Vaccine Hesitancy: Causes and Impacts on Public Health

Submitted by

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Abstract

In many areas throughout the world, incidence of vaccine-preventable diseases is increasing, despite the availability of vaccine services. This is in part due to an increase in vaccine hesitancy, which is the choice to refuse or delay vaccination when vaccine services are available. Parents report many reasons for choosing to forgo or delay vaccinations, such as concerns about vaccine safety, concerns about vaccine schedules, and concerns that vaccination might cause their child to develop autism. This literature review examines the causes of vaccine hesitancy and its impact on public health. Specifically, this review will investigate the reported causes of vaccine hesitancy and attempt to identify the common psychological and sociological factors shared between those causes. These common factors can be used to create effective materials targeted toward vaccine-hesitant parents that can educate them productively and compassionately.

Introduction

Vaccination is a tool that allows a patient's immune system to learn to fight a disease without the risk caused by actually contracting the illness. With the use of vaccines, even very contagious and dangerous diseases like measles have been nearly eliminated from the United States (US). Before the introduction of the measles, mumps, and rubella (MMR) vaccine, there were around 4 million cases of measles annually in the US. After the introduction of the MMR vaccine, however, cases dropped by nearly 99% (Novilla et al., 2023).

Although common childhood vaccines like the MMR and tetanus, diphtheria, and acellular pertussis (TDaP or DTap) vaccines are safe and effective (Guiso et al., 2019), growing vaccine hesitancy movements question the safety, necessity, and schedule of many childhood vaccinations.

Vaccine hesitancy is defined as the choice to delay or refuse vaccination despite the availability of vaccine services. Vaccine-hesitant parents report many reasons for choosing to delay or decline vaccinations for their children. Some of the most common are concerns about the safety and effectiveness of the vaccines, concerns that vaccines contain harmful ingredients or chemicals, concerns that too many vaccines at one time will overwhelm a child's immune system, concerns that vaccines will cause autism, worries that vaccinations are a for-profit business, and beliefs that naturally acquired immunity is better than vaccination (Lafnitzegger & Gaviria-Agudelo, 2022).

The goal of this analysis is to investigate the causes of vaccine hesitancy and its impact on public health. A good understanding of the causes and effects of vaccine hesitancy is necessary to develop strategies to address vaccine hesitancy. With the knowledge gathered through this

analysis, materials can be developed that communicate information to vaccine-hesitant parents in compassionate and easily understandable ways.

History of Vaccine Hesitancy

18th and 19th Century Vaccine Hesitancy

Vaccine hesitancy has existed for as long as vaccines have. In 1796, Edward Jenner developed the first vaccine, using intentional infection with cowpox to protect against infection with the more serious smallpox. Jenner faced significant backlash to his vaccine, including opposition from religious leaders who believed that the vaccine was against God's will, and rumors that the vaccine caused a woman to grow bull's horns (Nuwarda et al., 2022).

Through the 19th century, anti-vaccination societies and movements grew in the US and the United Kingdom (UK), mostly in response to attempts by lawmakers to pass mandatory vaccination laws. These activist societies were able to get compulsory vaccination laws repealed in some US states. However, "in 1905… the US Supreme Court ruled that the state may be justified in restricting individual liberty under the pressure of great dangers to ensure public safety" (Nuwarda et al., 2022, p. 4). This ruling was a blow for the organized anti-vaccine movements of the time, as it allowed for the implementation of vaccine mandates in the US, which had been the target of many anti-vaccination society campaigns.

20th Century Vaccine Hesitancy

In the 20th century, vaccines for tuberculosis, yellow fever, pertussis, tetanus, and polio were introduced. These vaccines decreased the incidence of these diseases and decreased childhood mortality, but alongside the successes of these vaccines also came doubters who questioned their safety and efficacy (Nuwarda et al., 2022).

A serious blow to vaccine trust came in 1955, when batches of polio vaccines were released with live polio viruses in them, instead of the inactivated viruses that were supposed to be in the vaccine. This vaccine was given to 120,000 children, 70,000 of whom developed polio. 200 of these children became permanently disabled, and 10 children died. This vaccine recall shook the public's trust in vaccines and the pharmaceutical industry (Nuwarda et al., 2022).

Further doubts about vaccine safety came about in the 1970s, when stories of patients developing seizures and neurologic problems were linked to the diphtheria, tetanus, and pertussis (DTP) vaccine. Although the Independent Joint Commission on Vaccination and Immunization (JCVI) determined that the risk of developing neurologic problems from the DTP vaccine was extremely low, vaccine rates dropped (from 81% in 1974 to 31% in 1980 in the UK), and the UK experienced an outbreak of pertussis (Nuwarda et al., 2022).

In 1998, a British doctor named Andrew Wakefield published a controversial paper connecting the MMR vaccine to the development of autism in 12 children (Nuwarda et al., 2022). These children were all experiencing gastrointestinal disease and regressive developmental disorder, which the authors of the paper attributed to possible environmental factors, indicating that the MMR vaccine may have been the cause (Eggertson, 2010). However, many aspects of the research done in this paper have been called into question in the years since. The study’s small sample size and lack of a control group have raised concerns about the reliability of the results (Eggertson, 2010).

In January of 2010, Britain’s General Medical Council ruled that Wakefield had acted unethically in the process of the research, and that the children had been carefully selected for the purposes of the paper. Additionally, it was discovered that some of the funding for the research came from lawyers representing parents who were involved in lawsuits against vaccine companies

(Eggertson, 2010). Essentially, these parents already believed that the MMR vaccine had caused their children to develop autism, and already had a financial interest in this being proven before their children were chosen to participate in Wakefield's research, and they provided Wakefield with financial resources to aid him in providing the results they wanted to see.

No studies in the years since have been able to replicate Wakefield's findings, and the paper was retracted in March of 2010 (Nuwarda et al., 2022). Additionally, in May of 2010, Wakefield was struck off the medical register by the General Medical Council, leaving him unable to practice medicine in the UK (Kmietowicz, 2010). However, despite the lack of evidence, the link between the MMR vaccine and autism has received widespread media coverage. In the time since the publication of Wakefield's paper, MMR vaccination rates have decreased, and measles cases have increased (Nuwarda et al., 2022).

21st Century Vaccine Hesitancy

Starting at the end of 2019, the COVID-19 virus caused a global pandemic, shutting down normal life across the world. However, when the COVID-19 vaccine was introduced at the end of 2020, many skeptics emerged. A 2020 survey of parents in a population known for high compliance with common childhood vaccines reported fear of side effects, concerns about vaccine safety in general, and concerns that the vaccine was being introduced for political or economic reasons, not medical ones (Fedele et al., 2021). Additionally, concerns about the impartiality of the research, concerns about how quickly the vaccine was developed, and concerns about unknown long-term side effects made many Americans hesitant to get vaccinated (Nuwarda et al., 2022). A 2021 survey of US parents found that around 40% of parents wanted to wait and see how others reacted to the vaccine before they vaccinated their children for COVID-19 (Hammershaimb et al., 2021). Attitudes towards vaccination in general were affected

by the COVID-19 pandemic and the release of the COVID-19 vaccine, as the pandemic and vaccine were highly politicized, and the trustworthiness of medical companies and governments were called into question (Nuwarda et al., 2022).

Vaccine Hesitancy in the Current Day

While many people view vaccines as a personal choice, vaccine hesitancy can have a large effect on the communities of those who choose to abstain from vaccinations. In 2019, the World Health Organization (WHO) named vaccine hesitancy as one of the top ten threats to global public health (Brugnoli & Delmastro, 2025).

Vaccine Hesitancy and Pertussis

Pertussis cases in the US began decreasing with the introduction of the first DTP vaccine in 1940. However, the cases of neurologic problems associated with the DTP vaccine caused hesitancy around DTP vaccine acceptance (Centers for Disease Control and Prevention [CDC], 2025a; Guiso et al., 2019; Nuwarda et al., 2022).

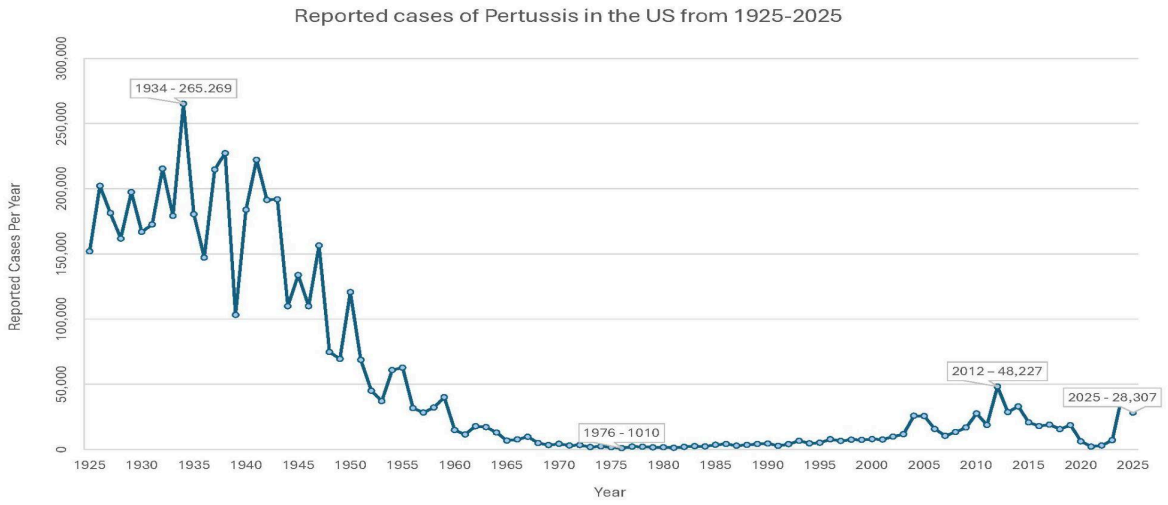

Figure 1. Reported cases of Pertussis in the US by year from 1925-2025 (CDC, 2025a).

A study from 1974 estimated that around one in every 20,000 children given the DTP vaccine would experience neurologic damage as a result. In response, scientists developed the TDaP vaccine, which contains pertussis virulence factors as opposed to an inactivated whole cell. This vaccine passed thorough safety reviews and has not been associated with the neurologic problems that had been connected to its predecessor (Guiso et al., 2019). As seen in Figure 1, cases reached a low point of 1,010 cases in 1976 (CDC, 2025a). However, in the years from 1976-2019, annually reported cases of pertussis have trended upwards until 2020, where there was a sharp decrease in pertussis cases related to quarantines and preventative measures taken to prevent the spread of COVID-19 (CDC, 2025a). However, provisional data for 2024 and 2025 show a reported 43,402 cases of pertussis in the US in 2024 and 28,307 cases of pertussis in the US in 2025 (CDC, 2025d). These results represent some of the highest case numbers in the US since the introduction of the TDaP vaccine in 1985 (CDC, 2025a).

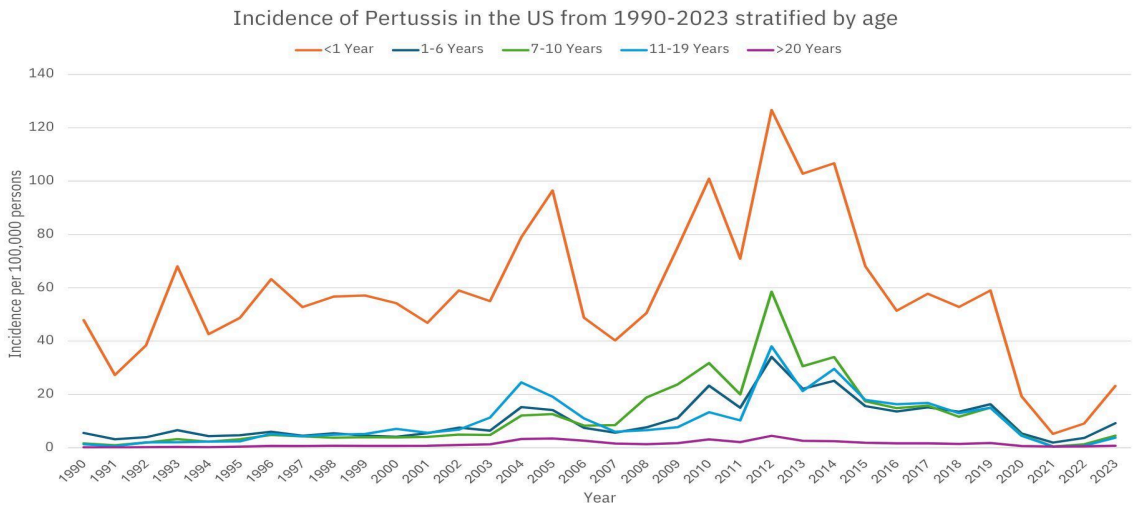

Figure 2. Incidence of Pertussis in the US from 1990-2023 stratified by age (CDC, 2025c).

The CDC's vaccine schedule recommends that the TDaP vaccine be given to the mother in pregnancy, and then to the infant in their first six months of life. Following that, a child should receive a booster around age 11 or 12, and then all adults should receive a booster every 10 years

(CDC, 2025b). It could then be possible to attribute the increase in pertussis cases in the US to adults missing their booster shots as opposed to childhood vaccine hesitancy. However, CDC data shows that on average, only 1% of annual pertussis cases in the US from 1990 to 2023 were in individuals over 20 years old, 11% were in individuals from 11-17 years old, 13% were in individuals seven to ten years old, and 11% were in individuals one to six years old. Meanwhile, 64% of cases were in individuals under one year old (CDC, 2025b). This data suggests that the increasing trend in pertussis cases is more likely due to unvaccinated or under-vaccinated infants than from adults who have missed a booster dose.

A 2023 review of studies on prenatal and childhood pertussis vaccination found that children with pertussis were 4.05 times more likely to be unvaccinated and 2.95 times more likely to be under-vaccinated than fully vaccinated. The study observed that vaccine hesitancy was a barrier to pertussis prevention, as children in the vaccine-hesitant groups with "non-medical [vaccine] exemptions were associated with significantly higher pertussis-related risks in children" (Wang et al., 2023, p. 6). Therefore, addressing vaccine hesitancy is crucial for increasing vaccine uptake and thus decreasing pertussis cases.

Vaccine Hesitancy and Measles

The MMR vaccine was approved for use in the US in 1971. Following the introduction of MMR across the country, measles cases in the US fell by over 99%, and measles was officially considered eliminated from the US in the year 2000 (Novilla et al., 2023). After the widespread dissemination of Wakefield's paper connecting the MMR vaccine to autism, MMR rates in the 2000s decreased, creating an increase in individuals susceptible to measles, which is highly transmissible and will infect 90% of susceptible individuals who come in contact with the virus (Novilla et al., 2023; Nuwarda et al., 2022). To maintain elimination status, 95% of the US

population needs to be fully vaccinated for measles, meaning that they receive both of the two required doses. By 2017, though, only 85% of the US population had received the first dose, and only 67% had received both doses (Novilla et al., 2023).

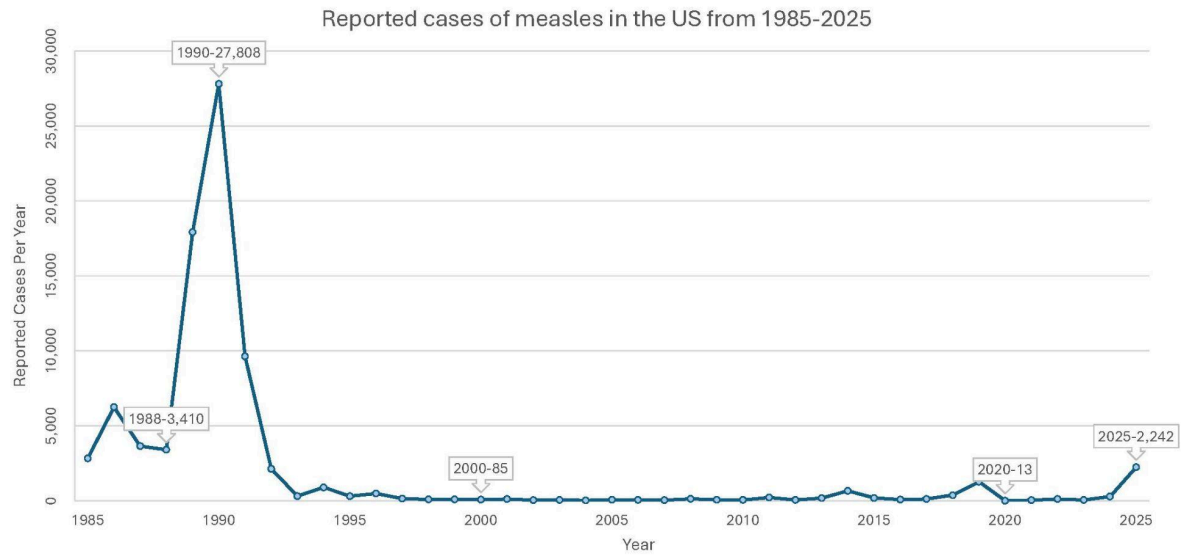

Figure 3. Reported cases of measles in the US from 1985-2025 (CDC, 2025e).

As seen in Figure 3, from 2000 to 2024, the average number of measles cases in the US was 179, with a low of 13 cases in 2020. However, 2,242 cases were reported in 2025, with 93% unvaccinated and 3% having received only one MMR dose (CDC, 2025e).

Methods

A search was conducted on PubMed to identify sources for review that included terms such as: vaccine hesitancy, anti-vaccination, pertussis vaccination, and measles vaccination. Sources were filtered to include only sources written in English and published from 2020-2025. These sources were reviewed to remove any duplicates, as well as any sources that did not discuss causes of vaccine hesitancy. Then an analysis of the sources was performed, reading each source and recording any time a reason or motivation for not vaccinating was mentioned.

Results

The initial search yielded 49 sources, 41 of which remained after the review for duplicates and relevancy. From the analysis performed, 386 reported reasons for not vaccinating were identified. After sorting and grouping repeated reasons, 169 individual reasons for not vaccinating were identified.

The most commonly reported reasons for not vaccinating were: concerns that vaccines are unsafe (5%), distrust of medical professionals/public health authorities (4%), concern about side effects of vaccines (3%), concerns/beliefs that vaccines are not effective (3%), and concern about the ingredients in vaccines (chemicals, genetically modified organisms, heavy metals, toxins, etc.) (3%).

Many of the reported reasons for not vaccinating followed similar themes or motivations. As seen in Figure 4, five categories of common factors were identified that encompassed almost all of the 169 reasons for vaccine hesitancy. First is *Fear/Safety Concerns*. This factor includes all concerns about vaccine safety and efficacy, along with other fear-based motivations, such as fear of needles, concerns about side effects, and concerns about vaccine ingredients. Second is *Suspicion/Political Distrust*. This factor includes general distrust of doctors, medical professionals, governments, and pharmaceutical companies, along with conspiracy beliefs such as ideas that vaccines contain microchips or are a method of population control. The third factor is *Education/Misinformation.* This factor includes any reported reasons that were based on misinformation, such as ideas that vaccines are not useful anymore since the diseases are no longer prevalent, along with patients who reported not knowing about or understanding certain vaccines, and patients who receive vaccine information from alternative media sources such as social media or friends and family. The fourth factor is *Convenience/Barriers to Access*. This

factor includes patients who reported financial or physical barriers to accessing healthcare, such as a lack of health insurance or no doctors' offices near where they live. This factor also includes patients who reported that their schedule makes it difficult to get to the doctor, or patients who reported that they felt it was too much hassle to get vaccines, particularly annual vaccines such as the influenza vaccine. The fifth factor is *Moral/Religious Concerns*. This factor includes patients who reported that their religious beliefs opposed vaccination, as well as those who were concerned about non-halal ingredients in vaccines, those who believed that the Human Papillomavirus (HPV) vaccine was unnecessary in religious communities, and those who were concerned about aborted fetal cells being used in vaccine development. Finally, there were a few reported reasons that did not fit into one of these categories, so they were categorized as *Other*. These reasons include adolescents who want to rebel against parental wishes for vaccination, previous negative experiences with healthcare providers, previous experiences with racial discrimination in healthcare settings, patients who are unwilling to seek medical care due to immigrant status, and parents who will only give their children vaccines required by their school. It is possible that some reasons may plausibly fit into more than one category. For instance, a motivation based in political distrust may also be rooted in fear of the government, or a motivation based in fear may be based on a misconception. However, each reported reason was only counted towards one category, the category to which the majority of the motivation could be attributed.

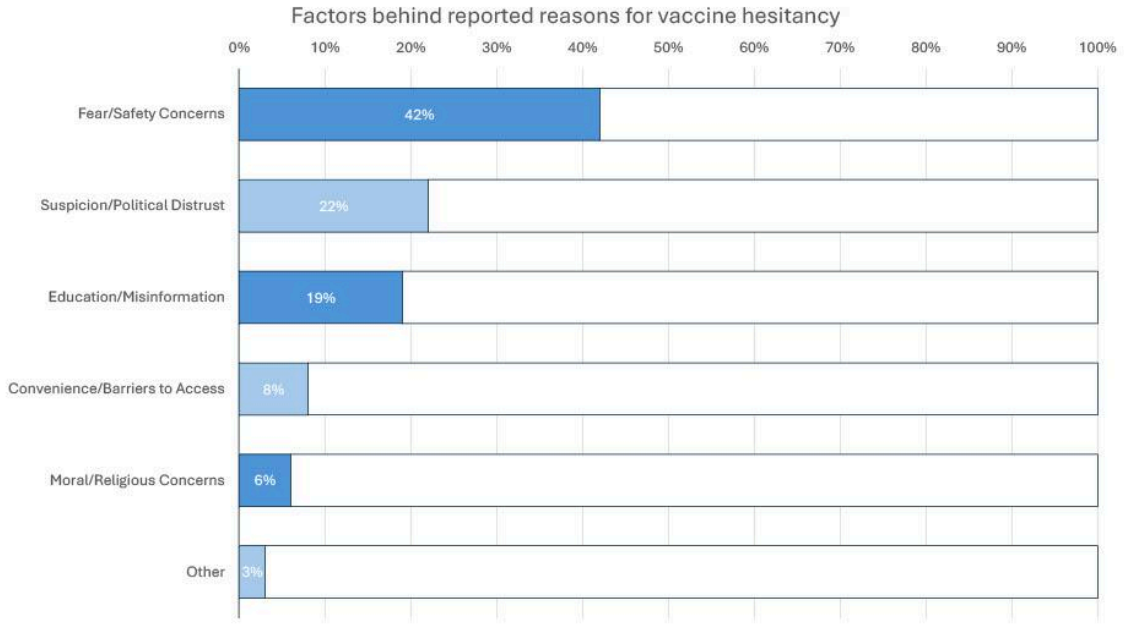

Figure 4. Factors behind reported reasons for vaccine hesitancy.

Of the 386 reported reasons for vaccine hesitancy, 42% were categorized as fear/safety concerns. 22% were categorized as suspicion/political distrust, 19% were categorized as education/misinformation, 8% were categorized as convenience/barriers to access, 6% were categorized as moral/religious concerns, and 3% were categorized as other (Figure 4).

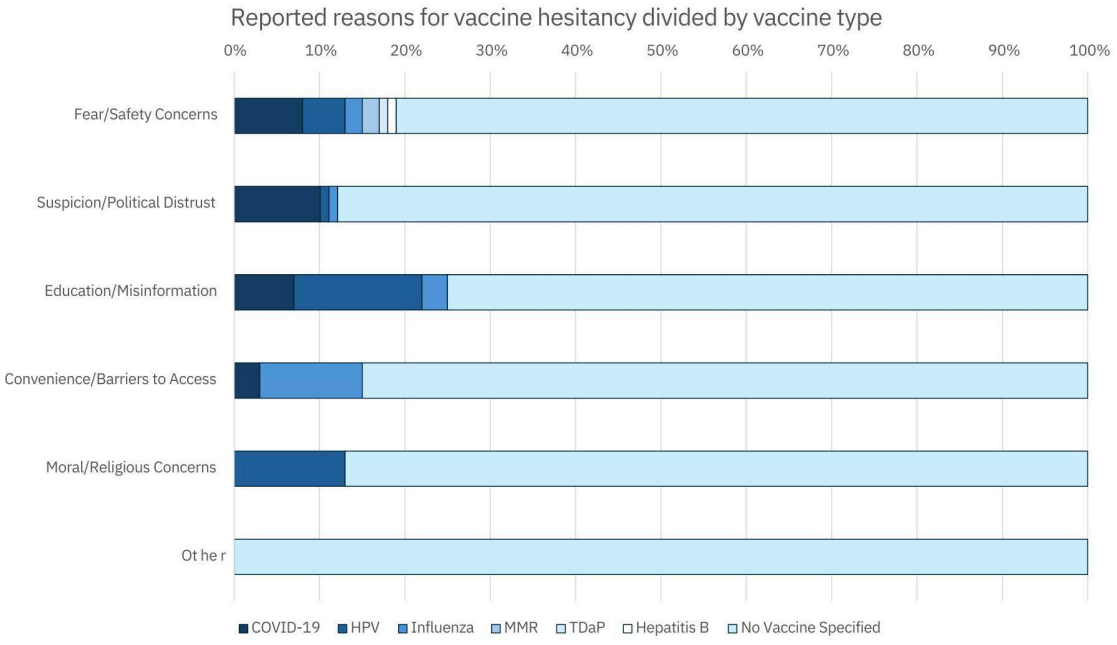

Figure 5. Reported reasons for vaccine hesitancy divided by vaccine type.

Of the 386 reported reasons for vaccine hesitancy, 68 of them listed concerns about a specific vaccine. The COVID-19 vaccine was mentioned 27 times, the HPV vaccine was mentioned 23 times, the influenza vaccine was mentioned 11 times, the MMR vaccine was mentioned three times, the TDaP vaccine was mentioned twice, and the Hepatitis B vaccine was mentioned once. Of fear/safety concerns, 8% were related to the COVID-19 vaccine, 5% were related to the HPV vaccine, 2% were related to the influenza vaccine, 2% were related to the MMR vaccine, 1% were related to the TDaP vaccine, 1% were related to the Hepatitis B vaccine, and 81% had no vaccine specified. Of suspicion/political distrust, 10% were related to the COVID-19 vaccine, 1% were related to the HPV vaccine, 1% were related to the influenza vaccine, and 87% had no vaccine specified. Of education/misinformation, 7% were related to the COVID-19 vaccine, 15% were related to the HPV vaccine, 3% were related to the influenza vaccine, and 75% had no vaccine specified. Of convenience/barriers to access, 3% were related to the COVID-19 vaccine,

12% were related to the influenza vaccine, and 85% had no vaccine specified. Of moral/religious concerns, 13% were related to the HPV vaccine, and 87% had no vaccine specified. All of the reasons categorized as other had no vaccine specified (Figure 5).

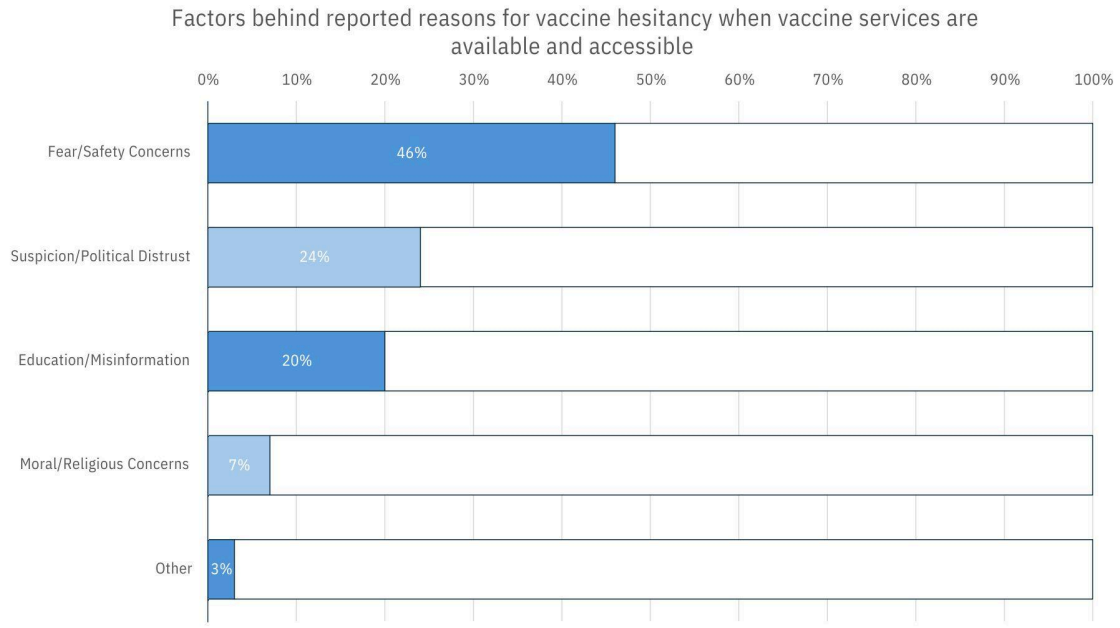

Figure 6. Factors behind reported reasons for vaccine hesitancy when vaccine services are available and accessible

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By definition, vaccine hesitancy is the choice to delay or refuse vaccination despite the availability of vaccine services (Lafnitzegger & Gaviria-Agudelo, 2022). Considering this, while addressing issues of convenience and barriers to accessing vaccination services is important, these reasons should not be considered when specifically discussing vaccine hesitancy.

When the reported reasons related to convenience/barriers to access are removed from consideration, 353 reported reasons for vaccine hesitancy remain. 46% were categorized as fear/safety concerns, 24% were categorized as suspicion/political distrust, 20% were categorized as education/misinformation, 7% were categorized as moral/religious concerns, and 3% were categorized as other (Figure 6).

Discussion

Reasons for Vaccine Hesitancy

Throughout the literature, fear of vaccine harm and concern about vaccine safety emerged as the most prominent reported cause of vaccine hesitancy. The most commonly reported individual reason for choosing not to vaccinate was concern that vaccines are unsafe, and of the most commonly reported reasons for vaccine hesitancy, four of the top five reasons fell into the category of fear/safety concerns. Furthermore, fear/safety concerns represented 46% of reported reasons for vaccine hesitancy, almost double the next highest percentage of 24% representing reasons related to suspicion/political distrust (Figure 6).

However, despite the fact that reasons related to fear/safety concerns are the most commonly reported reasons for vaccine hesitancy, fear/safety concerns still represent less than half of all reported reasons for vaccine hesitancy (Figure 6).

Additionally, different vaccines are associated with different reasons for vaccine hesitancy. For example, reasons for HPV vaccine hesitancy were mostly related to education/misinformation or moral/religious concerns, while reasons for influenza vaccine hesitancy were related mostly to issues of convenience/barriers to access (Figure 5).

This literature review highlighted the wide range of reasons for vaccine hesitancy, as well as the differences between vaccine hesitancy related to individual vaccines. To properly address vaccine hesitancy, it is essential to understand it as a complex and multifaceted issue, and employ multiple strategies to address the various motivations behind why someone might choose to abstain from vaccination.

Solutions for Vaccine Hesitancy

The most effective approach to addressing vaccine hesitancy must acknowledge each vaccine decision maker as an individual with a unique combination of motivations and must address the vaccine hesitancy issue from all sides. As identified in this review, this means separately addressing hesitancy to individual vaccines, as well as addressing the various factors that influence vaccine hesitancy, such as fear/safety concerns, suspicion/political distrust, education/misinformation, and moral/religious concerns.

One important player in the process of addressing vaccine hesitancy is the pediatrician. For parents whose motivations for vaccine refusal are based in fear/safety concerns, or education/misinformation, the pediatrician is a trustworthy figure who can provide information to soothe fears and correct misconceptions. In fact, a 2023 paper found that, “pediatric clinicians… are the most trusted sources for vaccine-safety information, and can positively influence a parent’s vaccine behavior, even among parents with concerns about vaccines” (Opel, pp. 309-310). Often, parents who come into a pediatrician's office with concerns about vaccines are still willing to vaccinate their children. Pediatricians can promote vaccination by using presumptive language, such as “Your child is due for a vaccine today,” giving strong recommendations for vaccines, and discussing vaccines with parents, addressing any questions or concerns that they have about vaccination (Gilliland & Kilinski, 2025). One way that pediatricians' offices can passively educate parents about vaccines is to have materials available in waiting rooms and exam rooms that can answer questions and spark a discussion when the pediatrician comes in. The most useful materials in this setting will address fear/safety concerns, and education/misinformation, as these are more common concerns among parents in a doctor's office setting.

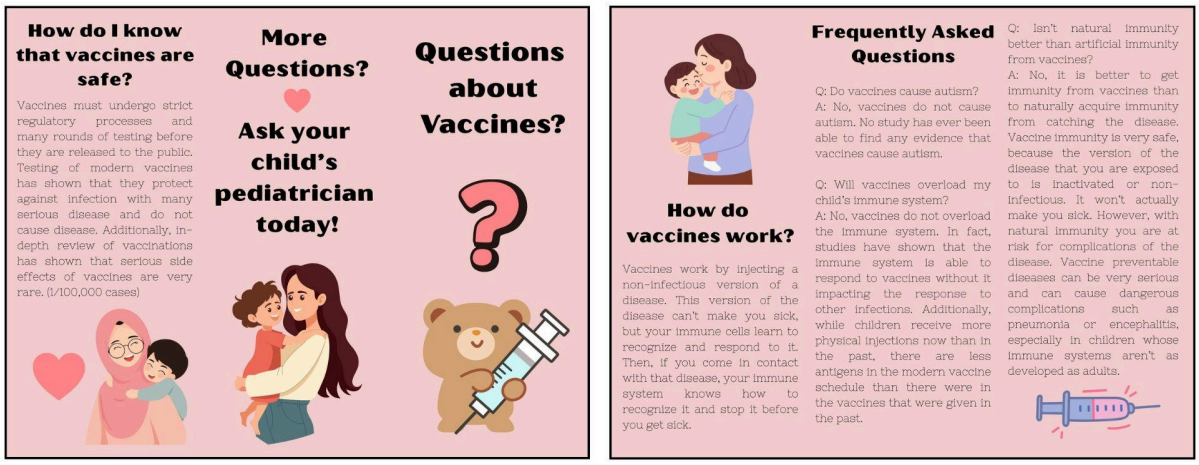

Figure 7. An example of a trifold brochure that could be placed in a pediatrician's office to spark discussion about vaccine safety and address common vaccine misconceptions (Conklin et al., 2021; Dudley et al., 2020; Novilla et al., 2023; Nuwarda et al., 2022).

An example of the type of educational material that might be useful to address parental vaccine hesitancy related to fear/safety concerns or education/misinformation can be seen in Figure 7. This example addresses vaccine hesitancy generally, focusing on safety concerns and misconceptions, but other effective materials would also address concerns about specific vaccines, each in individual pamphlets or brochures.

Another important location for addressing vaccine hesitancy is the internet. "Vaccine hesitancy is more common among people who seek information from the media and the internet rather than healthcare providers or government sources" (Cataldi & O'Leary, 2021, p. 521). While anti-vaccination movements have always existed alongside vaccines, the internet offers them a global platform with which to share their message. Studies have shown that anti-vaccination groups and ideas have a significant presence on social media platforms, and anti-vaccine information is shared on blogs and websites (Kalichman & Eaton, 2023). Throughout the history of the pro-vaccination movement, vaccine advocates have focused on stating truths and

promoting vaccine benefits while largely ignoring the anti-vaccination movement and the false information that they propagate. In the early days of vaccination, this was relatively effective. Anti-vaccination groups were often viewed as fringe or not credible. However, as the anti-vaccination movement grows in prominence and public opinion, it is not enough to simply state the truth. To successfully address the anti-vaccine movement, it becomes necessary to actively address the false claims shared by anti-vaccine advocates (Kerr, 2025).

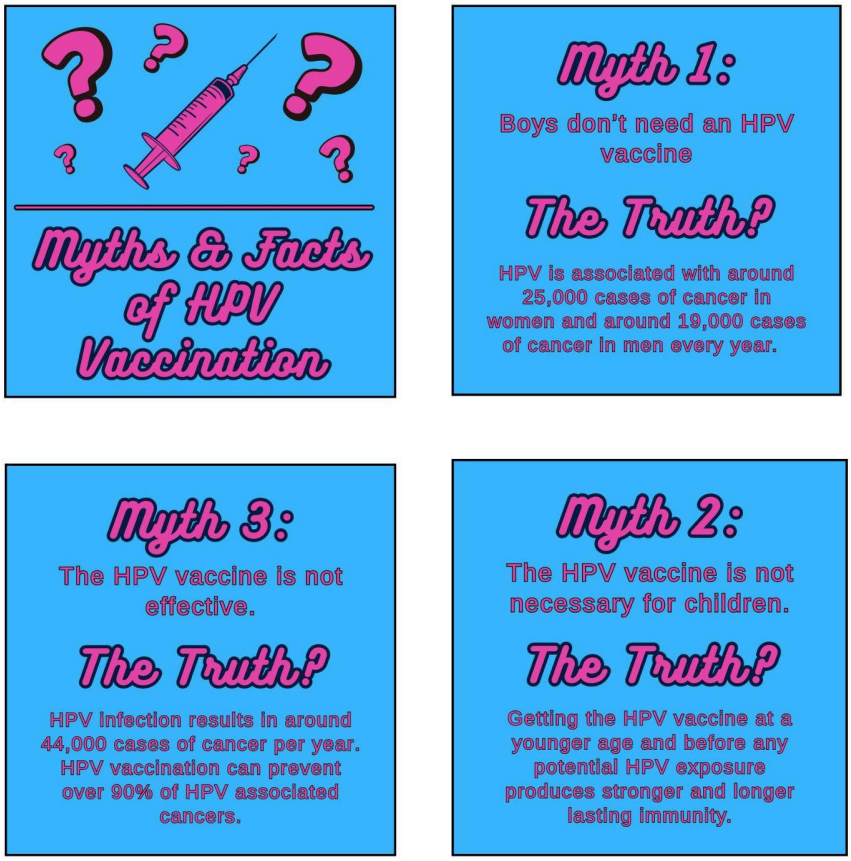

Figure 8. An example of a social media post addressing vaccine misconceptions (Boakye et al., 2023; Ellingson et al., 2023; Joshi & Kilinski, 2025).

An example of a social media post that could be used to directly address vaccine misconceptions can be seen in Figure 8. This example addresses HPV vaccination specifically. Reported HPV vaccine hesitancy was commonly related to issues of education/misinformation, so this approach

could be useful in addressing HPV vaccine hesitancy (Figure 5). The social media approach could also be useful in addressing other vaccines whose hesitancy was related to education/misinformation, such as COVID-19 or influenza (Figure 5). This approach may also be useful for addressing hesitancy related to suspicion/political distrust, since these patients might be less likely to go to a pediatrician's office or trust information from a medical professional.

Limitations

While these vaccine resources can be effective outreach tools for vaccine-hesitant parents, there are some limitations to the proposed materials that should be considered as further research is done and additional outreach methods are considered. While vaccine pamphlets can be a simple way to gently provide information to anxious or misinformed parents, they do rely on a vaccine-hesitant parent being at a pediatrician's office to be exposed to them. Many vaccine-skeptical individuals are not regularly engaging with healthcare systems, which limits the reach of a pediatrician. Additionally, these pamphlets are most effective when they spark a conversation with the child's provider, which may be limited due to time constraints and high patient loads for each pediatrician. Both the pamphlets in the pediatrician's office and the social media post are passive educational materials, and so they require a vaccine-hesitant individual to engage with them in order to provide a benefit. Additionally, these passive resources are static, so they may not engage with each individual's specific concerns, and they may not adequately address differences in audience health literacy, culture, and language. Social media interventions may also be challenged by misinformation, algorithm-driven echo chambers, and potential resistance to corrective messaging. Despite these limitations, these resources are a starting point for addressing vaccine hesitancy that approaches the issue from multiple perspectives and

addresses multiple causes of vaccine hesitancy. Further research needs to be done on each of the five identified reasons for vaccine hesitancy to determine more effective, targeted methods to address each cause. By truly understanding the root causes of vaccine hesitancy, the most effective interventions can be developed.

Conclusions

Vaccine hesitancy continues to be a threat to public health as vaccination rates decrease and cases of vaccine-preventable diseases increase. Although vaccine hesitancy has existed for as long as vaccines have, vaccine skepticism in the modern era has increased through the growing prevalence of the internet and social media platforms. Addressing vaccine hesitancy is a complicated task, as each vaccine refuser has their own reasons for choosing to abstain from vaccination, which can vary wildly between individuals. This review identified five categories of reasons for vaccine hesitancy, which are fear/safety concerns, suspicion/political distrust, education/misinformation, convenience/barriers to access, and moral/religious concerns. Additionally, this review identified clear differences in the reasons for hesitancy between different individual vaccines. Based on these results, it is clear that the best way to address vaccine hesitancy is a multifront approach, addressing each vaccine and each motivation for vaccine hesitancy individually. By targeting places where potentially hesitant individuals will be, such as social media platforms and pediatricians' offices, it is possible to present targeted materials to them that can address their questions and concerns while correcting misinformation.

Biographical Note

Natalie Ishioka is a fourth-year student at Oakland University with a major in Clinical and Diagnostic Sciences and a specialization in Medical Laboratory Science. She intends to complete a postgraduate internship at Labcorp School of Medical Laboratory Science before pursuing certification as a Medical Laboratory Scientist. In this role, she will be evaluating patient specimens to provide clinicians with information necessary for diagnosis. In the future, Natalie would like to work in public health. She is interested in epidemiology and disease prevention, particularly vaccine development and how vaccines can prevent the spread of infectious diseases. Additionally, Natalie has an interest in disease spread, management, and control in the United States, where she lives. These interests led her to research the increased incidence of measles and pertussis that have been in the news in recent years. While researching, Natalie read about many causes for the increased outbreaks of these diseases in the United States, but nearly every source mentioned vaccine hesitancy as a major contributor. She decided to investigate the causes of vaccine hesitancy, as well as its impacts on public health, to better understand the vaccine hesitancy movement and to address it with both information and compassion. This research project has been an opportunity for Natalie to explore the world of public health, which is a field that she is interested in as a future career.

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