the virus and resulting illnesses.

If we were to assume that an influenza vaccination was 100% effective, the vaccination rate for a population would need to be 50% or greater in order to keep R_0 less than or equal to one, which prevents exponential infection (an outbreak or epidemic). An equation showing the relationship between vaccinated individuals and the basic reproduction rate of influenza within a population can be derived:

$$V_c = \frac{I_c}{E} = \frac{1 - (1/R_0)}{E}$$

Where V_c is the critical vaccination coverage required to establish herd immunity, I_c is the herd immunity threshold, R_0 is the basic reproduction number of the flu virus, and E is the level of vaccine effectiveness (12).

For example, the HIT for influenza during the 2008-2009 H1N1 epidemic was 30-50% based on the above calculation (12). Visual representations of the relationship between population vaccination rate, vaccine effectiveness, and R_0 values may be viewed in Figure 2.

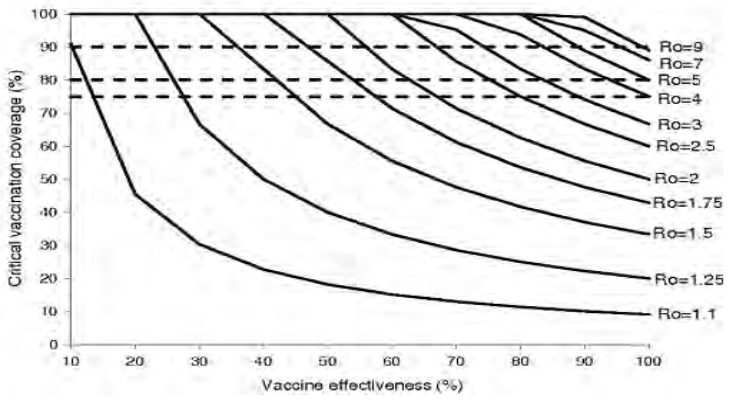

Figure 2: Vaccination coverage (%) required to establish herd immunity in a completely susceptible population based on basic influenza reproductive numbers (R_0) and vaccine effectiveness (%) (10).

Health decision-making in regards to receiving the flu vaccine. Despite great amounts of proof that vaccines are beneficial to health, are safe, effective, and low-risk in side effects, a portion of the population remains resistant to or skeptical of getting vaccinated. This year's vaccination rate was approximately 38% nationally. Only 8-39% of US college students on campus vaccinate during the season against influenza (13); a broad percentage exists as it is difficult for health services officials to keep track of those participating in vaccination events outside of college campus clinics. It has been nationally recognized that motivating college students to get vaccinated annually remains to be a public health challenge and contributor to rising influenza cases (13). The flu virus is so virulent on college campuses due to constant exposure in close quarters such as common living spaces, classrooms, shared restrooms, and social activities. A seemingly endless cycle of contamination and spread of infection also occurs because infected students do not want to be absent from classes while professors discourage students from missing class. On average, college students who contract the flu miss up to eight or more days of classes (13).

The "college student mindset" also remains a barrier to containing the spread of infection. Typically, healthy students don't worry about contracting the flu. Among college campuses across the US, there exists a conflicted belief about students' own risk of infection versus the risks to others (13).

Multiple studies show that risk perceptions and vaccination intentions of individuals are very much associated with the overall knowledge about vaccines, informational sources perceived by and available to the public, and overall patient trust of medical professionals and the government. Vaccination decisions, along with many other health-related decisions, require choosing between a set of options consisting of risks and benefits. It is common that people often make choices that do not align with scientific evidence or with their own values or beliefs. These types of inconsistencies are especially apparent when vaccine risk probabilities appear small, but when these risks are perceived with emotion based on misinformation (14).

One study tested the relationship between risk communication and values clarification regarding influenza vaccines, and whether or not these two methods could be utilized to help parents and guardians make more informed and "value-congruent" decisions about children's influenza vaccinations (14). The study defines "value-congruent" as the choices that align with the participants' stated values, such as the motivation to protect one's child. This study took place throughout 2013 and 2014, and was conducted online through different interactive, informational surveys pertaining to influenza vaccine facts (14). The informationally guided surveys utilized in the study provided clearly present numerical estimates of both the risks and benefits associated with child influenza vaccinations. Values clarification methods were also used to help the participants understand which option was the most likely to best align with their stated values. The results of the study indicated that the combination of risk communication and values clarification methods is most effective for encouraging intentions to vaccinate, especially for those parents or guardians who are more hesitant to vaccinate their children against influenza. The results are also indicative of a positive correlation between influenza vaccination intentions and increased standard vaccination rates, as well as rates of informed choice. The participants who had their children vaccinated before were more likely to consider getting their child a flu vaccine.

The vast majority of participants who made value-congruent decisions with adequate knowledge and informed choice had strong intentions toward vaccinating. This raises awareness in the importance of effective methods of risk communication and values clarification for increasing informed vaccination among populations (14).

Another study observed the trends in risk perceptions and vaccine intentions regarding the H1N1 influenza pandemic. In November of 2009, a safe and effective H1N1 vaccine was available to the public during the H1N1 pandemic. Despite this, H1N1 vaccines administered to the public during this time was very low; only 24% of the population were vaccinated during that season even though the vaccine's effectiveness was a high 62% (1). This study somewhat parallels this year's vaccination rate and vaccination attitudes. In this past flu season of 2017-2018, approximately 38% of the population received a vaccination despite the publicized virulence of the flu. The H1N1 study utilized a survey to answer questions regarding the chances the participant would be vaccinated, estimates of contracting H1N1, presumed risk of death by H1N1, and demographics were recorded for each participant. The study concluded that those who perceived a higher risk of contracting and dying from H1N1 were more likely to intend to be vaccinated. Participants who regularly received seasonal vaccinations in previous years were also more likely to intend to be vaccinated. Due to this, the encouragement of seasonal vaccination can be an important construct in strategies to prepare for and prevent a pandemic (15).

Although many types of vaccinations remain to be one of the most effective ways in controlling the spread and contraction of many diseases, parents and patients are still reluctant to get vaccinated due to many reasons. As stated in the above studies, factors such as risk communication, values clarification, patient vaccination history, transparent vaccine information availability, sources of misinformation, emotional significance of the vaccine, and trust of health officials all play key roles in determining one's risk perceptions of vaccines.

Effects of misinformation on vaccination rates. The infamous Andrew Wakefield vaccination study is still very prevalent and influences some individuals' medical decision making today. In 1998, Wakefield and twelve other scientists and doctors published a

scientific paper, which implied a link between the measles, mumps, and rubella (MMR) vaccine and autism. This caused an international scare among many, contributing to the increase in vaccine-wary individuals still existing today. The study contained no controls, associated common conditions with the vaccine, and based its findings largely on ill-informed parental beliefs about vaccines. Since this study was released to the public, numerous studies consistently found zero evidence of a link between the MMR vaccine and development of autism. It was later discovered that Wakefield altered much of the patients' medical histories within his study to support his claim of the MMR vaccine link to autism for personal financial gain (16).

Although Wakefield's fraudulent study was later retracted, the media and several celebrity activists supported and promoted the anti-vaccine "findings". Fraud situations and misinformation regarding the vaccine not only cause a lasting impact due to misunderstanding, but also cause mistrust of doctors and health officials' recommendations among the public. Despite today's knowledge and studies showing no correlation between vaccines and autism, people continue to believe the false claims and/or are afraid to get vaccinated. As stated before, this poses a huge health problem to every population. Vaccines reduce risk of disease pandemics by utilizing herd immunity and have the potential to save lives (16).

Bryant University Student Research Methods and Results

Methods. In order to determine the vaccination rate of Bryant students and understand the factors influencing their decision-making about getting the influenza vaccine, a 20-question survey coupled with individual interviews were conducted among students. The survey was conducted among 229 current Bryant students who voluntarily chose to participate, and consisted of multiple choice and free-response questions. These 229 students represent 6.19% of the total student population at Bryant University. Survey participants ranged in age from 17-24 years old, were 62.16% female, and almost half of respondents were in the process of completing their senior year at Bryant (45.95%). The survey questions consisted of basic student demographic information such as age, gender, and years attending Bryant University. Survey questions also obtained information

surrounding students' knowledge and opinions about the flu vaccine, the virus and spread of disease, and the Bryant University's Health Services facility. Survey questions also aimed to find the students' frequency of Health Services use, intentions toward vaccinating this season, overall vaccination habits, vaccination influencers, and knowledge about vaccine availability at the University. The individual interviews were conducted among three students and the director of Health Services.

Important background information regarding the University. Context behind the availability of the on-campus flu vaccine must be clarified to better understand the significance and reasoning behind the following data. Bryant University Health Services does not offer administration of the annual flu vaccination within their campus clinic. This is due to two major reasons. First, as observed in the survey results previously stated, only a small fraction of the student body strongly intends to get vaccinated each season. Second, upon physical opening of the actual vaccine vial, the vaccine within the vial must be administered within a month's time to prevent risk of microorganism growth in the vials. The CDC also recommends that vaccines pre-drawn into syringes must be discarded at the end of the clinical day (CDC). If Health Services' on-campus facility were to provide the administration of the flu vaccine, it would be wasteful because partially used vials of the vaccine along with pre-drawn syringes would have to be discarded due to the small student interest in getting vaccinated. Due to these reasons, Health Services hosts third-party companies such as Rite Aid and Maxim to provide vaccination clinics that are free of cost to the students and staff on campus.

Survey data. According to the survey, only 25.15% of participating students had received the flu vaccination this year. In Figure 4, it can be observed that this vaccination rate is below the HIT curve given the 36% vaccine effectiveness. The campus is far away from reaching herd immunity at this low vaccination rate, because in order to achieve herd immunity on campus - the R_0 was determined to be 1.3 - the University would need to increase its student vaccination rate to at least 64.10% for this year's vaccine, which can be viewed in Figure 4.

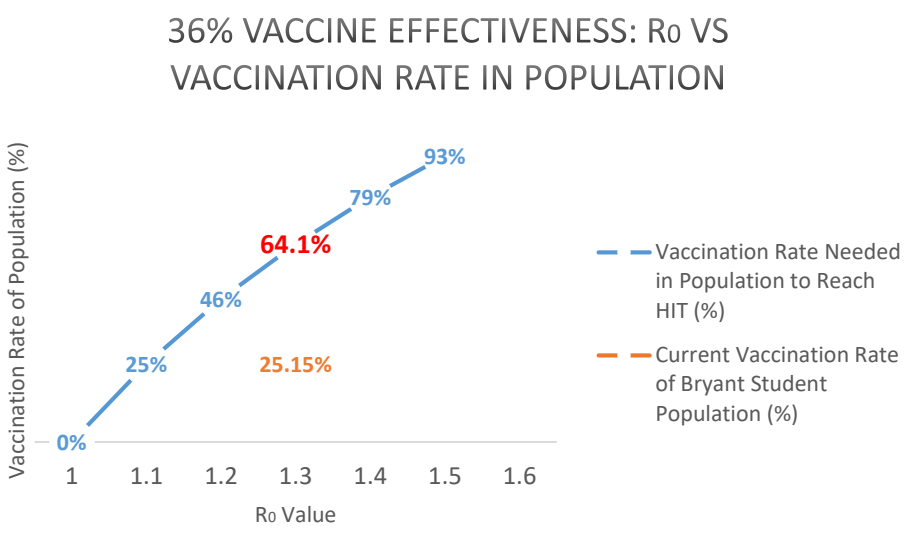

Figure 4: Necessary vaccination rates to be achieved within a population given the reproduction number (R_0), and this year's vaccine effectiveness (36%).

The results from the survey indicated that many students tend to make medically misinformed health decisions when deciding whether or not they should receive the flu vaccination. 69.72% of students who completed the survey stated that they are unlikely to receive the vaccine this year due to inconvenience, fear, and/or the fact that they lack knowledge about vaccine safety, efficacy, and biological mechanism. It was also found that those who were unsure about getting the vaccination this year would be more likely to be vaccinated if they received more information about it. The breakdown of students' overall opinions on receiving the vaccination can be viewed in Figure 5. Some major conflicting student beliefs surrounding the vaccine arose within the survey; many students stated that the vaccination is beneficial to their health and other's health despite the low vaccination rates among these same students. A large portion of the students also stated that the vaccine was not important to them or they didn't' know whether or not the vaccine was beneficial.

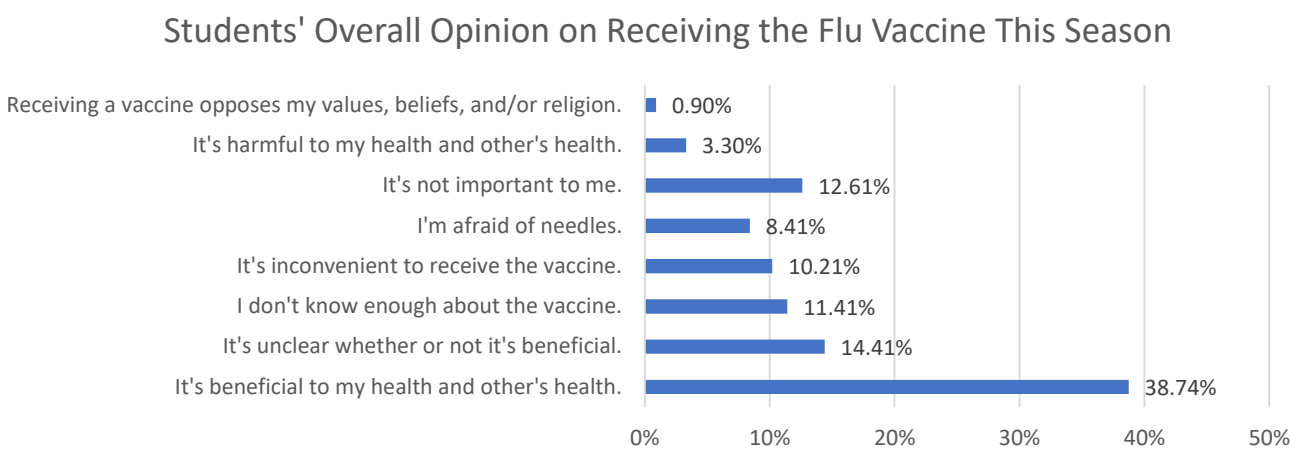

Figure 5: Students' Overall Opinion on Receiving the Flu Vaccine This Season.

75.89% of the respondents stated that they had been to Health Services before, on average about 1-2 visits per semester. Despite the fact that the vast majority of all respondents had been to Health Services (see Figure 6 for breakdown of students visiting Health Services) , it was very surprising to find that the majority (69.46%) of these students stated they had not: seen or heard any information about the campus' flu vaccination clinics from Health Services; been informed about the flu vaccine by Health Services staff; or been encouraged by Health Services professionals in any way to receive the flu vaccination. This fact plays a crucial role in the students' decisions to get vaccinated. Based on secondary research presented in the literature review, individuals are much more likely to get the influenza vaccine when they receive adequate information about it and are encouraged by trusted health professionals. Information about the vaccine provided at the University should definitely start at Health Services; they organize the on-campus vaccine clinics every year.

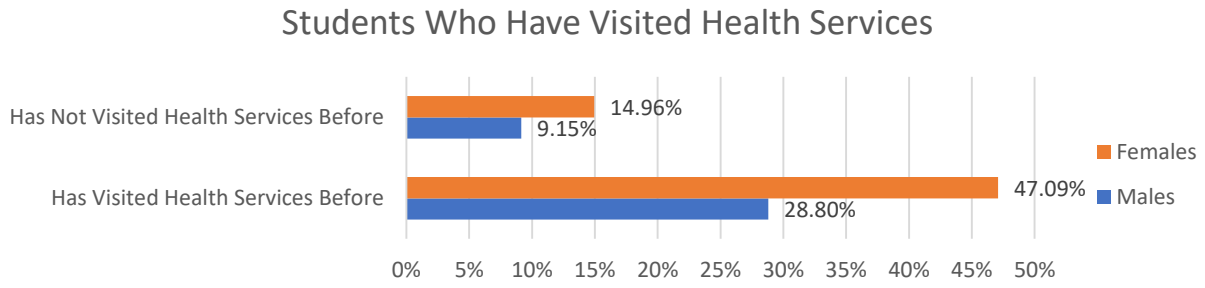

Figure 6: Males vs. Females Utilizing Health Services

Half of the students who *had* received a flu vaccination this year stated that they had received it at a doctor's office; 25.93% had received it at a pharmacy or vaccine drive; and 20.37% had received their vaccine at Health Services' vaccination clinics on campus. The majority of students stated that they did not encounter any sources of information regarding the flu vaccine that influenced them to vaccinate (61.11%). If they did encounter informational sources that encouraged them to vaccinate, these sources were primarily from a doctor or health professional, family member or friend, or an academic literature source; these sources were mostly provided outside of the Bryant University campus. A breakdown of *total student respondents'* vaccination locations can be viewed in Figure 7.

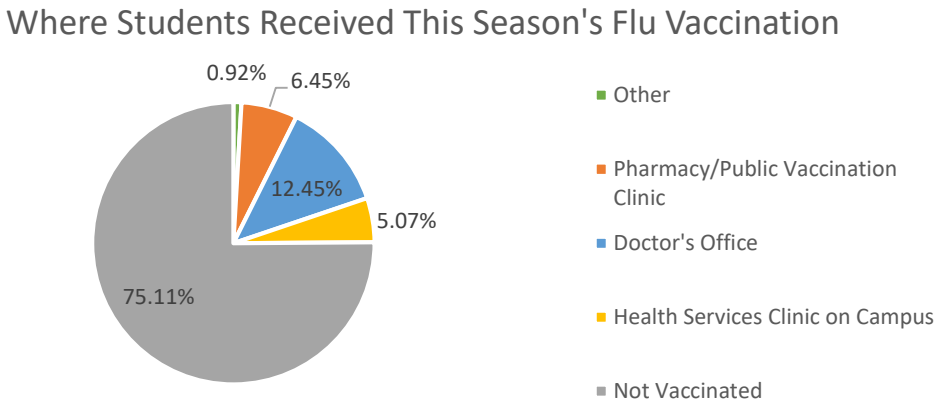

Figure 7: Where Surveyed Students Received Their Vaccination This Season.

According to the survey, Bryant students also reported that the vaccine is inconvenient to receive or not a priority to them. It was also indicated on the survey that at Bryant, advertising for the availability of the flu vaccine on campus is very sparse. Free responses such as "knowing the dates of the vaccination clinic", "sending out a Bryant Alert email about the clinics" and "knowing the location of clinics" were all encouraging influencers for students to receive the vaccination at Bryant. Increasing accessibility to vaccination clinics, increasing awareness of these events, and increasing general knowledge about the many benefits of vaccination has been proven to better motivate students on campuses to participate in vaccination events. Students also indicated on the survey that having an incentive, such as a cash reward or chance to win a free giveaway, would better encourage them to vaccinate (Figure 8).

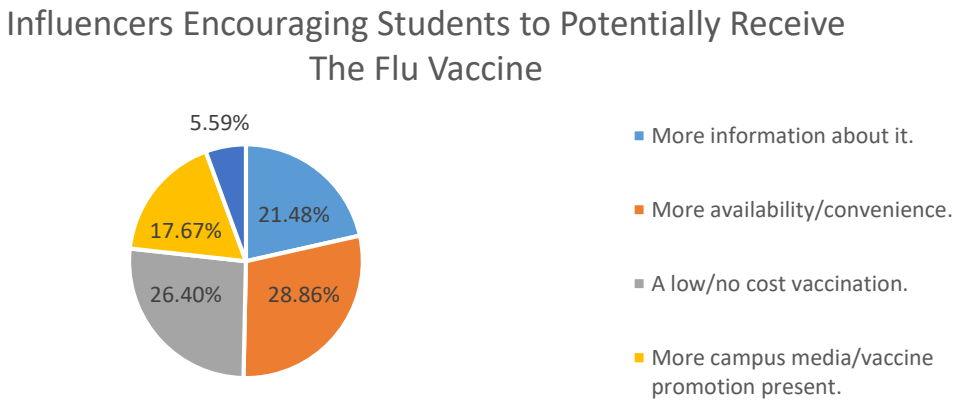

Figure 8: Influencing factors that would encourage students to vaccinate on campus.

The majority of students participating in the survey stated that they were unlikely or very unlikely to receive the flu vaccination this year (see Figure 9). Despite the fact that the majority of students normally receive the flu vaccination each year (40.37%) or had vaccinated at some point before (80.74%), the vast majority of students didn't intend at all to vaccinate.

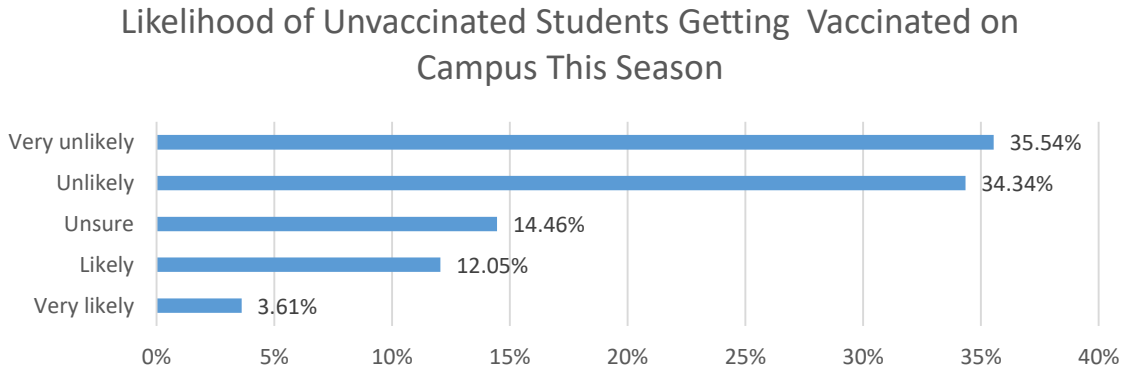

Figure 9: Unvaccinated students' likelihood of getting vaccinated on campus this season.

The results from the free response section also indicated that misinformation and lacking knowledge is a major factor when students decide not to vaccinate. A few students seemed misinformed as they shared the attitude of being invulnerable to contracting the flu. Their response stated that they "have decided to avoid the flu by eating healthy and exercising", they "don't see the need to get a vaccine for something their immune system can cope with", and "every time I have taken it [the vaccination] in the past I have gotten the flu and

when I don't I never get it. It's a scam in my opinion". Unfortunately, although being active and eating healthy foods may contribute to a heartier immune system, a newly introduced strain of flu is just as likely to infect a physically-active host's cells as they are to infect a physically-inactive host's cells. Many students also do not realize that the vaccination takes up to two weeks to build immunity to the actual virus (7). Perhaps if the student was better informed of the mechanism of the vaccination upon administration, they would understand that their "correlated vaccine and illness effects" were entirely coincidental.

Individual student interviews. Brief interviews with three students were conducted in order to get more insight on students' opinions about the flu vaccination and their understanding of the virus' mechanism of infection. The students' opinions ranged greatly dependent upon their educational background.

The first student interviewed was a senior and non-biology science major. She stated that she was afraid to receive the vaccine, because she didn't know what was in it and didn't know how the vaccine worked. This student was also asked if she thought that not being vaccinated severely affected those around her; her answer was that she didn't think it really affected anyone. She also stated that she had no intentions of getting vaccinated this season, or in the future.

The second interviewed student was also a senior non-biology science major. She stated that she did not receive the flu vaccine because she has a compromised immune system and feels quite ill for a couple of days after receiving the vaccine. She stated that she would probably receive the vaccine if it didn't have an effect on her wellbeing, and that her sister is a nurse and is a big proponent of the vaccination- so she trusted her sister's opinion.

The third student interviewed was a junior biology major. He stated that he intends to become a physician's assistant, and currently volunteers in Bryant University's Health Services. He stated that he understands the mechanism and effects of the vaccine, so he understands the importance of it and gets vaccinated annually. He also stated that he received the flu vaccine at his yearly physical that is *required* for University Athletics, so he does not need to get vaccinated at Health Services this season.

Director of Health Services interview. An in-depth interview with Kelly Quintal, the nurse practitioner and director of Bryant University Health Services, was conducted. From this interview, valuable information indicative of student decision-making effectors was discovered regarding flu vaccine events at the University. This year, the University held a total of three vaccination clinics presented by Rite Aid and Maxim, yet the number of students participating in these clinics remained very low.

Approximately 50 students were vaccinated in total at the October vaccination clinic held in the Unistructure within a large classroom. Nurse Quintal concludes that this vaccination clinic had a low student participation rate due to little outreach, as information delivery to students was lacking. Only a few posts on the Health Services Facebook page informed their followers about the October clinic. It was also noted that this Facebook page is currently followed by only 316 people on campus, and received no likes or other forms of student engagement.

Approximately 150 students were vaccinated at the November clinic, which was also held in the Unistructure but this time in the more accessible and visible rotunda on the first floor. Emails to students, signs scattered around campus, and Facebook posts about the time and location of this clinic were available to students prior to the clinic. Nurse Quintal also stated that at this time, she had been receiving many emails from students' parents inquiring about vaccination availability on campus. She stated that parents were pushing to get their children vaccinated, which could have served as a contributor to the influx of students participating in the November clinic.

During the February clinic, only 51 students were vaccinated. This clinic was held on the second floor of the Unistructure rotunda. Only Health Services Facebook posts served as a source of outreach to students during this clinic; a very last-minute location change also occurred the day of the vaccination clinic. The clinic was scheduled to occur on the first floor of the Unistructure rotunda, where many more students travel to and from classes and socialize. The second floor rotunda is much more quiet with few passersby, and out of view from those on the first floor. This location change also resulted in fewer students participating in the vaccination clinic.

During the month of February, Nurse Quintal estimated that 75% of the Health Services visits were due to the flu and flu-like illnesses. This influx of flu-infected students seeking treatment caused a large burden on Health Services' scheduling, medical supplies, and medical personnel. Nurse Quintal also stated that the students who typically visit Health Services have "present, not futuristic thinking" and that they usually only seek "immediate, not preventative care". She also believes that the misinformation of social media regarding the flu vaccination has a huge impact on students. When the vaccine effectiveness of 36% is broadcasted on media in a negative light, this discourages many, resulting in them not bothering to get vaccinated.

Along with this, Nurse Quintal made another interesting point; college students are transitioning to being responsible for managing their own health. During this transition, a knowledge gap about health and vaccination can be created, resulting from lacking education about the importance or benefits of vaccination. From this sprouts varying levels of awareness, knowledge, and attitudes toward the flu vaccine in a diverse crowd- which leads to varying vaccination intentions in a college student population.

Future Steps: Increasing Vaccination Rates at Bryant University

It can be concluded that many factors are key barriers to increasing student vaccination rates at Bryant University. These current barriers include:

- **Lacking knowledge.** When students are unsure of how the vaccine works, their uncertainty oftentimes causes fear which results in reluctance to get vaccinated. Unfamiliarity with the vaccination causes them to be very skeptical of it, and when they choose not to get more information about it, they have no intention to get vaccinated. When students are unfamiliar with the vaccine, they will also base their decisions off of misinformed sources or opinions of others. Once individuals are informed of how herd immunity works, what's physically in the vaccine, and how the vaccine produces a natural immune response, they are less fearful and view the vaccine as beneficial to their health and others.

- **Continued misinformation.** Common misinformation can lead to negative and fearful views surrounding the flu vaccine. If students believe that the vaccine can infect them with flu or cause serious diseases, they will not get vaccinated due to fear. If students believe that their immune systems can avoid flu infection with increased exercise, diet, or other remedy, they will not get vaccinated because they view the vaccination as unnecessary.
- **Lack of encouragement.** Students will be influenced by those who are viewed as reputable and trustworthy sources. These sources may include friends, family, Health Services staff, University professors, those who are famed on social media, elite athletes, or well-known health experts. Although some of these individuals may not be health experts specializing in epidemiology or the influenza virus, students will be more apt to get a vaccine if someone on a "higher platform" simply recommends it and reminds them of the vaccine availability on campus.
- **Lack of outreach.** When students aren't constantly reminded to get vaccinated, it is unlikely that they will get vaccinated because they don't naturally prioritize preventative health. Students are more likely to get vaccinated when they know when and where vaccination clinics are occurring on campus, and when informational outreach is readily present. When reminders for students to get the seasonal flu shot are "out of sight", they will also be "out of mind".

Although there may be some barriers to student vaccination currently existing, this research also revealed specific steps to increase vaccination rates on campus:

- **Increase information-sharing and outreach.** It is of utmost importance for Health Services staff and other campus resources to help educate students and advocate for the flu vaccination. Running educational programs or seminars, educational online crash-courses, providing informational guides in Health Services and around the University, or hosting other medical professionals to teach students about how the virus and vaccine work will aid in increasing the student vaccination rate. This will also debunk students' misconceptions about the vaccination.

Increasing students' knowledge leads to empowerment, enabling students to make more logical and meaningful decisions. When students are informed and familiar with how the vaccine works, they are more likely to get vaccinated.

- **Utilize informative sources who have a specialized platform.** Students trust information from those of which they view to have specialized expertise or those of which they have a personable relationship with. If the University were to better utilize Health Services staff or someone such as a well-known doctor, athlete, scholar, or celebrity profile to deliver information about the importance of the vaccine, this would further encourage students to get the vaccination because they trust and honor the reputable individual's opinion. When an individual is viewed as important by students, they will be more likely to view their opinion as important as well. Students are more likely to get vaccinated when they understand the importance of the flu vaccine and how they can contribute to better community health.
- **Provide incentives for students participating in the on-campus vaccine clinics.** Providing incentives such as free item giveaways, raffles for cash prizes, or providing a "get one give one" aspect during vaccination clinics can further encourage students to participate in vaccination clinics on campus. College students are encouraged to participate in campus events when they feel a sense that they are giving back to a greater cause; if the third party vaccine providers could donate a vaccine or some service to those in need after a certain amount of students get vaccinated, this would increase student vaccination rates. Students will see more value in getting vaccinated when they see an immediate, tangible reward.
- **Provide incentives for students participating in off-campus vaccine clinics.** Students who get vaccinated off-campus equally contribute to the betterment of campus health. Providing incentives to all who get vaccinated, regardless of vaccination location, will increase campus-wide vaccination rates. One interviewee stated that he received his vaccination at a yearly physical that was required for University Athletics. This physical took place prior to his athletic team's preseason, which begins in mid-August. If University Athletics could either make clear the

strong recommendation to get vaccinated against flu OR require the flu vaccination for all student athletes during these mandated physicals, the vaccination rate on campus would greatly increase. Student athletes comprise of approximately 20% of the Bryant student body (16).

- **Increase convenience and accessibility.** Holding the flu vaccination clinics in more than one location across campus in high-traffic areas will increase the students' likelihood of getting vaccinated. These locations might include the first floor of the Fischer Student Center, the first floor of the Unistructure rotunda, the first floor of the Chace Wellness Center, and outside of the Unistructure. All of these suggested locations have a higher chance of reaching more students that are available to be vaccinated. Scheduling different available vaccination times throughout the day can also make the vaccine more convenient to more students' schedules.

There are very specific steps that have been identified through this research to greatly improve vaccination rates of Bryant students on campus. If Bryant students' health remains a University priority, it is critical that informational resources on campus convince and encourage Bryant students to follow health professionals' recommendations in the early stages of a health crisis, such as this season's influenza outbreak. The aforementioned steps are necessary to increase student vaccination rates, and will remarkably contribute to controlling the spread of highly infectious diseases on campus such as the influenza virus. Bryant students will need to trust experts, namely the Health Services staff, before they take part in cooperating with their recommendations to get vaccinated. Thus, it is very important to foster trust, patient value, and information transparency between University students and Health Services staff to drastically improve vaccination rates at Bryant University. The vast majority of students who made values-congruent decisions with adequate knowledge and informed choice had strong intentions toward vaccinating. This raises awareness of the importance to achieve effective methods of communication and information-sharing regarding influenza and influenza vaccination to increase the vaccination rate among Bryant students.

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