Vaccine Hesitancy & Study of Attitudes and Barriers Towards the Influenza Vaccine in Public Health Students at Liberty University

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Abstract

Every year 2.5 million deaths worldwide are prevented because of vaccinations. Vaccine hesitancy is defined as delayed acceptance or refusal of vaccination and is a global threat to public health. Attitudes and barriers towards vaccines vary and change from group to group. Eighty-five percent of surveyed public health students at Liberty University did not receive the seasonal influenza vaccine. Their attitudes and barriers included: “I did not have time to receive a flu vaccination”, “I believe that as a result of the flu shot, I may actually get the flu”, and “I do not believe I am in danger of contracting the flu”. Interventions are aimed at increasing their vaccine uptake and their ability to educate future communities.

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Getting vaccinated is an important health behavior and the promotion of vaccines is a public health issue. There are many attitudes and barriers that prevent people from receiving vaccines and that contribute to vaccine hesitancy. Not getting a vaccine can result in individuals contracting serious diseases that are completely preventable. In 2019 the World Health Organization (WHO) declared that vaccine hesitancy is in the top 10 threats to global health (Wilson & Wiysonge, 2020). It is the responsibility of public health to use behavioral theories and models to help decrease vaccine hesitancy and increase rates of all vaccines.

Vaccine hesitancy is a new term and research in this area still needs to be developed. The term itself, vaccine hesitancy, does not have an agreed upon definition which makes any discussion of it difficult (Eskola et al., 2015). The following definition that was developed by the SAGE Working Group on Vaccine Hesitancy will be referred to in this paper: "vaccine hesitancy refers to delay in acceptance or refusal of vaccination despite availability of vaccination services" (MacDonald, 2015, p. 4163). This paper will attempt to explore some of the underlying causes of vaccine hesitancy and explore health theory construct that could potentially form a successful health intervention program.

This paper will strive to accomplish 3 objectives. The first objective is to explore general vaccine history and hesitancy, and to present the attitudes and barriers behind vaccine hesitancy in particular subgroups. The second objective is to present a study of the current attitudes and barriers of public health students regarding the flu vaccine at Liberty University. The goal of this is to discover possible gaps in education and discuss the specific ways that public health professionals' attitudes can influence the population's intentions to get the influenza vaccine.

The third objective is to formulate specific interventions to increase influenza vaccine uptake amongst public health students.

History of Vaccines

To understand vaccine hesitancy, the history of how vaccines have developed and the impact that they have had on society needs are presented. When the need for vaccines is forgotten, the fear of vaccines supersedes the fear of the diseases that once ruled the day-to-day lives of so many individuals. Therefore, it is important to understand where vaccines started and how both their use and the attitudes towards their use have changed throughout time.

One of the most influential public health advancements in history is the discovery of the first vaccine (De Gregorio & Rappuoli, 2014). As vaccines developed, and more vaccines became available, the impact they had on modern medicine was overwhelming. Much of our quality health in the western world today is owed to vaccinations and rigorous vaccine programs that have been implemented. Specifically, vaccinations have prevented 100 million cases of disease in the US and 2.5 million deaths per year worldwide (De Gregorio & Rappuoli, 2014). Attitudes towards vaccines have changed since the first vaccine was distributed and continue to do so. These attitudes influence the uptake of vaccines, particularly certain vaccines such as the measles, mumps, and rubella (MMR), human papilloma virus (HPV), and influenza vaccines.

The first vaccine was developed in 1796 for smallpox (De Gregorio & Rappuoli, 2014). This sparked the beginning of an era where people were no longer at the whims of disease but could take control and use preventative measures to protect themselves. The original inoculation was developed by using the dried pus extracted from the sores of infected individuals to infect others. This method caused severe cases of smallpox and resulted in some deaths. Edward Jenner alternatively discovered that by using dried pustules from cows infected with cowpox instead,

the individuals would develop a lesser form of the disease and be protected from smallpox as well (Lombard et al., 2007). At this time in history, there was no understanding of the immunology of the inoculations since the germ theory had not been discovered. The inoculations were found to work through trial and error.

It was not until the late 19th century, when Louis Pasteur and Robert Koch ushered in the scientific age of vaccinations, that there was a specific reasoning behind why vaccines worked (Smith, 2012). Importantly, the attenuation of vaccines was discovered at this time (De Gregorio & Rappuoli, 2014). This process involved heating, drying, and exposing the virus to oxygen, or passing the virus through an animal to achieve a less virulent form. This allowed the body to respond to the vaccine with an immune response without developing a full-blown version of the disease. These techniques made vaccinations safer and resulted in fewer deaths. Some key vaccines that were developed during this time were the rabies, anthrax, and tuberculosis vaccines.

The discovery of in vitro techniques in 1949 was another significant event in the development of vaccinations (De Gregorio & Rappuoli, 2014). This new science allowed researchers to develop vaccines using human cells cultured in petri dishes, making vaccines more compatible with the human body and its immune response. This advancement led to the golden age of vaccinations (Plotkin & Plotkin, 2011). Once again vaccines became even safer and more tailored to the specific response desired. Some vaccines developed during this time were the measles, mumps, rubella, polio, influenza, and rotavirus; interestingly, many of these vaccines are still in use today (De Gregorio & Rappuoli, 2014). The measles, mumps, and rubella vaccines were developed by passage in embryonated eggs or cell culture (Plotkin & Plotkin, 2011).

More recently scientists have been using glycoconjugate and recombinant DNA technology. Glycoconjugate vaccines were first developed in the 1970s to be used against meningococcus and pneumococcus (De Gregorio & Rappuoli, 2014). In this type of advanced vaccine, the antigen is combined with a carrier protein to make it immunogenic. For instance, the Hepatitis B and HPV vaccines have been developed through recombinant DNA technology. Because these viruses cannot be cultivated and grown, it was very difficult to create a vaccine without infected individuals. Utilizing virus samples collected from infected individuals also carried safety risk as deactivating viruses can be difficult (Plotkin & Plotkin, 2011). Thus, recombinant DNA technique was first used to clone the gene responsible for antigen production in the Hepatitis B virus into a yeast strain (De Gregorio & Rappuoli, 2014). This allowed researchers to produce antigens for a vaccine that were identical to those extracted from an infected patient's plasma. Recombinant DNA technology is currently being used to research vaccines for the influenza virus, respiratory syncytial virus (RSV), norovirus and parvovirus.

Vaccine Attitudes and Barriers

Vaccines are a major medical advancement, though attitudes regarding their use and their safety have resulted in various views throughout history. The attitudes and barriers individuals hold towards vaccines affect vaccine uptake rates. Both positive and negative perceptions of or attitudes towards vaccines are influences by the characteristics of each population group. Negative attitudes and barriers prevent specific groups from accepting vaccines and can have a negative effect on their health.

The History

Attitudes towards vaccines have not always been positive. In the beginning of the 1800's many people were very hesitant to get vaccinated. A contributing factor to this attitude was the

legitimate fear of sickness or death (Stern & Markel, 2005). As previously stated, the original inoculation for smallpox often caused the individuals to develop smallpox and sometimes caused them to die (De Gregorio & Rappuoli, 2014). Once Jenner discovered the procedure for cowpox inoculation people's fears shifted from personal safety to personal dislike of putting a substance that derived from an animal into their bodies. Many of the newspapers at the time had political cartoons that portrayed Jenner poorly and showed his vaccine causing people to transfigure into animals. There was also widespread public confusion when it was discovered that individuals had to revaccinate due to a decrease in immunity after years (Lombard et al., 2007). As a result, people did not trust the vaccine after having been led to believe it was permanent and then having to revaccinate.

However, people's attitudes changed quickly once they noticed the success of Jenner's vaccines (Stern & Markel, 2005). For example, it became very popular for the aristocracy to get vaccinated, and many presidents and kings began implementing nationwide vaccination campaigns. While this was a positive development in public views, it also caused a massive antivaccine movement. In the 1830's many people were still suspicious of putting foreign substances into their bodies and many saw the new nationwide vaccination campaigns as the government forcing itself upon the public. The totalitarian approach taken in the name of public interest resulted in many individuals not wanting to take an interest in vaccination efforts (Lombard et al., 2007). In the 1905 Supreme Court Case Jacobson v. Massachusetts, 197, U.S., the US Supreme Court ruled that states have the right to mandate smallpox vaccines (Omer et al., 2009). After this brief antivaccination upset, positive attitudes towards vaccines continued to grow and by the early 1900's, vaccines were generally accepted by the public.

During the 20th century people's attitudes towards vaccines were more positive due to the success vaccinations had in decreasing disease (Stern & Markel, 2005). Because of this positive attitude, important scientific breakthroughs occurred in vaccine research and many successful vaccination campaigns were conducted around the world. One such campaign was the Expanded Programme on Immunization (EPI) in 1974 which drastically increased the vaccination rates of children across the world, especially in developing countries. Importantly, the WHO also had smallpox vaccination campaigns in the 1960s and 70s that resulted in the last reported case of smallpox in Somalia in 1977.

A roadblock in the positive public view of vaccines occurred from data published by Wakefield et al. in 1998, that reported a link between the Measles, Mumps, Rubella (MMR) vaccine and the development of autism (1998). Noteworthy, the sample size for the study included only 12 children, the results were based on retrospective accounts of child behavior by parents and physicians, and they have never been repeated (Dudley et al., 2018). The study authors acknowledged that the results did not prove the association between autism and the MMR vaccine despite the lead author, Wakefield, claiming more than the paper concluded in the media. This study has since been retracted and has been disproven. Additionally, the Institute of Medicine (IOM), now known as the National Academy of Medicine (NAM), reviewed the body of work on the issue and concluded that it favors the rejection of a causal relationship between autism and the MMR vaccine (Baker, 2008). As one example, Farrington et al. (2001) found no link between autism and receiving an MMR vaccine at any point, whether at the recommended time or delayed. The authors studied 357 cases of children with autism using a self-matched case series method. They analyzed the age of autism diagnosis for children who received zero, one, or two doses of the MMR vaccine while considering the arbitrary 59-month risk period after the

MMR vaccine. They found no association between the MMR vaccine and the diagnosis of autism in any incident. In addition, the IOM had conducted 8 safety panels that determined that there was no link between child vaccination and autism (Baker, 2008).

Other notable events that highlighted the negative public view of vaccines was seen with the MMR vaccine and the resultant effects of vaccine hesitancy. Although measles was declared eliminated in the United States in 2000 (Patel & et al., 2019), there was a measles epidemic in 2008 (Shetty, 2010). A large outbreak post elimination occurred amongst Amish communities in Ohio with a total of 383 victims (Sundaram et al., 2019). Notably, 1,249 measles cases and 22 measles outbreaks were reported throughout the United States in 2019 (Patel & et al., 2019). The two largest outbreaks occurred in close-knit Orthodox Jewish communities. Out of all the measles cases in 2019, 89% were found in unvaccinated individuals. The high percentage of individuals not vaccinated against measles has been a significant cause of measles outbreaks in the post-elimination era (Sundaram et al., 2019). These events emphasize the adverse health effects that not vaccinating has on modern public health.

Throughout their history, vaccines were viewed positively by the public once their initial success with preventing disease became evident. However, since the 18th century, every time a new vaccination was introduced it was met with some initial trepidation and hesitancy (Stern, & Markel, 2005). Even though there have been low points in public opinion, attitudes towards vaccinations have been on an upward trajectory and individuals of the more recent antivaccination movement have been viewed as conspiracy theorists, uneducated, and unscientific (Stern, & Markel, 2005). This view is partially unfair considered that at the root of most antivaccination beliefs and theories is a basic fear for the safety of the vaccine recipients

(Salmon et al., 2015). This negative view on vaccines has slowly changed. This negative view on vaccines has slowly changed though vaccine hesitancy still prevails today.

Vaccine Hesitancy in the General Population

While vaccine hesitancy is a new term meant to depolarize the antivaccination movement, more research is needed to fully understand all the implications (McClure et al., 2017). Importantly, vaccine hesitancy occurs on a scale. For example, vaccine hesitancy can include individuals who flat out refuse to vaccinate and individuals who are hesitant about vaccinating their children on the vaccine schedule provided by their doctor. While the immediate epidemiological risk for disease occurs from those who refuse some or all vaccines, individuals who vaccinate while being concerned about the childhood vaccine schedule are more susceptible to misinformation and are at a higher risk of not accepting vaccines in the future (McClure et al., 2017). All levels of vaccine hesitancy are detrimental to public health and need to be addressed. While vaccination rates are high in the US, vaccine hesitancy is on the rise and a quarter to a third of parents are classified as being vaccine hesitant (Jacobson et al., 2015).

There are many general, complex attitudes that fuel anti-vaccination and vaccine hesitancy beyond the vaccine attitudes mentioned in the specific subgroups above. Since many diseases that people are vaccinated against are no longer prevalent in the US, vaccine hesitant people do not realize the severity of contracting these diseases or do not see themselves as susceptible. At first glance the root of vaccine hesitancy may appear to be the lack of information. Based on this assumption, one could utilize the Health Belief Model (HBM) to theorize that the key to addressing vaccine hesitancy would be education. According to the HBM, educating vaccine skeptics on the disease risk and how this risk affects them, can increase their perceived susceptibility and severity of not receiving a vaccine, thus potentially increasing

vaccine uptake. Unfortunately, health behavior theories that focus on individual-level access to information and perceived risks and benefits like the HBM are ineffective in changing attitudes in vaccine hesitant individuals (Bednarczyk, 2018). In some cases, this type of approach even causes a decrease in the intent to vaccinate.

Importantly, the causes of vaccine hesitancy go deeper than individuals not having enough information or having misinformation. Traditional behavioral change approaches work to influence the early adopters, defined as individuals who are open to change and only require evidence and knowledge that a behavior works to adopt it (Balas & Chapman, 2018). Diffusion of health innovations proceeds quicker in early adopters and they are the key group to convince to ensure diffusion through the rest of the population. But the issue is that many individuals who identify as vaccine hesitant are skeptics. The main psychological force that drives these individuals to change behavior is motivational reasoning (Hornsey et al., 2018). Decisions to not vaccinate are not based on empirical evidence but on personal attitudes and psychosocial factors (Brown 2018). Often, empirical data do not result in strong emotional responses, rather emotional beliefs and "gut" feelings cause individuals to seek out information to support the belief that they hold (Haidt 2001).

According to results from a study of 24 nations by Hornsey et al., there are four held attitudes that are at the root of vaccine hesitancy including conspiratorial beliefs, disgust, reactancy, and individualism (2018). Some people operate under the idea that there are powerful people who are consistently enacting mass hoaxes. Individuals that hold this conspiracy worldview are much more likely to hold anti-science sentiments and believe conspiracy theories. One of the most prevalent ideas in the realm of vaccine hesitancy is that "Big Pharma" is purposefully hiding the negative effects of vaccines to increase their wealth and power. Based on

this idea, an important point for healthcare providers is to not spend too much time talking about the myth or conspiratorial belief. Evidence shows that spending too much time on the belief can cement the myth in the individual's mind (McClure et al., 2017). It is important to focus on the facts and not the myth.

Disgust, and the fear of hospitals, needles, and blood, are additional factors that can influence anti-science attitudes. The intense aversions to these health-related factors can cause people to seek out information that give their fearful beliefs permission (Hornsey et al., 2018). These individuals finally feel justified in feeling afraid of vaccines for clinical reasons when they find theories about the dangers of vaccine.

Not all attitudes are equal or have the same effect on the individuals that hold them. Attitudes have a value expectancy, and the way people perceive them can influence someone's behavior (Hornsey et al., 2018). Some people cultivate and value holding a nonconformist role, and this can contribute to anti-science beliefs that ultimately contribute to vaccine hesitancy. Similarly, cultural perceptions can influence attitudes. Individualistic values of a culture can influence anti-science beliefs. People with strong beliefs in individualism are more suspicious of "Big Government" and are more likely to see vaccine initiatives as a push on individual freedoms (Hornsey et al., 2018). The Post-modern philosophy values of disillusionment and suspicion result in more distrust in traditional medical experts and government; these values increase the need to find information from other sources (Kata, 2012). Such attitudes also add up to an overall distrust in government, medical professionals, and experts. Higher levels of distrust are found in non-white and low-income individuals and this distrust makes individuals more likely to see alternative medicine providers and reject conventional medical practices like receiving vaccines (Lee et al., 2016). This eliminates the possibility of mandatory vaccination

programs fixing the vaccine hesitant views of the population. Complex and multi-faceted public health programs must be developed to combat this issue.

In addressing the issues of disillusionment and suspicion noted above, another model used to help understand vaccine hesitancy is the "3 C's" model. This model was developed by the SAGE Working Group on Vaccine Hesitancy and is made up of three components: confidence, complacency, and convenience (MacDonald, 2015). Confidence refers to trust in medical professionals, health services, and policy makers. Complacency occurs when the perceived risks are low, and vaccination is not seen as being necessary. This can ironically occur when an immunization program is successful because it results in viewing the risks of the vaccine as being higher than the disease that no longer commonly occurs. Self-efficacy determines the extent to which complacency effects vaccine hesitancy. Convenience is a significant factor that include the accessibility, availability, and appeal of immunization programs. These three factors contribute to a person's level of vaccine hesitancy and an intervention should target these areas. Additionally, trust in health services personnel, the biomedical system, and vaccine technology have been found to create an environment where vaccines are accepted (Lee et al., 2016). Unfortunately, only 36% of Americans report having confidence in the medical community and one in five say that they are skeptical of scientists (Chou et al., 2018). A public health program aimed at decreasing vaccine hesitancy should specifically focus on increasing trust in these areas before any other steps can be taken.

Attitudes and Barriers towards Vaccines in Specific Subgroups

Current attitudes towards vaccinations can vary based on different factors and subgroups. Some groups have higher vaccine uptake rate and others have higher levels of vaccine hesitancy.

Knowing the difference between attitudes and barriers in different subgroups allows public health interventions to be tailored to each specific population.

Healthcare Providers

One subgroup that has a predominately positive attitude of vaccines and vaccination programs are health care workers. Healthcare providers observe first-hand the effects that illnesses have on people and they understand the importance of disease prevention. Riccò et al. (2017) found that 70-90% of physicians had a positive view of vaccines. Moreover, they noted that the more scientific knowledge that an individual has the more likely they are to favor vaccination. Thus, because health care professionals are scientifically trained or have a degree in the sciences, there is a stronger correlation to a positive view of vaccines. It is vital that healthcare providers find vaccination a necessary and positive practice because they are responsible for administering the vaccines and educating the public on vaccine importance.

Post-Secondary Institutions and Students

Most institutions of higher learning have a positive attitude of vaccines and have required vaccinations for specific diseases that all students must complete before they are able to attend that institution. For example, to attend a public university in Virginia, students are required by state law to be immunized against diphtheria, tetanus, poliomyelitis, measles (rubeola), German measles (rubella), and mumps (Virginia, 2021). Immunizations for meningococcal disease and hepatitis B are also required unless the student is a minor or a parent or guardian signs a refusal waiver. These vaccines are required because there are hundreds of students living in small rooms and these institutions contain many central buildings that are visited by hundreds-to-thousands of students each day. Often, students attend these institutions from a variety of locations, including locations around the world. All these factors cumulate into a prime environment for a disease

outbreak. Therefore, it is important that institutions of higher learning stress the importance of vaccines and require students to have the appropriate vaccines.

Previous studies have found that the attitude of many college students towards vaccines are positive and they view vaccines as an effective way to control disease (Jadhav et al., 2018; Sandler et al., 2020). Despite these positive attitudes, vaccination rates for college students are low due to a low prioritization of vaccination and lack of knowledge in this demographic (Sandler et al., 2020). Many students still hold misconceived views about the safety of vaccines and their risk of contracting the diseases they are being vaccinated against. Sandler et al. (2018) found that the most important factor in college vaccination view was the perceived safety. The lack of education on the issue of vaccination for students in post-secondary institutions is the driving force of the low vaccination rate among students.

Antivaccination Group

Recently, one subgroup that has become more vocal in their negative view of vaccines is the antivaccination group. Jolley and Douglas (2014) state that individuals in this subgroup should be considered conspiracy theorists because of the effects and similarity of their beliefs to those who believe in conspiracy theories. Belief in anti-vaccine conspiracy theories introduces undue fear of the safety of vaccines, which then leads to disillusionment, feelings of powerlessness and mistrust in medical authorities. These factors all cause individuals to not get themselves or their children vaccinated. As such, belief in anti-vaccine conspiracy theories is directly correlated to a decrease in vaccination intent (Jolley & Douglas, 2014).

While anti-vaccine conspiracy theories are not widespread, they are becoming more common in vocal subgroups of people who regularly discuss vaccines on social media platforms (Jolley & Douglas, 2014). For example, one negative vaccine theory mentioned earlier that has

impacted the antivaccination group involves the redacted study by Wakefield and colleagues that linked autism ~~and~~ to the MMR vaccine. Even though this theory has been rejected by the scientific community, many antivaccination parents mistrust the science and continue to believe that the MMR vaccine causes autism (Gross, 2009). Another main concern that triggered this continued belief was that vaccines contained ethyl mercury (thimerosal) as a preservative component. Any infant vaccinated after 1988 could have been exposed to 187.5 mg of thimerosal, which is above the EPA recommended safety levels. Thimerosal has neurotoxic effects and the absorption into the bloodstream from an intramuscular injection, such as a vaccination, is 100% (Dórea at al., 2013). Thus, infant exposure to this toxin fed the conspiracy theories that vaccines caused autism. Importantly, vaccine developers responded quickly and removed thimerosal (the source of the ethyl mercury) from all vaccines by March 2001 (Gross, 2009).

Not only has the link between vaccines and autism been disproven, but the legitimate mercury concern has been removed. Once thimerosal was removed from vaccines, autism rates continued to rise, which would not occur if thimerosal exposure was linked to the increase in autism seen in the United States (CDC, 2020). Unfortunately, the reason this conspiracy still prevails is that medical experts revealed the presence of thimerosal use in vaccines while the conversation about autism was happening. This caused individuals to mistrust the scientific community and to question all assurances of vaccine safety. Now scientific evidence is not enough to dispel these fears. An example of this is that by 2001, the IOM had conducted 8 safety panels that determined that there was no link between child vaccination and autism, and parents continued to fear the side effects (Baker, 2008). Many antivaccination followers believe that

pharmaceutical companies lie about vaccine content for their own financial gain, which only feeds the mistrust and undue fear (Jolley & Douglas, 2014).

Christians

An interesting subgroup that sometimes has a negative attitude towards vaccines is select Christians. The Christian worldview introduces many moral convictions that influence individuals' views of vaccines and vaccine development techniques. One vaccine that is often negatively viewed in this subgroup is the HPV vaccine. A conviction for many practicing Christians is that sex should not be engaged in until a person is married. Since HPV is a sexually transmitted disease, many Christian parents believe that encouraging their child to receive the HPV vaccine communicates that they condone sexual behavior and that this will in turn encourage sexual behavior in their children (Fogel & Ebadi, 2011). This view fails to consider that parents cannot completely control the behavior of their children and that by failing to vaccinate them for HPV, they are potentially increasing their children's risk for diseases like cervical or oropharyngeal cancers.

Another concern that affects the attitudes of the Christian subgroup towards vaccines are the ethics of using fetal tissue for stem cell research for vaccine development. Many Christians believe in the sanctity of life and oppose abortion, and therefore the use of stem cells and tissue from aborted fetuses (Wombwell et al., 2015). Specifically, the MMR vaccine causes the most concern for these individuals because fetal cell lines from an aborted fetus are used in the development of the rubella portion of the MMR vaccine (McKee & Bohannon, 2016). These convictions have caused groups and communities to refuse to vaccinate their families with the MMR vaccine.

In yet another concern, a combination of Christianity with nationalism and libertarian ideals increases vaccine hesitancy. A study by Whitehead and Perry (2020) found that Christian nationalism is the second highest indicator of vaccine hesitancy due to a higher level of distrust in traditional medicine and scientists. Christian nationalists are also more likely to have voted for President Donald Trump, which has been associated with increased vaccine hesitancy. Specifically, Donald Trump has promoted anti-vaccination social media tweets warning readers not to trust doctors about vaccines and suggesting a correlation between vaccination and autism (Hornsey et al., 2020). It is important to note that this is a sub-group of Christians and these attitudes are only in conjunction with specific political ideations.

Racial Minorities

The most important indicator of whether someone will be accepting of vaccines is race (Whitehead & Perry, 2020). As this paper will elaborate on later, distrust in the government plays a key role in vaccine hesitancy. Racial minorities have a long history of being mistreated by the medical community and by the government, resulting in a lasting mistrust in these agencies. This sentiment amongst African Americans has resulted from centuries of slavery and ethical mistreatment in medicine, such as the Tuskegee study (Kennedy et al., 2007). As examples, one study found that black adolescents had a lower probability of vaccination for the flu and another study reported a lower uptake for the HPV vaccine (Webb et al., 2018; Lee et al., 2016).

Social Media

While vaccine hesitancy has been around for a while, it is growing, and a large part has to do with the involvement of social media. A UK study found that two out of five parents had been exposed to negative messages regarding vaccinations on social media (Community Practitioner,

2019). Despite the ability to access more scientific information than ever before, misinformation and fake news are more prevalent than ever. Anyone with a blog can disperse their opinions to millions of individuals across the world and anyone with social media can tailor their feed to create their own echo-chamber of information. While the ability for the average person to disseminate information is an amazing result of widespread internet access, in the case of misinformation it is an extremely dangerous ability. In 2012, 80% of internet users said that they sought out medical information online and 16% of users reported that they sought out information on vaccinations. Noteworthy, 70% of these users reported that the information influenced their treatment decisions (Kata, 2012). The internet has grown immensely since 2012, as has the effect of vaccination misinformation online. In a study of seven different search engines, 43% of the first ten websites that appeared when "vaccination" was searched were antivaccination sites, and 100% of the first ten websites listed were from the Google search engine (Davies et al., 2002). If anyone were to search for information regarding vaccines the likelihood of them encountering negative, antivaccination information is very high.

COVID-19

When COVID-19 hit the world, stage governments across the globe jumped into action, declaring nationwide shutdowns, mask mandates, and social distancing requirements due to high rates of disease transmission. Unfortunately, instead of COVID-19 being a public health issue, the pandemic became a political issue and the U.S. population polarized even further during the 2020 election cycle. During this time, misinformation concerning COVID-19 was spread through social media platforms, resulting in agencies such as the WHO responding with a "Mythbuster" page to fight myths (Sharma et al., 2020). During this time, there was an urgency to quickly develop a vaccine and this expedited process has contributed to the current vaccine hesitancy

towards the COVID-19 vaccine specifically. For example, one study found that thirty-one percent of Americans are planning on rejecting the COVID-19 vaccine and the two most reported reasons for rejection were vaccine safety and effectiveness (Callaghan & et al., 2020). Concerns about the sped-up approval process of the COVID-19 vaccine paired with the heightened emotions surrounding the pandemic have created an environment where vaccine hesitancy can thrive (Vergara et al., 2021). Any campaign to promote COVID-19 vaccination is going to have to dispel negative emotions and navigate the many conspiracies surrounding the pandemic.

Health Behavior Interventions

Since vaccine hesitancy is a relatively new topic of research, there is a dearth of evidence-based programs for behavior intervention. Previous intervention programs focused on dissemination of empirical data to combat myths and conspiracy theories, but as discussed, those approaches were not effective and often decreased the intent to vaccinate (Dubé et al., 2015). Although recent vaccine hesitancy intervention programs do not show empirical effectiveness, constructs from existing health behavior change theories can create an effective program (Kumar et al., 2016).

For example, social marketing constructs can be used to change underlying attitudes towards vaccinations. Social marketing seeks to use commercial marketing techniques and behavioral, persuasion, and exposure theories to change health behaviors (Evans, 2006). These methods target the distrust surrounding vaccines and the social environment of vaccine hesitant groups. Market-segmentation, a main construct of social marketing, involves splitting the target audience into smaller subgroups to tailor communication campaigns to increase effectiveness

(Evans, 2006). Since vaccine hesitant individuals already make up a subgroup of the population, market-segmentation is especially suitable.

Social marketing techniques can also aid immunization programs to identify and understand the physical, social, and economic environmental factors that determine vaccine acceptance and call attention to explore immunization convenience (Nowak et al., 2015). Moreover, these techniques can focus on both tearing down barrier attitudes and promoting benefits to increase trust and vaccine acceptance. Specifically, improved product branding of immunizations can increase vaccine attractiveness to those who distrust the medical system. These efforts require targeting stakeholders and influential people in anti-vaccine groups who could influence the others in vaccine hesitant circles.

As alluded, one priority for vaccine intervention programs is decreasing feelings of distrust and increasing vaccine confidence in those who are vaccine hesitant. Since these individuals have general distrust of government and healthcare agencies it is important to discover communication routes that are trusted by that subgroup. Specifically, churches and community organizations can be key persuaders towards vaccine acceptance. Typically, these organizations are not associated with government or healthcare, thus they can help address the confidence part of vaccine hesitancy. By increasing confidence, the social environment can move away from conspiracy and individualistic beliefs. Additionally, alternative medicine stakeholders, often sought out by vaccine hesitant individuals, can help communicate the necessity of vaccines. These individuals are trusted by those who value being nonconventional and by those who distrust traditional medicine (Lee et al., 2016). In contrast, if a medical provider can develop a trusting relationship with vaccine hesitant patients and the parents of children needing vaccinations, it can make a difference. Parents who were originally hesitant to

vaccinate and changed their minds listed, “information or assurances from health care provider” as being the most common reason that they decided to vaccinate their children (Gust et al., 2008).

Once relationships with organizations that are perceived as trustworthy by vaccine hesitant subgroups are established, more conventional health belief model constructs can address vaccine complacency. For example, these constructs can be used to educate individuals to increase their perceived susceptibility, severity, and benefits. It is important to find benefits and risks that are unique to the subgroup as they distrust the traditional risks and benefits touted by conventional healthcare communities. The product of immunization will have to be specifically branded and will need to be promoted by the right individuals in the correct environments. The marketing strategy will require community outreach and assessment.

Once complacency is addressed, then the focus can shift to vaccine convenience. The price of receiving a vaccine must be minimized and the placement of access must be accessible to make vaccination convenient to the individual (MacDonald, 2015). One perceived price to this subgroup may be pride. Changing their mind on vaccines could be too high a price, especially if they are tightly connected to others in their network who are vaccine hesitant. Once again it will be imperative to target influential stakeholders in the community to help change the social norms and to decrease the social cost. The vaccinations will need to be readily accessible, otherwise all the work put into changing the attitudes of individuals will not result in a measurable outcome. Having vaccination clinics at locations that are trusted and convenient to the subgroup instead of only at traditional clinics could increase vaccine uptake.

Vaccine hesitancy is a complex and evolving area of research. Many different attitudes and components contribute to vaccine hesitancy, which makes creating intervention programs

difficult. Public health professionals need to continue to research vaccine hesitant populations and possible interventions so that there can eventually be a multitude of evidence-based programs to choose from. Until then, components of many health behavior models and theories can be used to create complex, multi-level programs to help increase vaccine acceptance.

Study of Attitudes and Barriers of Public Health Students at Liberty

In 2018 a study on the attitudes and barriers towards the seasonal influenza vaccine in public health students at a large university in southern California was published (Rogers et al., 2018). In their review, Rogers et al. (2018) described literature on influenza attitudes in medical students/residents and in general college students, but up to the time point of their study, no literature had been reported on influenza attitudes in public health students. For example, Lee et al. (2012) reported that though influenza uptake rate in medical students were higher than other students they still rated fear of side effects, lack of vaccine information, lack of perceived risk, and inconvenience as reasons why they did not receive the flu vaccine. Thus, vaccination knowledge was well-reported among medical professionals but a gap in that knowledge existed in public health professionals.

Public health professionals are responsible for educating and promoting healthy behaviors. Therefore, these individuals have an impactful role in enabling communities, worksites, and medical workers to participate in healthy behaviors and become vaccine advocates themselves (Tappe & Galer-Unti, 2001). The attitudes of public health professionals on the seasonal flu vaccine can be just as helpful or detrimental as those of healthcare providers. Importantly, public health students are the next generation of workers in communities and their academic training must include correct information on the importance of vaccines, so they develop positives attitudes on vaccine promotion. To ensure that institutions are educating public

health students to advocate for the influenza vaccine, the attitudes and barriers towards the vaccine must first be investigated and understood. Once known, educational interventions can be developed and implemented to equip students to identify their own vaccine barriers to improve vaccine uptake.

Methods

A cross-sectional study of the attitudes and barriers regarding the influenza vaccination of residential undergraduate public health students attending Liberty University, in Lynchburg Virginia was conducted from September through October 2020. Participants were required to be 18 years of age or older and be a current public health major in Liberty's Bachelor of Science Public Health degree program. A 15-item Google Forms survey that kept participant identity anonymous, was distributed to all public health students through the department emails and Blackboard page. The survey was first distributed in early September and was sent out a second time in early October; the data collection period ceased by the end of October. The first section of the survey contained a consent form requiring individuals to agree to participate and once signed, the students completed the rest of the survey. The study methods were approved by the Liberty University Institutional Review Board.

Rogers et al. (2018) gave permission for the principal investigator of this study to use the attitudes and barriers to influenza vaccination survey that they had developed in the Liberty University sample. However, the original survey questions were adapted to include Liberty University's health services information. By using the same survey, the results reported from the Rogers et al. study were compared more closely to those reported in this study. Specifically, the original survey was in a PDF format and was transferred to a Google Form that allowed participants to answer anonymously. Data were compiled digitally and downloaded for analysis.

The original survey was designed to assess demographic and healthcare access data as well as the attitudes and barriers of the participants. It covered their vaccine history and whether they got the vaccine within the last 6 months. Of all the residential public health students at Liberty University that the survey was sent to, 61 individuals responded. Out of those who responded, 53 provided consent and completed the survey.

For analysis, the data were separated into two groups, those who had been vaccinated withing the past 6 months and those who had either been vaccinated later than 6 months ago or had not been vaccinated all. Research has shown that within 180 days (~6 months) of receiving the seasonal flu vaccine, there is a significant decline in the effectiveness against the flu (Young, Sadarangani, Jiang, Wilder-Smith & Chen, 2018). For this reason, those who had received the vaccine greater than 6 months ago were not considered as having the vaccine for the current season.

The descriptive statistics (sex, race, campus residence, year of undergraduate study, health insurance, last check-up) were compared between the group that had received the vaccine and those who had not. These two groups were compared using percentages of those who did or did not receive the flu vaccine. In addition, a comparison t-test and Fisher's exact test were performed on the data. Many data values were less than 5 and some were zero, therefore, a chi-square test could not be completed. All tests were run with a significance p-value of <0.05. The mean and standard deviation (SD) of the ages of both groups were analyzed using an independent t-test. The remaining descriptive data were analyzed using a Fisher's exact test.

The students that had not received the flu vaccine in the last 6 months were asked to answer a series of 8 Likert statements on their degree of agreement with the reasons not to get vaccinated. The scale included: "strongly disagree (1)", "disagree (2)", "agree (3)", and "strongly

agree (4)". The mean scores and the standard deviation (SD) were calculated for comparison. The percent agreement was also calculated, and the statements were ranked 1-8, from highest percentage of agreement to lowest. To calculate percent agreement all "agree" or "strongly agree" answers were tallied against the total responses.

Results

Fifty-three public health students responded and consented to participate, 84.9% were female and the most reported racial group was white/caucasian. The largest class of students were juniors (45.%) in the program and 56.6% reported that they lived off campus. Over half (64.1%) of the respondents said that they had been to a medical provider in the last 6 months, 45.3% said that they had visited the health clinic at Liberty Univerity, and 56.6% reported that they had health insurance. The vast majority of students (96.2%) who participated reported that they had been encouraged by a source to receive the influenza vaccine. All demographic variables were compiled into a table (Table 1) that was divided by the percentage of those who received the influenza vaccine within the last 6 months and those who had not. Only 15.1% reported that they had recived the flu vaccine. The only statistic that was signifficant was whether the individual had health insurance or not with a p-value of 0.007.

Table 1

Demographic and health related characteristics of respondents

	Received the Vaccine (%)	Did not Receive the Vaccine (%)	value*
Total	8 (15.1)	45 (84.9)	-
Age mean (SD)	20.37 (1.061)	20.35 (1.811)	0.976
Sex			0.195
Male	0 (0)	8 (100)	
Female	8 (17.8)	37 (82.2)	
Race/ethnicity			0.838
White/Caucasian	8 (17.4)	38 (82.6)	
Black/African American	0 (0)	1 (100)	
Hispanic/Latino	0 (0)	1 (100)	
Asian/Pacific Islander	0 (0)	1 (100)	
Multiracia/Other	0 (0)	4 (100)	
Campus residence			0.715
On campus	4 (17.4)	19 (82.6)	
Off campus	4 (13.3)	26 (86.7)	
Year of undergraduate study			0.709
Freshman/Sophomore	2 (20.0)	8 (80.0)	
Junior	4 (17.4)	19 (82.6)	
Senior	2 (10.0)	18 (90.0)	
Health insurance			0.007
Yes, I have health insurance	8 (26.7)	22 (73.3)	
No, I do not have health insurance	0 (0)	23 (100)	
The last time you went to a medical provider for a check up			0.082
In the past month	4 (40.0)	6 (60.0)	
In the past 6 months	4 (16.7)	20 (83.3)	
6-12 months ago	0 (0)	9 (100)	
Between 1-2 years	0 (0)	6 (100)	
More than 2 years	0 (0)	4 (100)	

Students that did not receive the vaccine were asked to answer a series of Likert scale statements of common reasons for not wanting to receive the flu vaccine. These statements and the data are organized in Table 2. Out of the students that received the vaccine in the last 6 months 29.7% agreed with, “I believe that as a result of the flu shot I may actually get the flu” and 30.8% agreed that “I do not believe I am in danger of contracting the flu”, making these statements the two most reported. The statements “I was not informed that flu vaccines might be important” and “I do not believe in vaccines for religious or cultural reasons” were both ranked

as the second lowest with 2.7% of respondents agreeing. No students reported that they agreed with lowest ranking statement, “I do not know where to receive the flu vaccine”.

Table 2

Potential barriers to receiving the influenza vaccine

	N	Mean (SD)	% agreement	Rank
Vaccines are too expensive for me right now	37	1.43 (0.689)	5.40%	5
I do not have time to get a flu vaccination	37	1.92 (0.954)	24.3%	3
I do not know where to receive the flu vaccination	37	1.24 (0.435)	0.00%	7
I believe that as a result of the flu shot I may actually get the flu	37	1.84 (0.986)	29.7%	2
I do not believe I am in danger of contracting the flu	39	2.13 (0.951)	30.8%	1
I believe vaccines may have dangerous side effects	37	1.89 (0.936)	21.6%	4
I was not informed that flu vaccines might be important	37	1.38 (0.545)	2.70%	6
I do not believe in vaccines for religious or cultural reasons	37	1.30 (0.617)	2.70%	6

Discussion

Despite the statistical analysis of the demographic data not being usable due to the small sample size, the more interesting and relevant data are found in the attitudes and barriers of the individuals who did not receive the flu vaccine. The most listed reason for not receiving the influenza vaccine was “I do not believe that I am in danger of contracting the flu” with 30.8% agreement. This finding supports the health behavior theory construct that low perceived susceptibility results in lower motivation to engage in a health behavior. In the study conducted by Rogers et al. (2018), this statement was ranked as the 4th most reported with 28.9% agreement, which is similar to the percentage agreement in this study.

Public health students are taught statistics and facts about health conditions throughout their education, yet many still do not believe that they are in danger of contracting the flu. Evidence shows that narratives and personal examples are more effective at communicating risk and susceptibility than statistics, especially those with increased emotional content (Ahn, 2016; Betsch, Ulshöfer, Renkewitz & Betsch, 2011). More communication methods containing these elements need to be included in public health education. The result will not only be an increase

in the number of public health students that believe that they are susceptible to contracting the flu but also serve to demonstrate how this type of communication can be used for their own work.

The second most listed reason reported in this study for not taking the vaccine was "I believe that as a result of the flu shot, I may actually get the flu" with 29.7% agreement. This is a common myth about the seasonal influenza vaccine. Nyhan and Reifler (2015) found in their research that the belief that the flu shot gives you the flu was the most cited reason for not receiving the seasonal influenza vaccine. Similarly, the same statement was ranked as the most reported barrier in the study by Rogers et al. (2018), with a 49.4% agreement amongst public health students. It is concerning that public health students that have undergone classes on vaccines and their importance would hold that attitude. Public health students need to evaluate their own incorrect beliefs about the flu vaccine to be effective in promoting the influenza vaccine.

Refuting myths in the public can be difficult. In individuals with high levels of concern of contracting the flu from the vaccine, corrective information was found to cement their belief in the myth while corrective information was found to be effective in counteracting the myths (Nyhan & Reifler, 2015). Healthcare professionals can play the most important role in counteracting myths if they are trusted (Edwards & Hackell, 2016; Nyhan & Reifler, 2015). Similarly, public health workers can have an impact if they gain the trust of their clients. Motivational interviewing and health counseling techniques need to be emphasized in public health education to equip students with the tools necessary to build trust with clients and communities. When public health workers promote health behaviors that they don't believe themselves it can be perceived as hypocrisy, which results in distrust from others (Weiss et al., 2018). When teaching on the importance of vaccines, professors cannot assume that students

have a proper baseline understanding of vaccines. Myths and conspiracies regarding not only the influenza vaccine but other vaccines as well need to be dispelled in the classrooms. This needs to be made one of the priorities of public health education programs in colleges and universities.

The third most common reason given for not taking the vaccine in this study was, “I do not have time to get a flu vaccination” with 24.3% agreement. This result indicates that there is a need to increase the accessibility of vaccines for students at Liberty University. Likewise, accessibility was a barrier in the study by Rogers et al. (2018). Not having time to receive a flu shot was the 2nd highest barrier with 44.9% agreement. In the Liberty University study, about 45% of respondents reported they had used the on-campus Liberty University Health Center and about 43% said that they live on campus. Of the students that live on campus, 83% did not receive the flu vaccine. The influenza vaccine is covered by the Student Health fee that is paid to attend the university (Liberty University, 2021). Public health students need to be made aware of the resources that are available to them through Liberty University. For off campus students, access may be more difficult due to travel, but the on-campus health center is still available to them. Advertising the ability to receive the influenza vaccine would also be beneficial for the 51% of students who did not receive the flu vaccine that do not have health insurance. Having health insurance was significantly linked to whether students received the vaccine. Better advertisement of the medical resources and influenza vaccine availability at Liberty University would not only benefit the public health students but the entire student body.

The most reported reasons for not receiving the vaccine are insightful but so are the lowest reported barriers. The two attitudes, “I do not know where to receive the flu vaccine” and “I was not informed the flu vaccine was important” were reported at 0% and 2.7% agreement, respectively. Likewise, both sentiments were reported at low percentages, 9.5% and 10.7%

agreement, in the Rogers et al. (2018) study and were ranked 6th and 5th. These show that there is not a lack of knowledge among the public health students regarding the importance of the flu vaccine or where to get one. This supports the concept that health knowledge does not always translate to health behavior (Faries, 2016). In a study done by Corace and Garber (2014) in Florence, Italy, researchers found that vaccination rates were still very low among educated health care workers. Further steps must be taken to move individuals from knowledge of a health behavior and initiating it for themselves. About 50% of Liberty public health respondents said that they intended to receive the flu vaccine for the current 2019-2020 flu season. While it appears promising, intentions do not always translate to health behavior. Intention only accounts for 30-40% of health behavior, the rest is determined by other intrinsic and extrinsic barriers (Faries, 2016).

Consequentially, barriers need to be removed to increase vaccine uptake. Several barriers of Liberty University public health students have been discussed. If each one of these barriers was addressed in a health promotion campaign aimed at increasing awareness in public health students, an impact could be made. In addition, any intervention aiming to increase influenza vaccination rates in public health students should be paired with an educational component on how to use the same interventions in their work. Lee et al. (2012) concluded that increasing routine reintroduction of the influenza vaccine among medical students and incorporating evidence-based education on vaccination would be beneficial for vaccine uptake amongst students. For example, portions of the public health curriculum could be changed to include focused information on the influenza vaccine and vaccine hesitancy, which could be effective in targeting public health students' attitudes towards the vaccine. Moreover, if focus were geared

toward improving vaccine knowledge in public health students, these students could have a positive effect on other students around them and the communities that they one day educate.

Limitations

The conclusions discussed in this study should be interpreted considering a few limitations. One limitation of this study is the small sample size, which limited statistical power and generalization of the results to a larger population. This study utilized convenience sampling, which could skew the data collected. The students that chose to answer the survey might not give representative responses that reflect the attitudes and barriers to vaccine uptake that the whole undergraduate public health student population at Liberty University would have given. The lack of diversity in the Liberty University public health program is another limitation. The majority of respondents were female and white. A homogenous demographic is going to have more similar answers than a more diverse group, limiting the ability to generalize the findings to a different population of public health students.

Conclusion

Vaccine hesitancy is a complex issue that ranges from vaccination delays to vaccine denial based on conspiratorial myths. Though the definition is relatively new, the concept has existed since vaccines were first introduced and it manifests differently in various groups. This makes interventions aimed at decreasing negative attitudes towards vaccine difficult since motivations vary. Progress can be made with careful study of health behavior and knowledge of the target audience. Public health students are not exempt from vaccine hesitancy and they fall victim to the same incorrect attitudes and barriers as everyone else. Importantly though, public health workers are influential in the education of communities, workplaces, and medical settings.

Therefore, it should be a priority to implement interventions that increase their vaccination rates and, in the process, increase their ability to educate others in their future workspaces.

In conclusion, this paper has reached all its presented objectives. A thorough examination of vaccine history and vaccine hesitancy was conducted. A study and analysis of the attitudes and barriers of public health students at Liberty University resulted in helpful data in the future of public health education. Interventions in public health students and their education were discussed.

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