Mandates, Mistrust, and Misconceptions: An Overview of Vaccine Hesitancy

Evelyn Ryan

A Senior Thesis submitted in partial fulfillment
of the requirements for graduation
in the Honors Program
Liberty University
Spring 2023

Acceptance of Senior Honors Thesis

This Senior Honors Thesis is accepted in partial
fulfillment of the requirements for graduation from the
Honors Program of Liberty University.

Ken Thompson, PharmD
Thesis Chair

Heather Humphreys, DNP
Committee Member

Cynthia Goodrich, EdD
Assistant Honors Director

Date

Abstract

Vaccines are one of the most successful ways to prevent diseases and are considered one of the most influential achievements in the history of public health. While vaccines have many benefits, the number of parents that refuse vaccinations for their children is increasing. People are concerned about potential risks and health problems that are thought to result from vaccination. There are risks and contraindications involved with vaccines, but many reasons for vaccine hesitancy that are cited by the public are not founded on evidence-based data. When making vaccine decisions, it is essential that the public has accurate information and that healthcare professionals are equipped to address concerns.

Mandates, Mistrust, and Misconceptions: An Overview of Vaccine Hesitancy

Vaccines are among the most instrumental achievements in the history of global public health (Macintosh et al., 2021). Over the centuries, the development of vaccines has made significant progress in public health and medical science. Immunization is one of the most successful ways to prevent morbidity and mortality in vaccine-preventable diseases (VPDs) (Makarić et al., 2018). The first vaccine, developed in 1792 by Edward Jenner, eventually led to the eradication of smallpox from the world (Burchum & Rosenthal, 2019; Geoghegan et al., 2020). Today in the United States, vaccines have decreased the incidences of numerous diseases (Burchum & Rosenthal, 2019). Five in particular – smallpox, diphtheria, poliomyelitis, rubella, and measles – have been virtually eradicated in the U.S. due to vaccines. Other diseases, such as *Haemophilus influenzae*, are significantly declining (Macintosh et al., 2021).

Vaccines continue to reduce diseases around the world and have been improving and advancing (Macintosh et al., 2021). Several vaccines can now be combined into one injection, reducing the number of injections for children. Vaccines are also an extremely cost-effective way to promote health and eradicate illness. It has been calculated that if all children were vaccinated according to the recommended schedule, $14 billion could be saved in healthcare costs throughout their lifetime (Macintosh et al., 2021).

Despite the great successes and advancements that vaccines have brought, the occurrences of VPDs appear to be increasing (Kubin, 2019). In 2018, approximately 700,000 children died of VPDs, with most of these deaths occurring in low- to middle-income countries (Frenkel, 2021). This number is small in the U.S. at 300 VPD-related deaths per year, but it seems to be rising (Kubin, 2019). A huge reason for this increase is thought to be because of declines in vaccination rates (Hotez, 2019). One study found that while 70% of children have

completed all of the vaccines recommended by age 2, 75% did not do so within the appropriate timeframe suggested by the vaccine schedule.

This research paper will address common misconceptions about vaccines as well as legitimate concerns about vaccines. It will examine the benefits and the risks of specific vaccines as well as vaccines in general, aiming to provide an overview and differentiate fact from myth. It is of the utmost importance that people can know the facts and make informed decisions based on trustworthy evidence.

Introduction to Vaccine Hesitancy

A vaccine is a preparation containing microbes that cause the host to produce antibodies against that specific microorganism (Burchum & Rosenthal, 2019). There are many different kinds of vaccines. Some contain microbes that are dead, while some contain live microbes that have been weakened. Vaccines provide people with active immunity by prompting them to make their own antibodies, resulting in immunization against a certain disease (Burchum & Rosenthal, 2019).

One of the largest factors in the prevention of VPDs is parental acceptance of immunizations (Makarić et al., 2018). Concerns about vaccine safety have always been prevalent, but parental hesitancy to vaccinate children has been increasing in recent years. Information about vaccine safety is readily found on the internet and in the media. Many parents are doubting vaccine safety, effectiveness, and necessity. Consequently, many are choosing to delay or refuse vaccinations for their children. This raises the greatly debated subject of vaccine hesitancy, in which people are unsure about one or more vaccines and may delay or refuse vaccination (Sahni et al., 2020). Each year, 2.1 million children between the ages of 1 and 3

receive few or no vaccinations (Burchum & Rosenthal, 2019). In some areas of the U.S., over 50% of children are behind the recommended vaccination schedule.

While these diseases are still considered eliminated in the U.S., measles, mumps, and pertussis continue to have outbreaks (Kubin, 2019). These resurgences are due to parental refusal to vaccinate, delays in vaccination, waning immunity, and imported cases from global travel. Refusals to vaccinate result in decreased herd immunity, which can alter the ability to produce effective antibody responses and the non-exposure time between the virus and immunization. This leads to less effective vaccines and waning immunity, as with acellular pertussis, tetanus, and influenza, all of which require booster doses (Kubin, 2019).

Reasons for Vaccine Hesitancy

In 2019, the World Health Organization (WHO) named vaccine hesitancy one of the top ten global health threats (Geoghegan et al., 2020). Several specific concerns are held by many people, especially parents. In the United States, the most common reason for vaccine refusal is the fear that they will cause harm (Macintosh et al., 2021). Parents are worried that vaccines, namely the measles, mumps, and rubella (MMR) vaccine, cause autism in children (DeStefano et al., 2019). Another concern is that immunizations cause neurodevelopmental disorders, Guillain-Barré syndrome, and autoimmune diseases. Others believe that giving too many vaccinations too early in life may predispose a child to health and developmental issues later in life. It is also a common belief that certain vaccines are not necessary or beneficial (Pluviano et al., 2019). Additionally, many people have simply lost confidence in the advice of medical personnel, public health officials, and the government. Each of these reasons for vaccine hesitancy will be evaluated. Myths will be disproved, misconceptions will be discussed, and the legitimate risks of vaccines will be addressed.

Autism and the MMR Vaccine

Of all concerns regarding vaccinations, none are as prevalent as the fear that the MMR vaccine can cause autism spectrum disorder (ASD) (DeStefano et al., 2019). This belief originated in 1998 from an article in *The Lancet*, a scientific journal. The article described 12 children with a history of pervasive developmental disorder and intestinal abnormalities, 9 of which had autism. The article claimed that there was a link between the development of autism in these children and the MMR vaccine. However, the only evidence presented for this claim was that worsening behavioral problems were reported in 8 of the children shortly after they received the MMR vaccine. The article was eventually retracted by the journal due to improper subject recruitment and reports of financial conflicts of interest. Because of the insufficient evidence, minuscule sample size, and illegitimate methods used by the researchers, this article does not hold up to its claims. Although it was retracted, the article gained so much attention in the media that MMR vaccinations began to decrease, resulting in more cases of measles and related deaths (DeStefano et al., 2019).

Numerous studies have been done since 1998, trying to identify a correlation between the MMR vaccine and ASD (DeStefano et al., 2019). To this day, no such correlation has been found. The evidence against any correlation between the vaccine and autism is very strong, simply because no study has ever supported it. Children whose older siblings have ASD are considered to be at a higher risk for developing the disorder. Researchers have searched for a connection between ASD and the MMR vaccine in this population. Even with their high-risk status, the studies have found no correlation at all.

Although it is usually not diagnosed until 2 or 3 years of age, autism is a neurodevelopmental disorder that is thought to develop changes in the brain before the child is

even born (Hotez, 2019). There has never been an established cause for autism, but it is thought to have a genetic component (Breggin, 2021; Hotez, 2019). Scientists have identified at least 99 genes that can be associated with autism (Hotez, 2019). Since the changes in the brain occur prenatally according to neurobiology, it is not likely that a vaccine administered during infancy or childhood could cause this disorder (DeStefano et al., 2019; Hotez, 2019). These developmental studies are even further evidence against any correlation or causation between MMR vaccination and ASD.

Even with significant evidence to the contrary, many people continue to question the safety of the MMR vaccine (DeStefano et al., 2019). Reportedly, up to 40% of parents of children with ASD believe that vaccines either caused or contributed to the disorder (Sahini et al., 2020). Parents of children with ASD have been found to have higher rates of vaccine hesitancy, declining to vaccinate their other children. The younger siblings of children with ASD are more likely to be under-immunized compared to their peers, either delaying vaccinations or refusing them altogether (Sahini et al., 2020).

According to the Centers for Disease Control and Prevention (CDC) (2023), there were 1,274 confirmed individual cases of measles in the United States in 2019. The cases occurred in 31 states and made up the highest number of measles cases seen in the U.S. since 1992. The CDC (2023) attributes this to an increased number of international travelers who bring measles to the U.S. and the spread of the disease in communities with large numbers of unvaccinated people. Most of these cases were among people who had not received the MMR vaccine. These outbreaks are more likely to occur in areas of the country where groups of people are unvaccinated. The number of measles outbreaks also increased in Europe, where cases rose from 5,000 in 2016 to 53,000 in 2018 (Hotez, 2019).

While the risk for measles remains very low for the general population of the U.S., it is still brought into the country by travelers (CDC, 2023). This causes outbreaks, which mostly affect unvaccinated people. Measles is highly contagious and can cause serious complications, especially in young children. It is usually the first breakthrough infection that is seen in unvaccinated school children because it is so contagious (Hotez, 2019). An increase as small as 5% could potentially triple annual measles cases (Kubin, 2019). Usually, the infant siblings of infected children are the most affected by measles (Hotez, 2019). It can potentially lead to pneumonia, encephalitis, or death (CDC, 2023). The MMR vaccine is effective in protecting against measles and rarely causes side effects. Some researchers would argue that the controversy surrounding this issue has distracted the public from focusing on other risks of vaccines that are legitimate (Breggin, 2021). These risks must be discussed, but the attention must move away from autism.

Too Many, Too Soon

In addition to the fears about autism, a big concern among parents is that a child's immune system can be overwhelmed by receiving too many vaccines so early in life (Geoghegan et al., 2020). It is true that children receive the most vaccines during the first year of life. This is when they are the most vulnerable to disease and more susceptible to complications. In some areas, it is recommended that children receive over 30 doses of vaccinations by 2 years of age, immunizing them from over 20 different diseases. They may receive up to 5 vaccines at one time (DeStefano et al., 2019). This schedule may concern parents, who worry that their child's immune system can be overwhelmed or weakened by receiving multiple vaccines (Geoghegan et al., 2020). They are also concerned that neuropsychological problems may result from giving too many vaccines early in life.

While it is true that the recommended number of vaccines for children has increased over time, the immunologic components in the vaccines have decreased (Geoghegan et al., 2020). Centuries ago, the smallpox vaccine contained approximately 200 proteins. Today, the 14 vaccines on the recommended schedule in the U.S. contain 160 immunologic components combined. These components include viral proteins, bacterial proteins, and bacterial polysaccharides. Advancements in protein chemistry and purification have allowed the simplification of vaccine components. The discovery of recombinant DNA technology has also resulted in vaccines being produced with fewer antigens (Geoghegan et al., 2020).

Many people are concerned that neuropsychological issues may result from administering too many vaccines, but researchers have found no correlation between the number of vaccines administered and the development of neuropsychological issues (Geoghegan et al., 2020). Delaying the vaccination schedule also has no positive effect or apparent neuroprotective benefit, as there has not been found any difference in neuropsychological outcomes for those who followed the recommended schedule compared with those who delayed (Geoghegan et al., 2020).

Numerous studies have found no difference between the immune function of children who had multiple vaccines and children who had none (Geoghegan et al., 2020). This suggests that vaccines do not weaken or overwhelm the immune system in any way. Research has found that, theoretically, infants could respond to at least 10,000 vaccines at one time (DeStefano et a., 2019). This is estimated based on infants' number of circulating B cells, the number of vaccine-specific antigens they are exposed to in their first few years of life, and the number of antibodies that are necessary to react to those antigens. Studies have found no long-lasting changes to the immune systems of children who followed the recommended vaccination schedule and no

increased risk of disease that correlates to the number of vaccines received. Based on these research findings, the immune systems of infants can handle the current vaccination schedule. No increased risk of damage to the immune system has been discovered (DeStefano et a., 2019).

In addition to beliefs that vaccines can weaken the immune system, it has also been speculated that vaccines can cause autoimmune disorders such as type 1 diabetes and multiple sclerosis, but there has not been an explanation presented on how this could occur (DeStefano et al., 2019). Numerous studies have been done on several specific vaccines, including MMR, diphtheria, tetanus, and pertussis (DTAP), influenza, hepatitis B, and human papillomavirus (HPV) vaccines. There has been no association found between vaccines and autoimmune disorders (DeStefano et al., 2019).

The recommended vaccine schedule considers the weaning of maternal antibodies, immune system maturation, susceptibility to disease, and the effectiveness of the vaccines (Geoghegan et al., 2020). It takes all these factors into account and plans the dosages accordingly. Delaying or refusing the vaccination schedule does not prevent immune disorders or neuropsychological problems (Geoghegan et al., 2020).

Harmful Ingredients

In addition to concerns about autism and the number of recommended vaccines, people are also worried that many vaccines contain ingredients that may cause harm (Geoghegan et al., 2020). The foremost subject of concern is mercury. Some vaccines contain thimerosal, which is a compound that contains the substance ethylmercury. It is true that some forms of mercury can accumulate in large amounts in the body and are toxic to the brain. However, ethylmercury is a specific type of mercury that is not neurotoxic. When it enters the body, it is cleared very quickly from human tissues and does not accumulate in large amounts. Some people also fear

that thimerosal can cause autism, but there has been no evidence found for this claim (Burchum & Rosenthal, 2019). As of today, thimerosal is being gradually removed from vaccines. There are only a few certain influenza vaccines that contain a small amount of thimerosal as a preservative. If these vaccines are used, they contain an extremely low amount that is considered safe by both the U.S. Food and Drug Association (FDA) and the Environmental Protection Agency (EPA). No risks associated with thimerosal in vaccines have been identified (Geoghegan et al., 2020).

There are also fears concerning aluminum in vaccines (DeStefano et al., 2019). Aluminum has been used in vaccines since the 1930s as an adjuvant to boost the immune response. Including a small amount of aluminum in the ingredients allows for smaller amounts and fewer doses of the vaccines. Currently, it is used in hepatitis A, hepatitis B, DTAP, *Haemophilus influenzae* type b (Hib), and pneumococcal vaccines. While a certain amount of aluminum in the bloodstream can be harmful, studies have shown that the aluminum in these vaccines leaves the body's serum aluminum levels well below the toxic range. Researchers have tested children's blood and hair aluminum levels as well as their levels of development. They have found no correlation between tissue aluminum concentrations and vaccine history. Additionally, no evidence connects aluminum concentrations with cognitive, language, or motor developmental status. It has been shown that the amount of aluminum in a vaccine is less than the amount that babies receive from breast milk and formula. While the presence of aluminum in a vaccine may sound concerning, the amount is simply far too little to pose a risk (DeStefano et al., 2019).

Lack of Necessity

Several studies have shown that another reason for vaccine hesitancy is a perceived lack of necessity (Gidengil et al., 2019). People may believe that immunity that is gained from the actual infection, also known as natural immunity, is more beneficial than the artificial immunity from vaccines. Others believe that natural remedies or lifestyle modifications can achieve the same effect as vaccines. Notably, few people in the United States have experience with VPDs because many of them are scarce or have been eliminated (Makarić et al., 2018). It is for this reason that many people question the necessity of vaccines today. Ironically, this doubt in vaccine necessity is a result of the effectiveness of vaccines. They have become so successful that people forget why they are needed. Although it is not as obvious in the U.S., vaccines still save lives. Studies estimate that vaccinations prevent approximately 2-3 million deaths worldwide each year (Mahmud et al., 2021).

Guillain-Barré Syndrome

Guillain-Barré syndrome (GBS) is an acute, immune-mediated polyradiculoneuropathy that is contracted in rare cases (Principi & Esposito, 2019). It occurs in 0.4 to 4 cases per 100,000 in the population, with the highest incidence in males over the age of 75. GBS classically presents with progressive, bilateral, relatively symmetric weakness of the limbs and generalized hyporeflexia or areflexia. In severe cases, patients can experience ascending paralysis. Symptoms progress over 12 hours to 28 days until they reach a plateau. In most cases, these patients fully recover within a few weeks. GBS causes death in approximately 5% of cases, usually due to respiratory difficulties or infection (Principi & Esposito, 2019).

Over 60% of GBS cases are caused by infection (Principi & Esposito, 2019). The most common causes are *Campylobacter jejuni* and cytomegalovirus infections, but GBS can also be caused by influenza. It has also been associated with *Mycoplasma pneumonia* and Epstein-Barr

virus, as well as varicella, measles, and *Haemophilus influenzae* on rare occasions. Studies have also found that some vaccines are possible causes of GBS as well (Principi & Esposito, 2019).

Numerous studies have been conducted on the influence of the influenza vaccine on GBS, with mixed results (Principi & Esposito, 2019). The evidence does seem to suggest that the influenza vaccine can, on rare occasions, result in GBS. The risk varies depending on the season, but it is extremely small (DeStefano et al., 2019). In fact, the risk of GBS from the flu vaccine is so minimal and the incidence so low that they cannot be calculated by studies (Principi & Esposito, 2019).

In the influenza pandemic of 2009, most cases of GBS were diagnosed in children who had not received the influenza vaccine (Principi & Esposito, 2019). It has been shown that, because influenza can cause GBS and the influenza vaccine prevents influenza infection, the vaccine can actually lower the risk of developing GBS. This depends on the effectiveness of the vaccine and the risk of contracting influenza. In general, however, the risk of developing GBS from influenza is thought to be higher than the risk from the vaccine because influenza is a stronger risk factor (DeStefano et al., 2019; Principi & Esposito, 2019). Principi & Esposito (2019) found that most of the time, influenza vaccination will likely decrease the risk of developing GBS.

The HPV vaccine has also been found to be associated with GBS, but the incidence is estimated to be 1 case per million HPV vaccine doses at the highest (Principi & Esposito, 2019). Studies have found no association between GBS and the MMR, meningococcal conjugate, polio, pneumococcal, varicella, Hib, rabies, tetanus, diphtheria, hepatitis A, or hepatitis B vaccines (DeStefano et al., 2019). Overall, the incidence of GBS resulting from vaccinations is so low that it cannot be demonstrated in research (Principi & Esposito, 2019). Principi & Esposito

(2019) reported that approximately less than 1 case of GBS occurs per million immunized people. Based on the evidence and the benefits of vaccines versus the risks, GBS does not appear to be a sufficient reason for vaccine hesitancy.

Specific Vaccine Concerns

In addition to doubts about vaccine effectiveness, questions about their necessity, and fears that they may cause certain diseases or disorders, many people have concerns about specific vaccines. A few of these include the recent COVID-19 vaccine, the HPV vaccine, and the influenza vaccine.

COVID-19 Vaccine

Aside from concerns about vaccines in general, many questions have arisen about the safety of several specific vaccines. In recent years, a subject with much controversy and debate has been the COVID-19 vaccine. COVID-19 is a respiratory infection that is triggered by the severe acute respiratory syndrome coronavirus 2 (SARSCOV-2) virus (Mahmud et al., 2021). In recent years, COVID-19 outbreaks have resulted in border closings, bans on travel, and quarantine guidelines across the world. The virus caused a worldwide pandemic and has killed millions of people in only a few years.

Ever since the emergence of the virus, scientists have been working to discover a vaccine (Mahmud et al., 2021). Vaccines for COVID-19 are being administered in great numbers. As of 2022, over 500 million doses have been given in the U.S. (Mushtaq et al., 2022). In the past, many vaccines have been developed during an outbreak and have helped to control the spread of disease, such as the H1N1 outbreak of 2009 (Mahmud et al., 2021). However, as COVID-19 vaccines are being developed, many people are hesitant or unwilling to receive them. According to various studies, higher vaccination intentions were correlated to the belief that the COVID-19

pandemic would continue for a long period of time, while lower vaccine intentions were linked to the belief that the situation has been overinflated and exaggerated by the media. The top reasons for hesitancy with the COVID-19 vaccine appear to be doubts about its side effects, safety, and efficacy (Mahmud et al., 2021).

While COVID-19 vaccinations are associated with decreases in infections and deaths, they are also associated with adverse hypersensitivity reactions and potentially lethal side effects (Novak et al., 2021). Most reactions to the vaccine were local cutaneous reactions at the site of injection. Patients who did experience anaphylaxis due to the vaccine usually had a history of an allergic reaction to medications, routine vaccines, or contrast media. Certain components of the vaccines are being examined for possible causes of these hypersensitivity reactions. PEG is a component in many drugs and cosmetic products that may cause some allergic reactions, as well as the substances tromethamine and polysorbate 80. Based on this information, the COVID-19 vaccine should be avoided in any person who has a previous history of allergic reactions to its components. Those who have allergies to the medicaments of routine vaccines should exercise caution (Novak et al., 2021).

There have also been thrombotic events associated with the COVID-19 vaccine (Rees, 2022). These events are estimated to occur in approximately 1 in 100,000 to 1 in 1,000,000 cases. Thrombocytopenia, thrombosis, and hemorrhages have been occasionally reported in temporal proximity to the administration of more than one type of COVID-19 vaccine. Within 5-20 days after receiving the vaccine, a small number of people experienced thrombosis in cerebral veins or intracranial hemorrhage. In some cases, these events were fatal. After these cases, which have proved rare but dangerous, thrombotic thrombocytopenia was included in the warnings as a rare side effect. However, an important note is that the development of cerebral

venous thrombosis (CVT) is 41 times more likely in patients with COVID-19 than in those without COVID-19 (Mushtaq et al., 2022). Consequently, vaccination provides a greater benefit regarding the risk of CVT. Notably, after approving the administration of the Ad26.COV2.S vaccine in April 2021, the CDC included a warning about the risks of thrombosis for women under the age of 50 with these vaccines (Mushtaq et al., 2022).

Another adverse effect of concern is myocarditis, which is a condition involving inflammation of the heart tissue (Mushtaq et al., 2022). Over 10,000 cases of myocarditis have been reported after COVID-19 vaccination, usually in teenagers and young adults after the second dose. Researchers have also noted that, while the risk of myocarditis slightly increases after vaccination, causality is difficult to attribute to the vaccine because many patients tested positive for the COVID-19 virus before or after receiving the vaccine. In individuals who do develop myocarditis after the COVID-19 vaccine, the clinical course is typically mild, rarely involving serious complications or hospitalizations. One study estimated the risk of myocarditis after vaccine administration to be 77 cases per million in males 12-17 years of age (Heidecker et al., 2022). At the same time, males of this age developed myocarditis at a rate of 450 cases per million COVID-19 infections. It is evident from this data that the risk of myocarditis from COVID-19 infection is much greater than the risk of myocarditis from the COVID-19 vaccine. When compared with the risk of hospitalization, severe complications, and death from the COVID-19 virus itself, the risk of developing post-vaccine myocarditis is considerably less, especially in older adults.

It has also been speculated that the COVID-19 vaccine can potentially cause fertility issues, in both males and females (Zace et al., 2022). However, when comparing vaccinated groups to unvaccinated groups, fertility rates did not significantly differ. A study by Zace et al.

(2022) found that sperm concentration and volume were not affected by vaccination. Pregnancy rates and estradiol levels also did not significantly differ between vaccinated and unvaccinated women. Testosterone, fetal stimulating hormone (FSH), and luteinizing hormone (LH) levels also did not change. This information suggests that as of today, there is no proof that COVID-19 vaccines are associated with infertility. It can also be noted that the COVID-19 infection could harm reproductive health, in which case the vaccine would be a protective measure against reproductive issues (Zace et al., 2022).

Overall, the data suggest that the risks of hospitalization and death related to COVID-19 infections are significantly greater than the risks from myocarditis associated with COVID-19 vaccination (Heidecker et al., 2022). It has also been shown that COVID-19 vaccines considerably reduce the risk of infection (Nagy et al., 2023). The efficacy rates range from about 70-94%, depending on the type of vaccine. Despite the possible side effects, the COVID-19 vaccine is considered very safe and protective against the virus itself and its associated complications (Heidecker et al., 2022).

HPV Vaccine

Even among parents who fully vaccinate their children, the HPV vaccine is often an exception (as is the influenza vaccine) (Gidengil et al., 2019). Genital human papillomavirus currently remains the most common sexually transmitted infection (Burchum & Rosenthal, 2019). HPV infects approximately 14.1 million people every year in the U.S. It affects about 50% of sexually active people, both males and females, during their lifetime. Most cases are benign and clear within a few months, never involving genital warts or cancerous lesions. However, cervical cancer is the third most common cancer among women across the world, affecting over 500,000 women each year (Burchum & Rosenthal, 2019). The U.S. sees much

fewer cases because most women have regular Papanicolaou (Pap) tests to detect cancer early. HPV is the cause of almost all anogenital warts and cervical cancers. It also causes many cases of oral and anal cancers (Burchum & Rosenthal, 2019).

People have many concerns regarding the HPV vaccine (Gidengil et al., 2019). The recommended dose is the Gardasil 9 vaccine, which protects against 9 types of HPV (Burchum & Rosenthal, 2019). Many parents choose not to vaccinate their child for HPV because they question its necessity for a child who is not sexually active (Gidengil et al., 2019). Many see it as a morality issue and fear that vaccine administration will imply sexual activeness and stigmatize the recipient. It is true that the Advisory Committee on Immunization Practices (ACIP) recommends routine vaccination for all males and females 11 to 12 years of age, which seems very young (Burchum & Rosenthal, 2019). However, the vaccine can only protect individuals from acquiring HPV. It is not effective if the person is already infected. Because of this, the only benefit from the HPV vaccine occurs when vaccination happens before patients become sexually active. The vaccine, when given early, is meant to protect the individual from infection and possibly cancer later in life (Burchum & Rosenthal, 2019).

The risk of autoimmune diseases, such as multiple sclerosis and type 1 diabetes mellitus, is also a concern with the HPV vaccine (DeStefano et al., 2019). However, no consistent evidence has shown that this is a risk. More than 270 million doses of the HPV vaccine have been administered, and repeated studies have found no association between the vaccine and autoimmune diseases (Geoghegan et al., 2020). Such concerns about the HPV vaccine are to be expected because it is relatively new, but studies have repeatedly demonstrated its safety (Geoghegan et al., 2020).

The safety of the HPV vaccine has been repeatedly studied by scientists and researchers (Geoghegan et al., 2020). Common side effects are injection-site reactions, which may involve pain, redness, swelling, and itching at the site (Burchum & Rosenthal, 2019). These effects are usually mild and of short duration. Some teenage girls have experienced fainting after the vaccine, requiring hospitalization in some cases. It should be noted, however, that fainting incidences with the HPV vaccine are no more common than with other vaccines. Out of the millions of people who have received the vaccine, only a few severe reactions have ever been reported. There have been 27 total deaths and 10 confirmed cases of GBS, but a significant relationship between the HPV vaccine and these severe cases has not been firmly established. As with other vaccines, severe events remain extremely rare. Overall, the HPV Gardasil 9 vaccine is considered to be very safe (Burchum & Rosenthal, 2019). Parents must evaluate their concerns, weigh the risks and the benefits, and make informed choices for their children.

Influenza Vaccine

Even parents who follow the recommended vaccination schedule for their children often defer the influenza vaccine (Gidengil et al., 2019). There are several reasons for this, including the belief that the vaccine is ineffective or that the vaccine itself causes the flu (Pullagura et al., 2020). The annual need for re-vaccination, the variations in efficacy by season, and the perceived low severity of the flu also contribute to influenza vaccine hesitancy. Just as in the case of any other vaccine, it is important to know the facts and separate them from the myths.

Influenza is responsible for up to 300,000 hospitalizations each year in the U.S. (Burchum & Rosenthal, 2019). Depending on the severity of the strain, annual deaths can range anywhere from 3,300 to 49,000. Because the influenza virus is constantly evolving, the vaccine manufacturers produce a new vaccine based on the strain that is predicted for that year. The

efficacy of the vaccine depends on the age and health status of the individual as well as how well the vaccine matches the strain for that season.

The belief that the vaccine somehow causes the flu is simply a myth (Pullagura et al., 2020). The most common side effects of the flu vaccine are soreness at the injection site, fever, myalgia, malaise, rhinorrhea, nasal congestion, cough, sore throat, headache, vomiting, and muscle aches (Burchum & Rosenthal, 2019). Significant adverse effects are rare. As stated previously, the risk for GBS is 1-2 cases per million, which is a much smaller risk than that of influenza infection. Although efficacy varies with each flu season, the annual flu vaccine is the best protection against the flu and its associated complications (Burchum & Rosenthal, 2019). The Centers for Disease Control and Prevention (2022) recommends that every person over the age of 6 months receive an annual flu vaccine.

Contraindications and Adverse Effects

In general, vaccines are considered very safe (Burchum & Rosenthal, 2019). Mild reactions are common, but serious adverse events are rare. However, just as with any medication or medical procedure, it is important to carefully evaluate the risks and the benefits. There are some instances in which vaccines are contraindicated or careful consideration should be used. Before making a decision about any vaccination, individuals should be informed of the risks. The risk of serious adverse effects can be considerably minimized by knowing the precautions and contraindications.

Anaphylaxis is a rare but potentially life-threatening side effect of vaccines (Geoghegan et al., 2020). The incidence rate of vaccine-induced anaphylaxis is 1.31 per million doses and no deaths. Hypersensitivity reactions are sometimes caused by the immunizing antigen in a vaccine, but most often are due to other components of the vaccine (Caffarelli et al., 2022).

According to Caffarelli et al. (2022), hypersensitivity reactions can range from 1 case in every 50,000 to 1,000,000 doses.

If a person has an anaphylactic reaction to a specific vaccine, it is recommended that he or she receive no further doses of that vaccine (Burchum & Rosenthal, 2019). If an anaphylactic response occurs as a reaction to a vaccine component, that individual should no longer receive vaccines that contain that substance. Individuals currently experiencing moderate to severe illness should avoid vaccination while sick. Another consideration is severely immunocompromised children, as they should receive no live vaccines. People who are immunocompromised can have their immune system overwhelmed by live vaccines, so this should be considered and avoided (Burchum & Rosenthal, 2019).

There are many effects of vaccines, however, that may appear to be contraindications when in reality they are only common side effects (Burchum & Rosenthal, 2019). These side effects may include a mild to moderate local reaction of swelling, redness, and pain at the injection site. A mild illness with or without a low-grade fever may develop. Current antimicrobial therapy, prematurity, recent exposure to disease, or a personal or family history of allergies are not contraindications to vaccination (Burchum & Rosenthal, 2019).

Special considerations for the influenza vaccine can be noted. As with other vaccines, people with an acute moderate to severe illness should wait until symptoms improve to receive the vaccine (Burchum & Rosenthal, 2019). Mild illnesses, such as the common cold, are not as much of a concern. In the past, individuals who have a hypersensitivity to eggs have had hypersensitivity reactions to influenza vaccines. This occurs because the vaccines are produced from viruses that are grown in eggs, so there may be trace amounts of eggs in the vaccine doses. However, these cases are extremely rare, with only 10 cases of anaphylaxis seen out of 7.4

million influenza vaccinations. Of these 10, most were in individuals without egg allergies. The only contraindication for the influenza vaccine is for those who have had a severe allergic reaction after a previous dose. Contraindication is relative for patients with a history of GBS that developed soon after vaccine administration. For high-risk individuals, decisions about vaccine safety are made between the affected individuals and their healthcare providers on a case-by-case basis (Burchum & Rosenthal, 2019).

Implications for Healthcare Professionals

Numerous studies have emphasized the importance of healthcare workers when it comes to vaccine hesitancy. Healthcare professionals are widely considered to be the most important source of information on vaccines (Kubin, 2019). According to one study, 84% of parents consider physicians the most influential source of vaccination information (Makarić et al., 2018). Based on this information, physicians and healthcare professionals must be prepared to offer accurate, up-to-date information about vaccines: their benefits, risks, precautions, and contraindications. It is especially important for pediatric healthcare providers to understand the misconceptions and fears that are commonly held by parents, as well as assess the knowledge and beliefs of each individual patient (Macintosh et al., 2021). These providers are critical to the education of patients and vaccination compliance.

There are many difficulties associated with education and communication with people regarding vaccines. It is a challenge for healthcare professionals to stay updated on parental concerns because they are constantly changing (Macintosh et al., 2021). Many people get information from blog sites, antivaccine websites, and social media. Consequently, there is a lot of misinformation and misconceptions surrounding vaccines. Some studies have found that attempts to correct misinformation about vaccines have had little to no effect or, surprisingly,

strengthen anti-vaccine beliefs (Pluviano et al., 2019). Researchers have observed that people are more convinced of an opinion when they hear it stated more than once and that the repetition of false information contributes to misconceptions about vaccines (Pluviano et al., 2019).

Many parents feel that they need additional information before making the decision to vaccinate their children (Kubin, 2019). These parents often state that they thought vaccines were not recommended, unnecessary, or that they simply did not have enough knowledge to make an informed decision. People may not have access to information about vaccines. Additionally, many people feel that it is difficult to talk to their healthcare provider about this issue. These are all considerations that healthcare professionals need to keep in mind when communicating with concerned patients and parents (Kubin, 2019).

Studies have also noted a phenomenon called the passive engagement loop (Pullagura et al., 2020). This occurs when vaccine conversations are initiated by the patients rather than the pharmacists or physicians. The patients who are most likely to initiate these conversations are those who believe strongly on either end of the spectrum. Conversely, patients who are more complacent or do not have strong opinions are less likely to bring up the subject. This leads to a binary outlook by physicians in which they view patients as being closed-minded either for or against vaccinations. Because of this, physicians tend to poorly perceive their ability to positively influence vaccine decisions. This results in passive physician engagement and starts the loop again. This common phenomenon causes many missed opportunities to have beneficial vaccine conversations and influence decisions. Future interventions are recommended to break this loop of passive engagement. Pharmacists and physicians should be encouraged to start proactive discussions about vaccination (Pullagura et al., 2020).

When having these conversations, research suggests that it is more helpful to first assess the patient's knowledge and beliefs about vaccines before providing any information (Kubin, 2019). It is usually more beneficial to counter any concerns that the patient personally has than it is to push ideas on the patient with which they may already agree or may already know. People should feel that their concerns are being heard and addressed. When evaluating the risks versus the benefits, many people base their information on anecdotes rather than scientifically accurate data (Macintosh et al., 2021). This results in the overestimation of the risks and underestimation of the benefits. Healthcare professionals should be encouraged to listen actively, build trust, provide accurate information, and collaborate with their patients and the population with a nonjudgmental approach (Kubin, 2019; Macintosh et al., 2021).

It is the responsibility of healthcare professionals to develop a trusting relationship with patients and to provide them with evidence-based facts (Macintosh et al., 2021). This will equip people to make informed decisions. It also would be greatly beneficial for concerned parents to be able to raise concerns and ask questions. Unless there is a clear contraindication or special consideration, healthcare providers can assure patients that vaccines are safe, effective, and provide life-saving benefits.

Conclusion

There are multiple reasons why people, especially parents, are hesitant about vaccines. Many people worry about the development of autism, harmful ingredients, overwhelming the immune system, and the safety of relatively new vaccines such as COVID-19 and HPV (DeStefano et al., 2019; Mahmud et al., 2021). Some parental concerns are valid, while others are based on misconceptions and false information from untrustworthy sources. Vaccines have made significant progress in public health over the centuries, but they involve risks as well as

benefits. While everyone has the right to decide the best course of action for their health and that of their children, the best possible decision must be made with adequate knowledge of the facts (Kubin, 2019). This is the reason that healthcare professionals' role in educating the public is so important. Studies have repeatedly shown that most of the population trusts the information from their physicians more than any other source. The increasing cases of vaccine-preventable diseases are a wake-up call to healthcare professionals to be up-to-date on information and prepared to communicate evidence-based data to the public. In addition to having accurate information, healthcare professionals must communicate it to the public in an effective way. When discussing vaccines, healthcare providers should address any concerns the patient may have with emphasis on the risks versus the benefits (Kubin, 2019). It is vital that the public has an accurate understanding of the life-saving benefits of vaccines and why they are one of the most significant public health achievements in the world (Macintosh et al., 2021).

References

Breggin, P. R. (2021). Moving past the vaccine/autism controversy – to examine potential vaccine neurological harms. *International Journal of Risk & Safety in Medicine, 32*(1), 25-39. https://doi.org/10.3233/JRS-200052

Burchum, J. R., & Rosenthal, L. D. (2019). *Lehne's Pharmacology for Nursing Care* (10th ed.). Elsevier.

Caffarelli, C., Liotti, L., Bianchi, A., Bottau, P., Caimmi, S. Crisafulli, G., Franceschini, F., Paglialunga, C., Saretta, F., & Mori, F. (2022). Hypersensitivity reactions to vaccines in children: from measles to SARS-CoV-2. *Pediatric Allergy and Immunology, 33*(27), 58-60. https://doi.org/10.1111/pai.13631

Centers for Disease Control and Prevention. (2023). *Measles Cases and Outbreaks.* https://www.cdc.gov/measles/cases-outbreaks.html

Centers for Disease Control and Prevention. (2022). *Seasonal Flu Vaccines.* https://www.cdc.gov/flu/prevent/flushot.htm

DeStefano, F., Bodenstab, H. M., & Offit, P. A. (2019). Principal controversies in vaccine safety in the United States. *Clinical Infectious Diseases.*, *69*(4), 726–731. https://doi.org/10.1093/cid/ciz135

Frenkel L. D. (2021). The global burden of vaccine-preventable infectious diseases in children less than 5 years of age: Implications for COVID-19 vaccination. How can we do better? *Allergy and Asthma Proceedings*, *42*(5), 378–385. https://doi.org/10.2500/aap.2021.42.210065

Geoghegan, S., O'Callaghan, K. P., & Offit, P. A. (2020). Vaccine safety: Myths and misinformation. *Frontiers in Microbiology*, https://doi.org/10.3389/fmicb.2020.00372

Gidengil, C., Chen, C., Parker, A. M., Nowak, S., & Matthews, L. (2019). Beliefs around childhood vaccines in the United States: A systematic review. *Vaccine, 37*(45), 6793-6802. https://doi.org/10.1016/j.vaccine.2019.08.068

Heidecker, B., Dagan, N., Balicer, R., Eriksson, U., Rosano, G., Coats, A., Tschöpe, C., Kelle, S., Poland, G. A., Frustaci, A., Klingel, K., Martin, P., Hare, J. M., Cooper, L. T., Pantazis, A., Imazio, M., Prasad, S., & Lüscher, T. F. (2022). Myocarditis following COVID-19 vaccine: Incidence, presentation, diagnosis, pathophysiology, therapy, and outcomes put into perspective. A clinical consensus document supported by the heart failure association of the European Society of Cardiology (ESC) and the ESC working group on myocardial and pericardial diseases. *European Journal of Heart Failure, 24*(11), 2000-2018. https://doi.org/10.1002/ejhf.2669

Hotez, P. (2019). America and Europe's new normal: the return of vaccine-preventable diseases. *Pediatric Research, 85*(7), 912-914. http://dx.doi.org/10.1038/s41390-019-0354-3

Kubin, L. (2019). Is there a resurgence of vaccine preventable diseases in the U.S.? *Journal of Pediatric Nursing, 44,* 115-118. https://doi.org/10.1016/j.pedn.2018.11.011

Macintosh, J. L. B., Rowberry, C., Peterson, N., Luthy, K. E., & Beckstrand, R. (2021). Responding to questions from parents with vaccine concerns, *Journal of Pediatric Health Care, 35*(6). https://doi.org/10.1016/j.pedhc.2021.07.011

Mahmud, S., Mohsin, M., Khan, I. A., Mian, A. U., & Zaman, M. A. (2021). Knowledge, beliefs, attitudes and perceived risk about COVID-19 vaccine and determinants of COVID-19 vaccine acceptance in Bangladesh. *PLoS ONE, 16*(9). https://doi.org/10.1371/journal.pone.0257096

Makarić, Z. L., Kolarić, B., Tomljenović, M., & Posavec, M. (2018). Attitudes and beliefs related to childhood vaccinations among parents of 6 years old children in Zagreb, Croatia. *Vaccine, 36*(49), 7530-7535. https://doi.org/10.1016/j.vaccine.2018.10.055

Mushtaq, H. A., Khedr, A., Koritala, T., Bartlett, B. N., Jain, N. K., & Khan, S. A. (2022). A review of adverse effects of COVID-19 vaccines. *Le Infezioni in Medicina*, *30*(1), 1 –10. https://doi.org/10.53854/liim-3001-1

Nagy, H., Hameed, M., Khan, F., Co, E. L., & Rauf, U. (2023). COVID-19 ramifications: A scientific approach to bridge the existing gap between COVID vaccines hesitancy and effectiveness. *Avicenna Journal of Medicine,* https://doi.org/10.1055/s-0042-1760338

Novak, N., Tordesillas, L., & Cabanillas, B. (2021). Adverse rare events to vaccines for COVID-19: From hypersensitivity reactions to thrombosis and thrombocytopenia. *International Reviews of Immunology*. http://doi.org/10.1080/08830185.2021.1939696

Pluviano, S., Watt, C., Ragazzini, G., & Sala, S. D. (2019). Parents' beliefs in misinformation about vaccines are strengthened by pro-vaccine campaigns. *Cognitive Processing, 20*, 325-331. https://doi.org/10.1007/s10339-019-00919-w

Principi, N., & Esposito, S. (2019). Vaccine-preventable diseases, vaccines and Guillain-Barre' syndrome. *Vaccine, 37*(37), 5544-5550. http://dx.doi.org/10.1016/j.vaccine.2018.05.119

Pullagura, G. R., Violette, R., Houle, S. K. D., & Waite, N. M. (2020). Shades of gray in vaccination decisions – Understanding community pharmacists' perspectives of, and experiences with, influenza vaccine hesitancy in Ontario, Canada. *Vaccine, 38*(11), 2551-2558. https://doi.org/10.1016/j.vaccine.2020.01.085

Rees, A. R. (2022). *A new history of vaccines for infectious diseases: Immunization – chance and necessity.* Elsevier. https://doi.org/10.1016/C2016-0-01809-0

Sahni, L. C., Boom, J. A., Mire, S. M., Berry, L. N., Dowell, L. R., Minard, C. G., Cunningham, R. M. & Goin-Kochel, R. P. (2020). Vaccine hesitancy and illness perceptions: comparing parents of children with autism spectrum disorder to other parent groups. *Children's Health Care, 49*(4), 385-402. https://doi.org/10.1080/02739615.2020.1740883

Zaçe, D., La Gatta, E., Petrella, L., & Di Pietro, M. L. (2022). The impact of COVID-19 vaccines on fertility—A systematic review and meta-analysis. *Vaccine, 40*(42), 6023-6034. https://doi.org/10.1016/j.vaccine.2022.09.019