Factors Influencing Immunization Against Measles, Mumps, and Rubella

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**Introduction**

In recent years, vaccines have made some of the most impactful positive influences on global health through the limitation of infectious disease prevalence.  “It is estimated that vaccines have prevented 6 million deaths from vaccine-preventable diseases annually. By 2055, the earth’s population is estimated to reach almost 10 billion” (Rodrigues & Plotkin, 2020). One of the most common and successful vaccines is the Measles, Mumps, and Rubella (MMR) vaccine. This vaccine is most commonly given to children in two doses before the age of 4, but teens and adults can also be vaccinated. (CDC, 2021a) While vaccination has become a widespread norm and requirement for most public schools, the decision to receive the vaccine is still a personal choice for each patient or legal guardian to make. The personal decision to receive the MMR vaccine is a health behavior that can significantly impact the health of both an individual and a population.

The major health impact of receiving the MMR vaccine is the decrease in susceptibility of individuals to acquiring and spreading the disease. According to the CDC, “One dose of MMR vaccine is 93% effective against measles, 78% effective against mumps, and 97% effective against rubella…Two doses of MMR vaccine are 97% effective against measles and 88% effective against mumps.” (CDC, 2021b) Measles, mumps, and rubella are all infections caused by a virus, which can have detrimental health outcomes. Among the common complications, mumps may lead to sterility in males, and the acquisition of rubella in pregnant women can result in birth defects. (Stanford Children’s Health, 2022) On a more global scale, the development and widespread distribution of this vaccine has shown immense success in the decrease of these disease rates. Between 2000 and 2016, the number of deaths caused by measles decreased by 84%. (PAHO/ WHO, 2018)

Currently, 86% of children between 12 and 24 months globally have received the MMR vaccine. Among high income countries, vaccination rates are up to 90%, while lower income countries face vaccination rates of only 70%. (The World Bank, 2022) Despite these rates and improvements on a global scale, the fight against these infections is far from over. In 2019, rubella killed more than 207,500 people, and infected over 9 million (CDC, 2021b). Measles saw a similar rate of infection, and mumps has an estimated 500,000 yearly cases. (CDC, 2021c) These three diseases are all major causes of death in children, especially in poorer and less vaccinated countries.

Consequently, the US Department of Health and Human Services has identified MMR vaccination as an important health behavior that should be prioritized to improve the health of our country’s population. Within their Healthy People 2030 initiative, one of their goals already recognized the vast improvements our population has made in the prevention of this disease in recent years, with the goal to “Maintain the elimination of measles, rubella, congenital rubella syndrome, and polio- IID-01.” Goal IID-03 works with the same successful foundation of vaccination we have established in the US, stating “Maintain the vaccination coverage level of 1 dose of the MMR vaccine in children by age 2 years — IID‑03.” Another goal focuses more on parental decision-making regarding MMR vaccination in the US, which states “Reduce the proportion of children who get no recommended vaccines by age 2 years - IID‑02.” Furthermore, goal IID-04 considers both the schooling organization and the level of vaccination by stating “Maintain the vaccination coverage level of 2 doses of the MMR vaccine for children in kindergarten.”  (HHS, n.d.) Overall, MMR vaccination is a health behavior that has a significant positive impact on global health, and should be encouraged and prioritized in order to avoid preventable death and disease.

**Theory**

When it comes to understanding and influencing behavior, theoretical models are among some of the most useful tools. Their ability to organize and label the complex factors and methodology of human behavior has enabled scientists to intervene and influence behavior in testable and reproducible ways. Of the many models used to influence behavior regarding MMR vaccination, the Health Belief Model and the Theory of Planned Behavior are among the most applicable and the most utilized in the scientific community.

Theory of Planned Behavior

Formerly known as the Theory of Reasoned Action, this model suggests that intention is the main determinant of the behaviors over which we have control. There are six constructs that all combine to help explain the influences on one’s intention to complete a behavior. These constructs are attitude, behavioral intention, subjective norms, social norms, perceived power, and perceived behavioral control (LaMorte, 2019). Among the six constructs, attitudes, subjective norms, and perceived behavioral control all impact intention more closely than the others. Additionally, the model demonstrates that while each of these constructs directly influence intention, the perceived behavioral control construct has a more direct influential relationship with actual behavior.

 This model’s main application to decision making surrounding MMR vaccination involves the constructs of attitudes, social norms, and perceived behavioral control. Attitudes, defined as the individual’s personal evaluation of the behavior, are a possible area in which vaccination can be further encouraged. Because of the historical distrust of the vaccine’s efficacy following suspicion of its causational relationship with autism, it is very likely that those who continue to hold these beliefs may change their intention to vaccinate upon receiving further education about the true validity and effectiveness of the vaccine. One study examining the motivations of college students to receive vaccines found that the constructs of subjective norms and attitudes had a direct relationship with the students’ intent to vaccinate. (Wiemken et. al., 2016)

Along with attitudes, subjective norms may be an important area of influence regarding MMR vaccination. This construct is defined as an individual’s perception of the public’s attitudes towards a certain behavior. In the case of the supposed autism side effect, this may also be a valuable area of utilization for change of intention. Those who still oppose vaccination for themselves or their child may find themselves in one of many anti-vax communities, who create a culture for others to root themselves in. For members of these communities, consideration and education about the reasoning behind the majority population’s decision making may help encourage them to change their intention about getting vaccinated. Because subjective norms have been shown to directly impact intention for a behavior, introducing new information may change their overall perception of subjective norms, and consequently change their intention.

Another study, in the form of a meta-analysis, found that the intention of parents' health of behaviors that impact their children is impacted by attitudes, subjective norms, and perceived behavioral control. It also found that the perceived behavioral control construct had the strongest relationship with actual behavior of the parents. (Hamilton et. al., 2020) Perceived behavioral control is a construct that can be defined as the control someone thinks they have over their behavior. The MMR vaccine is strongly suggested for young children, and can certainly be included in the list of behaviors that parents should make to promote the health of their children. Based on these findings, parents may be much more likely to vaccinate their young children if they believe they have the means and capability to do so. Promotion of vaccination using this construct may look like reminding and educating parents on the resources available to them, or even encouraging them to take advantage of their ability as parents to take every stop possible for the promotion of their children’s health.

Health Belief Model

 The health belief model is a mechanism widely used to help predict the likelihood of a health behavior to be carried out. It includes five constructs which all inform the personal decision to complete a behavior. These constructs are perceived benefits , perceived threats, cues to action, perceived barriers, and self-efficacy. Among these constructs, one study found that cues to action may be the largest player among decision making regarding the MMR vaccine. (McHugh, 2016) Cues to action can be defined as any external influence that sparks action in someone. Due to the heavy debate in the media, despite the overwhelming scientific consensus, individuals may find themselves exposed to many differing messages either encouraging or discouraging vaccination online, in their communities, or on other media platforms. Another study found that in Chinese caregivers of young children, the construct of perceived threat was a major predictor of action when it comes to vaccines. It found that those who perceived a disease to be more harmful/ dangerous were more likely to prioritize vaccination for that specific disease. (Wagner, et. al., 2017) Perceived threat can be defined as one’s perception and interpretation of the danger of an illness. This line of thinking can be implemented into under vaccinated populations because they may have a low perceived threat of these diseases. Parents may choose to not vaccinate their children against measles, mumps, and rubella because they don’t perceive those diseases as a particularly harmful infection. Through education of parents and caregivers on the true dangers and consequences of these diseases, there is a high possibility of increasing the overall likelihood of parents to vaccinate their children at a young age.

**Intrapersonal Factors**

Among all the factors influencing one’s likelihood to receive the MMR vaccine or to vaccinate their children, intrapersonal factors are important to consider. One of the most commonly held misconceptions about the MMR vaccine in recent years is that it can cause the development of autism. This belief, although largely developed through involvement in social groups, has a very strong influence on the decisions of each individual in their decision of whether to get vaccinated or not. In fact, the European Centre for Disease Prevention and Control has documented the active spread of misinformation regarding autism and the MMR vaccine as a serious threat to vaccination rates, as well as trust in the medical and scientific communities at large. (ECDC, 2010) Although they embody a small minority of the population, those who believe and distribute this incorrect association between the vaccine and autism, their influence among overall vaccination rates is undeniable.

Research has shown that certain personality traits can make certain individuals more likely to believe in false or unsupported claims about the vaccine. According to a 2021 study, having a high need for cognitive closure, or an aversion to uncertainty, can increase one’s likelihood to adopt the conclusion that the MMR vaccine causes autism, and also be less persuasive towards new sources of information regardless of its source. (Lunz Trujillo et al, 2021) Historically, there has been a high volume of contradictory information circulating in the media. This resulting lack of certainty in some individuals, in combination with the ambiguity surrounding the actual cause of autism, can push those with a high need for certainty and closure to adopt the conclusion that the MMR vaccine causes autism. For those with this trait, the belief provides a level of closure and eliminates the tension of not having a complete understanding of these topics. This sense of security would also cause these individuals to reject new information, especially if it contradicts their current beliefs in some way.

Misinformation can influence more than just individuals with particular personality traits. Many parents decide not to vaccinate their children due to their incorrect knowledge of its effect on the body. One study conducted in London found that among parents who chose against the MMR vaccine for their children, the majority believed that the long-term side effects were more dangerous than the disease itself. (Smailbegovic et al., 2003) Because these parents have incorrect knowledge about the vaccine and its effects, they have a very low perceived risk of measles, mumps, and rubella.

Attitudes toward vaccination, whether positive or negative, have a very tangible influence on behavior. Those who have strong feelings towards a particular behavior are more likely to behave in alignment with their emotions. Those who are predisposed to high levels of anxiety around blood and needles are more likely to avoid getting vaccinated. In fact, one study found that anticipation of pain caused by injections is the one of the largest single reasons why parents avoid vaccinating their children. (Lunz Trujillo et al, 2021) The fear of injection is often stronger than the motivation to receive the vaccine for those who avoid vaccination for this reason. This suggests that for some, an increase in motivation to receive the vaccine may raise their willingness to endure the negative experience of the injection.

**Interpersonal Factors**

 Interpersonal factors are the influences that exist in social relationships of all kinds and have a very high influence on health decision-making. One important example is the social influence of family and friends, which can be a very strong predictor of the beliefs that someone will hold. This influence was highlighted in a study among adults and their decision to vaccinate their children, which explained that parents are much more likely to believe information coming from their peers than from scientific information sources. (Braverman, 2021) For most parents, peer groups and family members are arguably the most influential forces on their personal beliefs and decisions.

 Another influential factor is the relationship between patients and providers, which facilitates a mutual trust that is vital to the integrity of the entire medical system. Trust enables patients to have confidence in their health decisions, because it eliminates fears of malpractice and abuse from their provider. A study surveying a subgroup of Somali mothers and their attitudes about the MMR vaccine found that when mothers trusted the nurses, they were much more likely to vaccinate their children on time. On the other hand, mothers who had a negative experience with a nurse were much less likely to visit their healthcare facility regularly, and much less likely to vaccinate their children on time. (Jama, et al., 2021) Furthermore, a 2021 report highlights that trust within a patient-provider relationship can have significant implications for the patient’s trust in their overall health system. (Diviani et al., 2021) This highlights the direct relationship between the patient-provider relationship and the patient’s overall quality of care, which includes vaccination. This places a responsibility on providers to communicate and facilitate good rapport with patients, because it strongly influences their subsequent personal health decisions.

**Organization, Community, Environment, Policy**

There are many factors within an individual’s organizations, community, environment, and policy that provide major influence upon personal vaccination decision making. Arguably the single strongest influence on this choice is the implementation of a vaccination requirement policy in public schools. All 50 states currently require children to receive the MMR vaccine in order to enroll in private school, public school, or any licensed childcare center. (CDC, 2022) Individual states vary in both their requirements for proof of vaccination and for which reasons and circumstances a student is exempt from this requirement. This mandate can be identified as one of the most important influences in American families prioritizing the vaccination of their children because it equates vaccination to participation in important societal organizations. This mandate sets the standard that vaccination should be seen not as a decision to make, but as a requirement to check off.  In addition to schools, some state governments have chosen to implement MMR vaccination requirements for their healthcare workers, patients, or both. These laws apply to three major categories of healthcare facilities, which are hospitals, outpatient facilities, and long-term care facilities. These laws, which vary by state, require healthcare workers, patients, or both to show proof of vaccination in order to treat or be treated.” (CDC 2022) These policies are all major encouraging influences because they not only ensure that large subgroups of state populations have been vaccinated, but they also facilitate the idea that vaccination is important in the protection of both patients and health care workers. It equates the public’s trust of hospitals to the trust of the MMR vaccine.

 The organizational level of influence on vaccination decision-making includes programs such as schools, workplaces, churches. The policies discussed previously are enforced by the vast majority of schools, and workplaces for healthcare workers in select states. While all these influences are developed with the goal of vaccine promotion, those who utilize the option of religious exemption from these policies experience a large influential force from their organizational religious involvement. For example, although the leadership of the Catholic church does not advise its members to avoid receiving the MMR vaccine, it has labeled it as “morally inadvisable,” due to its derivation from a cell from an aborted fetus. This reluctant and negative view towards vaccination has influenced a significant portion of their congregation to avoid these vaccines, and to opt for religious exemption within their organizations. For a similar reason, this quality of the vaccine has led some Buddhists to avoid the MMR vaccine under the belief that the vaccine breaks their commitment to take no life.  (Pelčić et al, 2016) Furthermore, many groups of protestant Christians believe that vaccines contradict God’s intervention and should be avoided for this reason. (Oregon Legislature, n.d.) While few religious organizations give clear instructions to avoid vaccination, many offer contradictory messaging and vague standpoints, which motivate many to opt for religious exemption of vaccination. As a result, those involved in these organizations are much more likely to decide against vaccinating themselves or their children for religious reasons.

The historical success of the MMR vaccine has not prevented a more recent blow to its reputation in recent years. As mentioned earlier, a 1998 report suggesting a causational correlation between the vaccine and autism led Americans to develop serious skepticism towards its safety. Although this hypothesis has been subsequently discredited and disproved many times, the legacy of this suggestion has left a mark on permanent trust for many years to come. (DeStefano & Shimabukuro, 2019)​​ In a recent study, 12% of Americans believe the risks of the vaccine, including autism, outweigh the possible benefits (Pew Research, 2019). This is an incredibly misleading and damaging narrative and continues to skew the public’s opinions and decision-making today.

Another important aspect of influence is the community-level factors, which promote or discourage vaccination in varying degrees. Influences on the community level can largely include availability of healthcare facilities regarding proximity, transportation, and affordability of a visit. One study found that parental education level and race were among the two highest determinants of an infant’s likelihood to receive the seven-vaccine series, which includes the MMR vaccine. Experimental results uncovered that infants whose mothers did not graduate high school are 27% less likely to be vaccinated than children born to mothers who received a college degree. Also, black children were found to be vaccinated less than white children due to both a lack of knowledge about the importance of vaccination and a lack of access to healthcare. (Kulkarni et. al., 2021)

**Suggestions for Intervention**

In recent years, there has been an increase in programs and interventions with the goals to increase MMR vaccination rates in various populations, especially of low socioeconomic status. Because lack of access to healthcare is a problem that disproportionately affects those of low socioeconomic status, a federally funded program Vaccination for Children (VFC) is working to increase vaccination rates by offering free vaccines to members of these communities. (CDC, 2016) This program enters the community directly, and targets the populations with the lowest rates of vaccination. Another intervention that targets populations of low socioeconomic status targets the barrier of insufficient education about the vaccine, as seen in a study completed by Community Health Improvement for Milwaukee Children. After educating parents of young children on the importance of MMR vaccination within a low-income community, vaccination rates increased from 45% to 84% in less than 5 years. (Willis, et. al., 2016)

 Other programs have worked to improve vaccination among parents who choose against vaccinating their child for various personal reasons. For those in the stage of decision making, the personal nature of immunization status has led many intervention strategies to take place in conversation with patients’ primary care providers. For patients with a low perceived risk for the severity of measles, doctors have been encouraged to use facts and statistics to educate parents on the reality of the possible severe consequences of these illnesses if they are acquired, in hopes to increase their motivation to avoid these risks. When addressing those who hold incorrect beliefs about the vaccine’s safety or side effects, doctors are encouraged to correct misinformation using scientific knowledge as well. They are also encouraged to reference the extensive body of literature that has diligently refuted common misconceptions, including those about autism as a side effect. (Torracinta, et. al., 2021) In attempts to combat vaccine refutation for religious reasons, many religious leaders have published official statements in more recent years to encourage their congregations to vaccinate themselves and their children. One example of this is *Christians and the Vaccine,* a project developed by Christian leaders who encourage and equip other Christians in leadership roles to promote vaccination using spiritual justification. (Christians and the Vaccine, n.d.) This directly combats the ideas of those who opt for religious exemption and helps break down the deterrent social influence that some religious subgroups may impose on their community.

These programs are extremely important for the promotion of vaccination rates in populations experiencing barriers to vaccination that are out of their control. However, these groups do not embody all of those who are not immunized. One population often overlooked in intervention programs are those who choose against immunization for a fear of injection. Often confounded with a low perceived risk, a fear of needles is among one of the most common reasons parents choose against vaccination. (Lunz Trujillo et al, 2021) As seen in the Health Belief model, the perceived barriers to change can create a major obstacle in the decision-making process, and for those who fear injections, the obstacle can be very difficult to overcome. To combat this, addressing the issue and including anti-anxiety exercises may be a useful addition to current educational messaging encouraging MMR vaccination. By empowering patients with skills to use during the immunization process, barriers to change are likely to decrease as self-efficacy increases in their ability to manage their fear.

Another possible intervention strategy is to further educate the public on the risks of developing measles, mumps, and rubella. As vaccination rates increase over time, newer generations have less experience with these illnesses, and are less educated on their consequences. (Smailbegovic et al., 2003) This is seen within the Health Belief model as decreased susceptibility and decreased severity, both of which have an inhibitory effect on one’s likelihood to complete a health behavior. It is possible that exposure to stories of those who experienced health complications from these diseases may help to increase the public’s knowledge about the prevalence of these illnesses today and reinforce the importance of vaccination to prevent these consequences. This method of telling personal stories may be an extremely useful tool moving forward to help increase perceived susceptibility and perceived severity, both of which are currently decreasing. This messaging would be particularly impactful for those who haven’t been educated on the nature of these illnesses and may instill in them a new motivation to seek vaccination for them or their children.

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