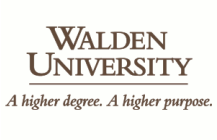

2018

Evaluating Parents' Decisions Regarding Recommended Childhood Vaccinations

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This is to certify that the doctoral dissertation by

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has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

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2018

Abstract

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by

Jennifer Lynn Kline

BS, Rasmussen College, 2011

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health

Walden University

July 2018

Abstract

Vaccinations are among the greatest accomplishments of public health. However, many parents are choosing not to vaccinate. The purpose of this study was to explore the association between social media influence and parents' decisions to vaccinate their children. The health belief model indicates that individuals' likelihood of engaging in a health-related behavior is determined by their perceptions of susceptibility, severity, benefits, and barriers. The research questions addressed whether there is an association between parents' perception of their children's disease susceptibility and their decisions about vaccination, and whether there is an association between exposure to messaging from social media and parents' decision to vaccinate. A quantitative, cross-sectional research design was used. The primary dependent variable was vaccination choices, and the primary independent variable was exposure to information about vaccination through social media. Data were gathered through a questionnaire administered to 269 White parents residing in Illinois with their own children between the ages of 0 and 18 years living with them. Binomial logistic regression showed that there was not a statistically significant relationship between parents' perception of disease susceptibility and vaccination choice or between parents' vaccination choice and exposure to online antivaccine advertisements. These study findings help in defining an overall picture of vaccine hesitancy in the United States. By focusing on the predictors of this behavior, it may be possible to implement interventions to combat the antivaccine movement with the goal of increasing vaccine compliance among parents.

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Dedication

This doctoral study is dedicated to Chris, Kate, and Maddie. You are my inspiration and love.

Acknowledgments

The completion of this dissertation was made possible by an amazing team of supportive people. I thank my family, Chris, Kate, and Maddie, for always understanding and rooting me on to finish my dream. I thank my committee chair, Dr. Kate Callahan-Myrick, for her mentorship and constant positive encouragement. I thank my committee member, Dr. Frazier Benjamin Beatty, for sharing his expertise and support, and I thank my university research reviewer, Dr. Simone Salandy. Each and every one of these people played a very important and special role in the attainment of my goals and I will be forever grateful.

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Chapter 1: Introduction to the Study

Introduction

Vaccinations are well known as one of the greatest accomplishments of public health. The reduction and elimination of many deadly diseases have been reported in the United States due to vaccinations, and yet there are parents choosing not to vaccinate their children. Many parents are making the choice not to vaccinate, resulting in this behavior being called the "antivaccine movement" (Hoffman, 2013). Because of this movement, the likelihood of vaccine-preventable diseases (VPDs) is increasing. Fifteen vaccines are currently recommended by the Centers for Disease Control and Prevention (CDC) as of January 1, 2016 (CDC, 2016a).

Current research indicates that parents choose not to vaccinate their children for a variety of reasons. Parents use many different sources of information when making decisions regarding their children's health (Brunson, 2013). People often search for health information on the Internet, which increases exposure to antivaccine messages. A study by Brunson (2013) indicated that social networks play a fundamental role in parents' decisions regarding vaccinations. Messages displaying negative information regarding vaccines are more prevalent on the Internet than in other forms of media (Harmsen et al., 2013). In a study by Guidry, Carlye, Messner, and Jin (2015), it was found that visiting antivaccination websites for 5-10 minutes has the potential to decrease the likelihood of parents choosing to vaccinate their children.

The most significant negative effect of vaccine hesitancy is the potential for VPDs to make a significant comeback in the United States (Domachowske & Suryadevara, 2013). Domachowske and Suryadevara (2013) referred to standard immunization programs as being among the safest and most effective interventions in medicine, but parents still choose to seek out information on vaccines from the media, among other sources. Per Kurosky, Davis, and Krishnarajah (2015), appropriate vaccination coverage improves health outcomes and is cost saving. A study in the United States examining a 2009 birth cohort showed that completed vaccination schedules prevented about 42,000 early deaths and 20 million cases of disease throughout participants' lives, with routine vaccination saving $69 billion in costs to society (Kurosky et al., 2015). Vaccination rates are lower in states that allow philosophical exemptions, which has resulted in VPDs such as pertussis and measles appearing in these areas (Domachowske & Suryadevara, 2013). In 2012, the average incidence of pertussis in the United States was 13.4 cases per 100,000 persons, and in 63% of states allowing personal belief exemptions, the incidence was higher than that average (Domachowske & Suryadevara, 2013). In states where exemptions were not allowed, only 29% were above the average (Domachowske & Suryadevara, 2013).

Children are at greatest risk for complications related to VPDs in the first 2 years of life (Kurosky et al., 2015). Regardless of this, in 2013, national vaccination coverage in children aged 19-35 months was 83.1% for diphtheria, tetanus, and pertussis (DTaP); 92.7% for poliovirus, 91.9% for measles, mumps, and rubella (MMR); 82% for *Haemophilus influenzae* type b (Hib); 90.8% for Hepatitis B (HepB); 91.2% for varicella;

and 82% for pneumococcal conjugate vaccine (PCV; Elam-Evans, Yankey, Singleton, & Kolasa, 2014). It was also noted that there was a large variation in the vaccination coverage in each state in the United States. (Elam-Evans et al., 2014). Choosing not to follow the recommended vaccination schedule of the Advisory Committee on Immunization Practice (ACIP) has a detrimental impact on the herd immunity of the community, thereby contributing to the spread of disease (Siddiqui, Salmon, & Omer, 2013). Disease eradication is one of public health's larger focuses, and the increase in vaccine refusal threatens global eradication efforts (Saint-Victor & Omer, 2013). Almost all deaths from VPDs have been eliminated in the United States. (Hedden, Jessop, & Field, 2014). Vaccinations are unquestionably safe in most patients that they are recommended for (Poland & Jacobson, 2012). Serious, life-threatening side effects from recommended childhood vaccinations are very rare, and vaccination poses a great benefit to the individual and the population (Poland & Jacobson, 2012).

This chapter reviews the background of the issue, defines the problem and purpose of the study, and states the research questions. The scope of the study, including assumptions, delimitations, and limitations, is addressed. Finally, the significance of the issue and the study's implications for positive social change are discussed.

Background

Approximately 6.6 million children die worldwide each year from VPDs (Greenwood, 2014). Routine administration of vaccinations for children such as tetanus toxoid, diphtheria toxoid, killed pertussis (DPT), and polio vaccine began in 1950, resulting in reduction in the associated diseases (Greenwood, 2014). Additionally, from

1970 through 2010, worldwide life expectancy increased from 58.5 years to 70 years, with the highest decreases in mortality occurring in children and young adults (Rappuoli, Pizza, Guidice, & De Gregorio, 2014). Despite this success, there are still outbreaks of pertussis and measles reported. Research has linked these outbreaks to reduced vaccination coverage, also known as the "antivaccine movement" (Olpinski, 2012). It is necessary that coverage levels are maintained to prevent the transmission of VPDs (Olpinski, 2012). In response to this concern, the World Health Organization (WHO) started the Expanded Programme on Immunization (EPI) with the goal of achieving universal access to all relevant vaccines for all populations at risk (WHO, 2013).

Per the National Immunization Survey (NIS), coverage for many childhood vaccinations was around 90% from 1994 to 2013. It was estimated that in children born from 1994–2013, 322 million illnesses, 21 million hospitalizations, and 732,000 deaths will be prevented by vaccinations throughout their lives (Whitney, Zhou, Singleton, & Schuchat, 2014). Since vaccine coverage has remained at or around 90%, per the NIS, many VPDs have been rare in the United States., and measles was declared "no longer endemic" in the year 2000 (Gostin, 2015). Vaccinations accounted for the prevention of an estimated 71 million cases during the Vaccines for Children (VFC) era, which covers the years 1994 through 2013 (Whitney et al., 2014). There are about 4 million children born in the United States every year who have the potential to be exposed to VPDs (Whitney et al., 2014). The varicella vaccine has been 90% effective in children since 2007; before vaccination, there were approximately 11,000–13,000 hospitalizations and 100–150 deaths annually due to varicella in the United States. (Baxter et al., 2014).

Today, many people take active roles in managing their health, want more information about their health, and have a variety of sources available to access that information (Harmsen et al., 2013). People use the Internet, health care providers, friends, family, television, radio, and newspapers to access information they are seeking related to their health (Harmsen et al., 2013). The use of the Internet is gaining popularity due to ease of access, widespread information, anonymity, social support, and the ability to personalize information gathering (Harmsen et al., 2013). With growing concern about re-emerging VPDs, there is a threat of increased morbidity and mortality. Vaccine refusal and hesitancy are becoming more common in the United States. as well as globally (Dube, Gagnon, Nickels, Jeram, & Schuster, 2014). Children who did not get the DTaP vaccination on schedule were found to be 4.4 times more likely to be diagnosed with pertussis than those who were vaccinated appropriately (Salmon, Dudley, Glanz, & Omer, 2015).

There have been several recent VPD outbreaks in the United States, which have brought forward the issue of vaccine compliance (Woo, 2016). Many of the children infected in these outbreaks were either unvaccinated or undervaccinated (Woo, 2016). It is imperative that immunization rates stay high to prevent the resurgence of these diseases in the United States. (Jolley & Douglas, 2014). For example, in the case of measles, 95% of the population must be vaccinated to prevent outbreaks (Jolley & Douglas, 2014). This is also essential for the protection of those who cannot be vaccinated for various reasons (Jolley & Douglas, 2014).

Most parents choose to vaccinate, but evidence has shown that 20% of parents have safety concerns with vaccines (Glanz, Kraus, & Daley, 2015). *Vaccine hesitance* has become a popular term for those who hold these safety concerns (Kestenbaum & Feemster, 2016). Concerns like these, among others, are threatening the health and safety of children and their communities (Woo, 2016). Parents seek out information about immunizing their children from the Internet and other sources with questionable credibility (Shelby & Ernst, 2013). Social media are often used for health promotion, but there is growing concern that these media are also used to shed negative light on positive health behaviors such as vaccination (Shelby & Ernst, 2013). It is also difficult for parents to understand the risks associated with VPDs because they are rarely seen in the United States. (Glanz et al., 2015).

Vaccine hesitancy is coupled with the availability of exemptions to school immunization laws for children (Wang, Clymer, Davis-Hayes, & Buttenheim, 2014). High vaccination rates have prevented morbidity and mortality while contributing to cost savings in the United States. (Siddiqui et al., 2013). Parents can choose to get an exemption from the various state vaccination laws for medical concerns, as well as for their philosophical, personal, or religious beliefs (Siddiqui et al., 2013). There are 48 states that allow religious exemptions, and 20 states that allow philosophical or personal exemptions, which makes it easier not to vaccinate (Siddiqui et al., 2013). A study by Kestenbaum and Feemster (2016) indicated that approximately one in eight children in the United States under the age of 2 are under vaccinated, and pediatricians see at least one vaccine refusal each month. Kestenbaum and Feemster also stated that parents with

vaccine concerns are more likely to search for information that reinforces their concerns. Parents are also questioning their healthcare providers as well as the medical and scientific community at an increasing rate (Jolley & Douglas, 2014).

Current research shows that being exposed to antivaccine messages directly affects the intent to vaccinate (Jolley & Douglas, 2014). These types of messages have been referred to as *antivaccine conspiracy theories*, and they are causing parents to question vaccine safety, increase their feelings of powerlessness and disillusionment, and increase distrust in authorities, which plays a direct role in vaccine hesitancy (Jolley & Douglas, 2014). Mistrust, suspicion, and antivaccine messages are found at high levels in the United States, Western Europe, Africa, India, and other countries, posing exposure risks due to increased travel (Poland & Jacobson, 2012). On the Internet, where the dissemination of information is inexpensive and easy, there is an even larger risk of the spread of these sentiments (Poland & Jacobson, 2012). Understanding how exposure to antivaccine messages on social media affects parents' decisions regarding vaccinating their children can help to guide interventions to prevent the growth of the antivaccination movement.

Negative information about vaccines is much easier to disseminate through the Internet, and it circulates at a very fast pace (Dube et al., 2013). Social media outlets play a role in increasing concerns about recommended childhood vaccinations (Dube et al., 2013). There are mounting fears, increasing misinformation, and growing antivaccine messages that are threatening one of public health's greatest achievements (Dube et al., 2013). Some parents feel that they do not have enough information about vaccines to

make a decision (Harmsen et al., 2013). Lack of information can lead to a search for information and contribute to more parents joining the antivaccine movement. According to a study by Brunson (2013), parents' social networks and people networks have significant roles in vaccination decision making. Brunson also mentioned that parents' perceptions of vaccination are negatively affected by the media. Negative messages focus on ineffectiveness, uselessness or danger, the idea that too many vaccines are given at once, and violation of parental rights regarding vaccination (Guidry et al., 2015). The idea that VPDs are no longer present is also a barrier to vaccination (Guidry et al., 2015). There are a variety of studies exploring the reasons parents choose not to vaccinate their children as well as ideas about interventions that could be effective in increasing vaccine compliance. There has been an increase in the use of the Internet as an information source as well as an increase in the prevalence of vaccine hesitancy (Kata, 2012). There is a gap in research when it comes to whether social media contributes to parents' decisions regarding vaccinating their children. Efforts to reach and maintain recommended vaccination levels need to continue (Kurosky et al., 2015).

Problem Statement

Vaccination is responsible for the elimination of smallpox and polio from the United States. (Hoffman, 2013). Diseases like measles and rubella had previously been eliminated but have since resurfaced (Hoffman, 2013). VPDs like pertussis have increased significantly in the United States because immunity has decreased (Hoffman, 2013). One of the reasons for this threat is the "antivaccine movement" (Hoffman, 2013). This movement is affecting public health through increases in the prevalence of these

diseases that were thought to have been eradicated (Camargo & Grant, 2015). It is said that this movement could be a result of the public's mistrust of science (Camargo & Grant, 2015). Parents see vaccines as "unsafe and unnecessary," and lower vaccine acceptance rates have been noted (Dube, Vivion, & MacDonald, 2015). Vaccines have become mistrusted through skeptics, critics, and the antivaccine movement, which was created by fraudulent scientists and is continued by parents who are frustrated and looking for answers related to autism (Federman, 2014).

As indicated in the *Morbidity and Mortality Weekly Report* (MMWR), in the years 1994–2013, childhood vaccination coverage was at around 90%, which helped to keep levels of VPDs low (Elam-Evans et al., 2014). The NIS showed that vaccination rates remained high (Elam-Evans et al., 2014). Data from 2014 indicated that coverage was high, but poverty status and geographic area differences consistently showed variations resulting in the need to improve coverage in specific groups (Hill, Elam-Evans, Yankey, Singleton, & Kolasa, 2015).

There are now enough children not being vaccinated that there is a real concern for increased disease prevalence in the United States. (Federman, 2014). With the growth of online journals and blogging, there are more opinions being shared and portrayed as fact (Federman, 2014). The Internet is full of websites opposing vaccines (Kata, 2012). Antivaccine activists can spread their message online; power has shifted from doctors to patients, and science is being questioned (Kata, 2012). People are using the Internet to research vaccines and using this information to make decisions regarding vaccinating themselves and their children (Kata, 2012). Beliefs related to the risks of vaccines are

changing the epidemiological profile of infectious disease in middle-class families in industrialized countries because of Internet sites, blogs, and celebrity influence (Vasconcellos-Silva, Castiel, & Griep, 2015). The use of social media is increasing around the world (Moorhead et al., 2013). Per Moorhead et al. (2013), social media constitute a vehicle that can be used by the public, patients, and health professionals for communicating health issues and outcomes. Social media offer great tools for health communication, but there exists a need to monitor the quality and reliability of the information that is published (Moorhead et al., 2013). There is a need for research regarding the use of social media for education on vaccination and how it influences parents' decisions on vaccination.

In a study by Barbieri and Couto (2015), the authors stated that "the spread of antivaccine movements via social networks, the internet, and media, as well as the greater visibility of certain vaccines' adverse effects, has affected vaccine acceptance, particularly in some developed countries" (p. 3). The antivaccine movement became popular in England in 1998 after a paper was published reporting a link between the MMR vaccine and autism and colitis/bowel disease (Barbieri & Couto, 2015). This caused a decrease in vaccination immediately, even after the study was proven to be fraudulent (Barbieri & Couto, 2015).

Purpose of the Study

The purpose of this quantitative, cross-sectional study was to explore the association between social media influence and parents' decisions on whether to vaccinate their children. With the abundance of antivaccine messaging on various

Internet and social media sites, as well as an increase in the number of parents choosing to side with the antivaccine movement, there may be a quantitative relationship between exposure to social media messages and vaccination outcomes. Other independent variables that have been found to be associated with vaccination choice that were included in the modeling of this study were parent age, number of children, marital status, and level of education.

Research Questions and Hypotheses

RQ1—Quantitative: Is there an association between parents' perceived disease severity for their child and whether they had their child vaccinated?

H_0: There is no association between parents' perceived disease severity for their child and their decision of whether to vaccinate.

H_A: There is an association between parents' perceived disease severity for their child and their decision of whether to vaccinate.

RQ2—Quantitative: Is there an association between exposure to messaging from social media and a parent's decision to vaccinate?

H_0: There is no association between messaging from social media and a parent's decision of whether to vaccinate a child.

H_A: There is an association between messaging from social media and a parent's decision of whether to vaccinate a child.

Theoretical Framework

The health belief model (HBM) was developed in the 1950s with the purpose of investigating why people fail to take preventative health measures (Orji, Vassileva, &

Mandryk, 2012). The HBM suggests that messages will result in positive behavior change if perceived barriers, benefits, self-efficacy, and threats are targeted (Jones et al., 2015). The theory behind the HBM indicates that an individual's likelihood of engaging in a health-related behavior is determined by his or her perception of four variables: perceived susceptibility, perceived severity, perceived benefit, and perceived barrier (Orji et al., 2012). These variables can be considered on their own or in combination with each other to explain certain health behaviors (Orji et al., 2012). It has been proven that perceived barriers are a significant predictor of health behavior (Jones et al., 2015).

Perceived threat is a variable in health behavior, in that a person is likely to participate in a practice if a threat from disease or a health condition is present (Orji et al., 2012). *Perceived susceptibility* is the probability that a person assigns to a personal vulnerability to developing a health condition (Orji et al., 2012). *Perceived severity* involves how serious a person thinks the consequences of a health condition are, and *perceived barrier* refers to a person's subjective evaluation of the difficulties or the hindrances associated with the behavior (Orji et al., 2012). *Perceived benefit* is the person's opinion of the value or usefulness of participating in the health behavior to offset the perceived threat (Orji et al., 2012).

According to a study by Smith et al. (2011), there is a significant association between vaccine hesitancy and all four of the psychosocial domains of the HBM, and parents who had vaccine safety concerns and had fewer perceived benefits associated with vaccines chose to delay and refuse vaccines. Parents who delayed or refused vaccinations for their children were significantly less likely to believe that vaccines are

necessary to protect the health of their children compared to those who did not, indicating a low perceived benefit (Smith et al., 2011). Parents who delayed or refused vaccination also had low perceived susceptibility, as evidenced by a lower likelihood of believing that their child might get a disease if not vaccinated and that vaccines are safe (Smith et al., 2011). It was also determined that the children of those parents who delayed or refused at least one vaccination had significantly lower coverage for all childhood vaccines (Smith et al., 2011).

Nature of the Study

This was a quantitative study involving survey data that examined parents' perceptions of disease severity for their children. This study also assessed whether antivaccination messaging from social media is associated with parents' vaccination decisions. A survey was sent out through Facebook, a popular social media outlet. Participants were parents with their own children between the ages of 0 and 18 years. Participants resided in the state of Illinois. Parents were surveyed regarding their decisions on whether to vaccinate their children.

Focusing on factors associated with parents' vaccination decisions while aligning the theories of the HBM was helpful in pinpointing what led parents to make the decisions they did regarding vaccination. The association between negative messaging on social media about vaccination and an increase in vaccine hesitancy was explored by using the survey results and evaluating trends in vaccination. Results of the survey were analyzed using SPSS version 24 (IBM, 2017). Binary logistic regression was used to

determine the association between negative antivaccine messaging on social media and perceived severity of VPDs.

Definitions

Two databases were searched for literature for this study: PubMed and Google Scholar. Key terms used were *vaccine, vaccination, immunization, antivaccine movement, vaccine preventable disease, social network, social media, outbreak, vaccine refusal, vaccine hesitancy, vaccine exemption,* and *vaccine compliance.* The following terms are defined:

Vaccine: A product that stimulates a person's immune system to produce immunity to a particular disease, which offers protection from that disease. Vaccines are most often administered through injections but also can be given by mouth or nasal spray (CDC, 2014).

Vaccination: The act of introducing a vaccine into the body to produce immunity to a specific disease (CDC, 2014).

Immunization: A process by which a person becomes protected against a disease through vaccination (CDC, 2014).

Antivaccine movement: The networking and dissemination of antivaccination ideas (Tafuri et al., 2013).

Vaccine-preventable diseases: Diseases that are prevented by vaccines. There are currently 16 diseases that can be prevented with vaccines (CDC, 2016b).

Social networks: Online communities where people can go to interact with friends, family, coworkers, acquaintances, and others with similar interests. Examples include Facebook, Google+, Twitter, and Pinterest (CDC, 2016c).

Social media: Powerful channels to reach target audiences with strategic, effective, and user-centric health interventions (CDC, 2015).

Outbreak: An increase, often sudden, in the number of cases of a disease above what is normally expected in a population in a limited geographic area (CDC, 2012).

Vaccine refusal: The refusal to vaccinate (Olpinski, 2012).

Vaccine hesitancy: Applies to a group of people who have varying degrees of indecision about vaccines, pertaining either to vaccines as a whole or to specific vaccines (Kestenbaum & Feemster, 2016).

Vaccine exemption: An exception to state vaccine laws based on medical, religious, and philosophical/personal beliefs.

Vaccine compliance: Applies to children who were given each ACIP-recommended vaccine dose during an age-appropriate window (Kurosky et al., 2015).

Assumptions

In this study, it was assumed that all survey participant information was accurate. All participant information was anonymous, so it was also assumed that questions were answered honestly and to the best of the individuals' ability. It was assumed that the sample represented the target population. It was also assumed that all data analyzed in the literature review were accurate.

Scope and Delimitations

The goal of this study was to examine whether exposure to social media messaging about childhood vaccination influences parents' decisions on whether to vaccinate their children. I sought to investigate the beliefs and perceptions of parents who chose not to vaccinate and how these factors related to the HBM while reviewing current barriers to vaccination and existing interventions designed to promote compliance with the recommended vaccination schedule. In gathering these data, I hoped to inform the development of an effective antivaccine counterstrategy. The research plan encompassed parents living in Illinois with children aged 0 to 18 years. Variables including parental age, education level, marital status, and number of children were taken into consideration. People without children and people who did not live in Illinois were excluded.

Limitations

This study helped to fill the research gap noted in the problem statement by investigating quantitatively parents' decisions of whether to vaccinate their children when exposed to messaging about vaccination on social media. The results of this study provide information, knowledge, and insight that may help public health professionals understand the factors that affect parents' decision making, which can be used to implement effective interventions to counter antivaccine message exposure and influence and ultimately increase vaccine acceptance.

Significance

There were 644 cases of measles in 27 states in 2014 (Gostin, 2015). This is more than threefold higher than in any other year since 2000 (Gostin, 2015). Most cases were

in unvaccinated individuals or individuals with unknown vaccination status (Gostin, 2015). Vaccinations are safe and effective and helped to prevent an estimated 100 million cases of serious disease from 1924 to 2012 (Gostin, 2015).

This study contributes to the literature by identifying social media influences associated with parents' decisions of whether to vaccinate their children. Once these associations are better understood, effective social-media and Internet-based intervention strategies can be examined and implemented. The goal of this research was to identify factors that are associated with parents' vaccination decisions. This research can be used to create strategies that will reduce the incidence of VPDs by reducing the number of vaccine-hesitant parents. Increasing vaccine compliance would benefit individuals, communities, society, and the economy by decreasing VPD incidence, potentially impacting morbidity and mortality rates in the United States. (Carrillo-Marquez & White, 2013). As the antivaccine movement continues to gain momentum (Camargo & Grant, 2015), the results of this study could be used to create effective intervention techniques using the same methods of social media communication that contribute to the antivaccine movement.

Summary

Some childhood diseases have been eradicated through the use of vaccines. However, with increased fear of vaccine side effects and adverse reactions as well as parents' desire for control over their children's health, the antivaccine movement has gained popularity (Saint-Victor & Omer, 2013). Through this movement, previously

reduced, eradicated, and controlled VPDs have made a comeback (Olpinski, 2012). The prevalence of VPDs is increasing, which poses a serious public health threat.

Assessing the factors that contribute to parents' beliefs and attitudes regarding vaccination can help in creating successful counterstrategies with the goal of reducing the number of people participating in the antivaccine movement. There are multiple studies showing that vaccine hesitancy and the antivaccine movement are steadily growing. Antivaccine attitudes and beliefs are affecting the health and safety of children as well as communities. There are several reasons that parents believe that vaccines are not safe and choose to delay, refuse, or be selective in vaccination. This is a serious public health concern posing the potential for a resurgence of deadly VPDs.

Based on the literature review, there is an immense amount of information on vaccine hesitancy and why parents choose not to vaccinate their children. There is also information on vaccination exemptions and how health care workers can educate parents on vaccine compliance. There is a lack of information linking the increase in vaccine hesitancy with increasing use of the Internet and social media. This study is useful in identifying the significance of social media influence on parents' decisions of whether to vaccinate their children. It may provide insight into effective intervention techniques involving Internet and social media use. In the literature review in Chapter 2, I provide a more thorough discussion of vaccine hesitancy and the influence of the Internet and social media.

Chapter 2: Literature Review

Introduction

The purpose of this study was to assess whether the increase in social media use for healthcare information is influencing an increase in vaccine hesitancy. Vaccine hesitancy has contributed to a growing number of childhood vaccine refusals by parents and the increased use of alternative childhood vaccination schedules. Because of this, there has been an increased number of outbreaks of VPDs such as measles, and pertussis in areas where there are higher numbers of vaccine-hesitant parents. It is also noted that states permitting philosophical exemptions for the vaccines required for children to enter school are seeing an increase in VPDs, leading to a decrease in herd immunity. This research may be useful in planning effective intervention strategies with the goal of reducing vaccine hesitance in parents.

Over the past 15 years, the percentage of American adults who have reported hearing about the disadvantages of vaccines has doubled to 30%. Over 52% report being unsure about the link between vaccines and autism, and 90% of physicians in the United States frequently get requests to delay childhood vaccinations (van der Linden, Clarke, & Maibach, 2015). The concerns that parents have about vaccines can influence public support for vaccination, causing decreases in immunization rates and increases in VPD incidence (van der Linden et al., 2015). Parents of children who are unvaccinated are sometimes referred to as *antivaxxers* or as *vaccine hesitant* (Glanz et al., 2015). Vaccine-hesitant parents are those who have concerns about the safety of childhood vaccines. These concerns are threatening the health of children and their communities (Glanz et al.,

2015). Immunization rates must be high to keep VPDs absent or low in incidence (Glanz et al., 2015). Even though vaccination is considered one of the greatest contributions to public health, 6.6 million children continue to die every year worldwide, and about half of these deaths are from VPDs (Greenwood, 2014). About 95% of the population should be vaccinated against measles to prevent an outbreak (Glanz et al., 2015). In 2000, the CDC announced that endemic measles had been eliminated; rubella, and congenital rubella syndrome were also eliminated in 2004 (Gostin, 2015). It is important that high vaccination rates are maintained for those vulnerable populations whose members cannot get vaccinated, including those who are too young for vaccines and those for whom vaccines do not work (Glanz et al., 2015).

Compulsory immunization laws help to protect vulnerable populations, and mandatory vaccinations for school entry have contributed to the eradication or control of diseases that previously made thousands ill and caused many deaths (Glanz et al., 2015). However, VPDs such as pertussis, tetanus, diphtheria, measles, mumps, and rubella are now increasing as parents are delaying immunization, selectively immunizing, and refusing to immunize their children (Gostin, 2015). When these VPDs were prevalent in the United States, parents understood the benefits of vaccination and knew that the benefits outweighed the risks (Glanz et al., 2015). Parents were more confident in the national immunization program at that time (Glanz et al., 2015). Vaccination continues to be the mainstream choice, but national survey data show that greater than 20% of parents have concerns about vaccine safety (Glanz et al., 2015). In 2014, the United States.

reported 644 measles cases from 27 states—more than 3 times the yearly rate since 2000 (Gostin, 2015).

Since the start of the WHO EPI in 1974 and the Global Alliance for Vaccination and Immunization in 2000, polio has been eradicated, and the control of measles has made significant improvement, offering the hope of eventual eradication (Greenwood, 2014). Despite these gains, over the past 20 years, more parents have chosen to refuse, or delay recommended vaccinations for their children (Glanz et al., 2015).

Alternative vaccination schedules are being requested by 10-15% of parents (Glanz et al., 2015). Alternative vaccination schedules involve the parents changing the spacing and timing of vaccines without regard to scientific evidence (Glanz et al., 2015). There is research showing that children on an alternative schedule have a significantly increased risk for pertussis, pneumococcus, and varicella infection (Glanz et al., 2015). Before vaccination, half of the population died from smallpox, and measles (Greenwood, 2014). By the end of the 1950s, most children routinely received DPT, and polio vaccines, which contributed to a significant decrease in the incidence of these infections (Greenwood, 2014). Parents often prepare themselves to make vaccination decisions with information from the Internet, books, and other nonmedical sources that question vaccine safety (Glanz et al., 2015). Vaccine hesitancy can lead to the resurgence of VPDs (Domachowske & Suryadevara, 2013).

In a study by Lieu, Ray, Klein, Chung, and Kulldorf (2015), it was concluded that the rate of vaccine refusal in some communities might create barriers for local clinical groups to achieve national quality benchmarks for vaccine coverage. VPDs are very rare

in the United States because of wide-scale vaccination (Glanz et al., 2015). For a child, the risk of disease depends on where the family lives, where they have traveled, whom the child played with, and the child's immunity (Glanz et al., 2015). More than 30% of pediatricians have had to dismiss families because they chose not to immunize (Olpinski, 2012). The geographical clustering of parents who refuse or delay childhood vaccinations poses a risk to public health and barriers to improving immunization coverage (Lieu et al., 2015). Underimmunization is associated with a higher risk of VPDs (Lieu et al., 2015). Monitoring current trends in vaccine hesitancy can help in the creation of effective interventions (Siddiqui et al., 2013). Nonmedical exemptions have been linked to a higher community risk of measles, and pertussis (Lieu et al., 2015).

In this chapter, I present and discuss a review of the current literature. Major sections of the literature review address literature search strategies, the theoretical foundation of the study, and a literature review based on the main variables, ending with a summary and conclusions.

Literature Search Strategy

Search engines and databases used for the literature review included the CDC, Academic Search Complete, and PubMed. Search terms used were *vaccine hesitancy*, *childhood vaccination*, *vaccinations*, *vaccine refusal*, *social media*, and *Facebook*. Most of the articles chosen were published from 2011–2016. Some pertinent background information that was published more than 5 years ago was also included. These articles provided theoretical and foundational information that added to the current research. Literature searches in peer-reviewed journals related to pediatrics, vaccines, health

behavior, computer use for healthcare, public health, immunotherapy, preventative medicine, and infectious disease were performed. Additionally, federal government sources and non-peer-reviewed material published and updated in the last 5 years were used to add to the understanding of the current research. The online databases used were EBSCOhost, Google Scholar, Medline, and PubMed. The search terms used were *health belief model*, *vaccination*, *vaccine refusal*, *social media*, *childhood vaccinations*, and *vaccine hesitancy*.

The Health Belief Model

The HBM is a behavioral theory developed in the 1950s by social psychologists who wanted to understand why people do not engage in behavior that prevents or detects disease (Crosby, 2013). The HBM can explain why people choose behaviors that lead to a healthier life (Smith et al., 2011). One of the HBM's first uses was to learn about health barriers to polio vaccination in the 1950s (Smith et al., 2011). The three main components of this theory are individual perceptions, modifying factors, and likelihood of an action influencing behavior (Crosby, 2013). Individual perceptions are associated with perceived susceptibility to the severity of disease (Crosby, 2013).

According to Smith et al. (2011), the psychosocial domains of the HBM include the following: parent's assessment of the child's risk of getting a VPD, parent's assessment of whether VPDs are a sufficient health concern to make vaccinations relevant, parent's assessment of whether vaccinating the child can reduce the threat of a VPD, and concerns and influences that facilitate or discourage a parent from having a child vaccinated. Risk perception is subjective and originates from the facts presented

and how the individual feels about those facts (Feemster, 2013). Modifying factors could include age, sex, ethnicity, personality, socioeconomics, and knowledge, which can affect the perceived threat of disease (Crosby, 2013). These factors can be modified by things such as education, the presence of symptoms, and media, which also have a relationship with the perceived threat of disease (Crosby, 2013). Parents who refuse vaccination for their children are aware of the risks involved, but many believe that their children are more likely to experience adverse vaccine effects than to contract a VPD (Saint-Victor & Omer, 2013). The likelihood of action is related to the perceived benefits minus the perceived barriers to behavioral change, which determines the likelihood of behavioral change (Crosby, 2013). Often, children with parents who choose not to vaccinate are protected through herd immunity (Saint-Victor & Omer, 2013). If the number of people relying on herd immunity increases, those who are not vaccinated will no longer be protected (Saint-Victor & Omer, 2013). Many parents consider the risk of VPDs or vaccine side effects based on their perceptions of how healthy their children are and their vulnerabilities (Dube et al., 2013). Often, parents also consider the benefits of vaccination just for their children, rather than considering the benefit to herd immunity (Dube et al., 2013).

The HBM is a very common theory used to predict several different types of vaccine behaviors (Guidry et al., 2015). When the HBM's main constructs are applied to vaccinations, they are perceived susceptibility (the likelihood of contracting the disease), perceived severity (how serious the disease is, if contracted), perceived benefits (how effective the vaccine is in protecting against the disease), perceived barriers (the

perceived costs of receiving the vaccine), and self-efficacy (belief that one can successfully take the steps to get vaccinated; Guidry et al., 2015). Usually, regarding health, there are two dimensions used to assess risk perceptions: (a) perceived vulnerability or likelihood of harm if no action is taken and (b) perceived severity or seriousness of the consequences if there was harm (Dube et al., 2013). This is a difficult concept because vaccinations are used as preventative interventions and are given to healthy people, and the benefits can be difficult for parents to assess (Dube et al., 2013).

Literature Review

The life expectancy in the United States in 1900 was 47.3 years, and communicable diseases were the leading cause of death (Rappuoli et al., 2014). Vaccination, improved hygiene practices, and antibiotics have played a large part in eliminating much of the mortality caused by infectious disease in the last hundred years (Rappuoli et al., 2014). Data showed that since 1924, vaccines have been responsible for preventing 40 million cases of diphtheria, 35 million cases of measles, and a total of 103 million cases of childhood diseases (Rappuoli et al., 2014). The life expectancy in 2014 was 78.7 years, and noncommunicable diseases were the leading causes of death (Rappuoli et al., 2014).

In 1809, immunizations were introduced in the United States in Massachusetts to prevent and control a smallpox outbreak (Olpinski, 2012). In 1905, states were given the right to pass and enforce compulsory vaccination laws, and in 1922, the court determined that the school immunization requirement was constitutional (Olpinski, 2012). The current immunization laws in the United States started in the 1960s. By 1969, 17 states

had laws requiring measles vaccination before children entered school, and 12 states had requirements for immunization against six prevalent diseases (Olpinski, 2012). Standard immunization programs are the most safe and effective, and important ongoing public health interventions are available (Domachowske & Suryadevara, 2013). They have produced significant reductions in disease (Domachowske & Suryadevara, 2013). At the start of 1980, all 50 states had immunization requirements, but exemptions were allowed, varying by state (Olpinski, 2012). During the 1900s, immunizations against polio, measles, tetanus, pertussis, and tuberculosis were introduced, and these vaccines were readily accepted by parents, resulting in dramatic reduction in outbreaks, morbidity, and mortality (Kestenbaum & Feemster, 2016).

It is imperative that vaccination programs have a high uptake level to reduce the occurrence of VPDs (Dube et al., 2013). The goal of 95% coverage at kindergarten entry set by Healthy People 2020 was met by 18 states; states with higher exemption rates had lower vaccination rates (Woo, 2016). Even though measles is no longer endemic in the United States, it is still endemic in many other countries around the world, and with widespread travel, it is easily imported, placing unvaccinated children at significant risk (Woo, 2016). Childhood vaccination is cost efficient and necessary for children's health, but it poses a controversial question for parents (Austvoll-Dahlgren & Helseth, 2010).

VPD outbreaks are increasing because immunization campaigns are not successful unless people are compliant with recommendations (Saint-Victor & Omer, 2013). To effectively eliminate VPDs, vaccine refusal must be countered (Saint-Victor & Omer, 2013). The antivaccine movement started in the United States in the 1850s after

many smallpox mandates were created due to concerns about safety and the belief that these laws were tyrannical and a violation of individual liberty (Domachowske & Suryadevara, 2013). The activities coming from this movement have caused a decline in immunization rates, which has led to an increase in smallpox incidence (Domachowske & Suryadevara, 2013). Infectious diseases are a significant concern and are directly related to mortality and morbidity globally, which is seen more in communities with low vaccination coverage (Saint-Victor & Omer, 2013). Per the WHO, approximately 1.5 million children under the age of 5 years die from VPDs, which account for 17% of the under-5 child mortality globally (Saint-Victor & Omer, 2013). The hope of eradicating VPDs in the future depends on global vaccine coverage (Saint-Victor & Omer, 2013).

Current Immunization Recommendations and Compliance

The great potential of vaccines is dependent on parental acceptance, and this requires parents to gain confidence in vaccines and the vaccination process (Salmon et al., 2015). Standard immunization programs are among the safest and most effective interventions available (Domachowske & Suryadevara, 2013). The ACIP makes recommendations for childhood vaccinations at certain ages for maximum effectiveness that coincide with the well-child visit schedule (Kurosky et al., 2015). The ACIP recommends vaccinations against 14 diseases for children from birth to age 2: three doses of inactivated poliovirus vaccine (IPV), one dose of MMR, three or four doses of Hib vaccine, three doses of HepB vaccine, one dose of varicella vaccine, and four doses of PCV; this represents the 4:3:1:3:3:1:4 series (Kurosky et al., 2015). The ACIP also recommends two or three doses of rotavirus vaccine, one or two doses of influenza

vaccine, and at least one dose of hepatitis A vaccine (HepA) by age 2 years (Kurosky et al., 2015). They recommend 5 DTaP doses for children at 2, 4, and 6 months; at 15 to 18 months; and then at 4 to 6 years, as well as a tetanus, diphtheria, and pertussis (Tdap) booster between the ages of 11 and 18 and at age 19 and older (Phadke, Bednarczyk, Salmon, & Omer, 2016). The benefits of following the recommend vaccination schedule include improved health outcomes and cost savings (Kurosky et al., 2015).

In an outbreak in 2010, in California, there were 4,415 cases of pertussis reported in children aged 6 months to 18 years who had an available vaccination history (Phadke et al., 2016). In the cases reported, 45% of the children had not been appropriately vaccinated (Phadke et al., 2016). Another outbreak in Washington in 2012 reported 1,829 cases, and 28% of those children did not have up-to-date pertussis vaccinations (Phadke et al., 2016). In 2014, the NIS showed that 71.4% of children received the combined (4:3:1:3:3:1:4) vaccine series and only 0.8% of children in the United States were completely unvaccinated (Woo, 2016). For kindergarteners in the 2014-2015 school year, median coverage for three doses of MMR vaccine was 94%, for two doses of varicella coverage was 93.6%, and for DTaP coverage was 94.2% (Woo, 2016).

According to Zhou et al. (2014), the routine childhood immunization program continues to be one of the most cost-effective prevention programs in public health. Routine vaccination may save about $69 billion in costs to society (Kurosky et al., 2015). Vaccines not only prevent disease, but also prevent complications such as pain, suffering, long-term disabilities, and death from disease (Zhou et al., 2014). A review of the completion of the childhood vaccination schedule in the 2009 United States birth cohort

showed that about 42,000 deaths and 20 million cases of disease were prevented in the cohort member's lifetimes (Kurosky et al., 2015). Healthy People 2020 goals include 90% of children receiving all doses of individual vaccines, 80% receiving all doses of rotavirus vaccine, and 80% receiving all doses in the 4:3:1:3:3:1:4 series by age 19 to 35 months (Kurosky et al., 2015). Vaccination coverage has improved, but only about 68% of 2-year olds completed all doses in the 4:3:1:3:3:1:4 series in 2012 (Kurosky et al., 2015). Additionally, the goal of 90% completion was not achieved for DTaP (83%), PCV (82%), rotavirus (69%), and HepA (82%) vaccines (Kurosky et al., 2015).

An outbreak of measles in the later part of 2014 that began at Disneyland in Anaheim, California makes the issue of vaccine refusal even more prevalent (Phadke et al., 2016). Because of this outbreak, there were 111 cases of measles in seven different states which accounted for two-thirds of the total measles cases reported by April 2, 2015 (Phadke et al., 2016). Close to half of those measles cases were in people who had not been vaccinated even though they were eligible to receive the vaccine (Phadke et al., 2016).

Woo (2016) states that there is a clear association between children and adolescents not being vaccinated and the occurrence of VPD outbreaks. Children are most susceptible to severe complications from VPDs in the first 2 years of life, so it is important to measure vaccine compliance during this time (Kurosky et al., 2015). Almost 75% of children do not get all doses on time indicting that many children are not adequately immunized from birth to 2 years (Kurosky et al., 2015). Due to vaccine

refusals, there have been outbreaks of invasive Hib, varicella, pneumococcal disease, measles, and pertussis (Phadke et al., 2016).

Again, in California in 2014, a pertussis outbreak with 222 reported cases, only 24% had gotten any DTaP doses even though more than half were eligible (Phadke et al., 2016). Phadke et al. (2016) also concluded that vaccine refusal was associated with increased measles infections in people who refuse vaccines and those that are fully vaccinated. The authors went on to also conclude that the pertussis resurgence is also caused by waning immunity among other factors as well as vaccine refusal in some populations (Phadke et al., 2016).

Vaccine-Preventable Diseases

Worldwide, the prevalence of VPD has increased because of decreasing vaccination rates (Kestenbaum & Feemster, 2016). In the United States, approximately one in eight children less than 2 years old is undervaccinated because of parental choice (Kestenbaum & Feemster, 2016). The VPDs that were almost forgotten are making a comeback in the United States. (Olpinski, 2012). Herd immunity can stop endemic transmission of VPDs which will reduce the prevalence, but to eradicate VPDs, prevalence needs to be eliminated, not just reduced (Saint-Victor & Omer, 2013). Small areas with resistance will continue to have outbreaks in children who have not been vaccinated (Saint-Victor & Omer, 2013). It is necessary to prevent widespread non-compliance to reach the goal of the eradication of VPDs (Saint-Victor & Omer, 2013).

Measles is a very contagious respiratory virus that is accompanied by a high fever, cough, coryza, and conjunctivitis (the three C's), and a maculopapular rash (Woo,

2016). The virus can incubate for 7 to 14 days and the rash appears about 14 days after exposure (Woo, 2016). It is contagious from 4 days prior to 4 days after the rash appears (Woo, 2016). The symptoms can be treated but the virus cannot, however, it is recommended that all infants and children with measles receive vitamin A to decrease morbidity and mortality (Woo, 2016). The measles vaccine was developed in 1963 (Woo, 2016). Between the years 2000 and 2015, 56.8% of measles cases in the United States were in those who had not had the measles vaccination (Phadke et al., 2016). The number of those cases that held nonmedical exemptions was 41.8% (Phadke e al., 2016). In the time where there was a resurgence of measles in the United States (1989-1992), unvaccinated children with a vaccine exemption were thirty-five times more likely to be infected with measles than vaccinated children (Phadke et al., 2016).

Mumps is a contagious virus spread through respiratory secretions and saliva (Woo, 2016). It is accompanied by fever, headache, anorexia, and swollen salivary glands (Woo, 2016). The mumps virus can be detected in saliva from 7 days before parotitis until 8 days after the swelling of the salivary glands (Woo, 2016). People who are infected with mumps should be isolated for 5 days after parotitis occurs and children should not go to school or daycare (Woo, 2016). The virus incubates for 16 to 18 days (Woo, 2016). The mumps vaccine was licensed in the United States in 1967 and is given as part of the MMR, and measles, mumps, rubella, varicella (MMRV) vaccines (Woo, 2016).

Mumps can be prevented with the MMR vaccine (CDC, 2016d). The vaccine is about 88% effective when a person gets two doses (CDC, 2016d). In May of 2015, there

was a Mumps outbreak at the University of Illinois at Urbana-Champaign (Albertson et al., 2016). There were 317 cases of Mumps from April 2015 through May 2016 in a group of people who had high two dose coverage with the MMR vaccine (Albertson et al., 2016). After this outbreak, the CDC recommended a third dose for people in close contact settings such as in the outbreak in Illinois (Albertson et al., 2016). Prior to the mumps vaccination program in 1976, the disease was often seen in children (CDC, 2016d). After the vaccination program, there was a 99% decrease in mumps in the United States. (CDC, 2016d).

Varicella (chicken pox) is another highly contagious disease that spreads from person to person through contact or by respiratory secretions (Woo, 2016). This infection is accompanied by a prodromal period of fever, headache, and anorexia, then a pruritic, vesicular rash that goes through various stages (Woo, 2016). People at risk for severe disease are those who are immunocompromised, and pregnant women (Woo, 2016). The incubation period is 14 to 16 days and those infected are contagious from 1 to 2 days before the rash appears until all lesions are crusted (Woo, 2016). The varicella vaccine was started in 1995 and lead to a reduction of 95% over 10 years (Woo, 2016). Before routine varicella vaccination, wild varicella virus infections were the most common cause of vaccine-preventable death in children in the United States. (Poland & Jacobson, 2012). The varicella vaccine can significantly decrease the varicella burden through herd immunity (Baxter et al., 2014). Since the varicella vaccine was introduced 15 years ago, varicella incidence has decreased by about 90% to 95% in all age groups (Baxter et al.,

2014). Varicella hospitalization rates have declined by about 90% as well (Baxter et al., 2014).

Meningococcal disease (meningitis) is caused by a bacterium called *Neisseria meningitides*, which has 13 serotypes (Woo, 2016). This disease is accompanied by a sudden fever, chills, malaise, myalgia, and a rash that can be maculopapular, petechial, or purpuric (Woo, 2016). It worsens quickly, causing limb ischemia, pulmonary edema, coagulopathies, shock, coma, and death within hours (Woo, 2016). Treatment must occur immediately with broad-spectrum antibiotics and treatment of shock (Woo, 2016). In 1981, a polysaccharide vaccine for serotypes A, C, Y, and W was approved to use in children age 2 years and older (Woo, 2016). There is also a meningococcal conjugate vaccine approved for infants and children aged 6 weeks to 18 months (Woo, 2016).

Pertussis (whooping cough) is caused by the bacteria *Bordetella pertussis* and is accompanied by mild upper respiratory tract symptoms that mimic the common cold and progress to a coughing stage that lasts for 6 to 10 weeks (Woo, 2016). The cough is very distinctive: a whoop on inspiration followed by paroxysms of coughing, which can lead to vomiting (Woo, 2016). It usually affects infants under the age of 6 months more severely and may include gagging, gasping, bradycardia, and apnea (Woo, 2016). Treatment may require hospitalization due to hypoxia, or apneic spells, which can lead to sudden, unexpected death in young infants (Woo, 2016). Antibiotics can decrease the severity of symptoms if initiated early enough and help to minimize spread to others (Woo, 2016). The incubation period is 7 to 10 days, and the most contagious period is the beginning stage mimicking the common cold (Woo, 2016). Severe disease can be seen in

infants and people with health conditions that can be worsened by pertussis infection (Woo, 2016).

Administration of pertussis vaccine started in the 1940s; a new vaccine with fewer side effects was licensed in 1997 (Woo, 2016). Pertussis continues to be endemic in the United States, and the incidence of this disease continues to increase (Phadke et al., 2016). For the past 10 years, there have been more than 10,000 cases reported each year, and these numbers are higher than in the past 50 years (Phadke et al., 2016). In 2010, there were 143 cases of pertussis in California—the most reported in 63 years (Olpinski, 2012). During this outbreak, 10 infants died (Olpinski, 2012). There were also outbreaks in Michigan, Ohio, and other states (Olpinski, 2012).

Parental Beliefs and Contributing Factors

The Periodic Survey of Fellows in 2006 showed that 75% of pediatricians had parents who refused a vaccine, and in 2013, a follow-up study showed that 87% of pediatricians had parents who refused a vaccine (Edwards, Hackell, The Committee on Infectious Diseases, & The Committee on Practice and Ambulatory Medicine, 2016). Parents are not accepting of mandatory vaccination and a survey done in the United States showed that more than 10% of parents opposed compulsory vaccination (Dube et al., 2013). Parents who do not have enough information about vaccines or VPDs tend to have more negative feelings about vaccination, providers, vaccination requirements, and trusting those responsible for the immunization policies (Kestenbaum & Feemster, 2016). People tend to overestimate how often children experience adverse effects of vaccines (Siddiqui et al. 2013). Some parents also prefer what is referred to as “natural risks”

rather than “manmade risks” as well as “errors of omission” rather than “errors of commission” (Siddiqui et al., 2013). Parents do not want to be told what to do with their children’s health and want to be included in the decision-making process with their child’s healthcare provider (Siddiqui et al., 2013). In a study by Williams et al., (2013), the authors concluded that 86.9% of parents get their vaccine information from their healthcare provider, 39.3% from the internet, 26.2% from friends, 25.4% from family, and 13.9% from the news and media.

Most parents have not had any direct experience with VPDs, so their fear of those diseases is less than their fear of vaccines (Kestenbaum & Feemster, 2016). Parents can also be influenced by social norms such as values, beliefs, attitudes, and behaviors (Kestenbaum & Feemster, 2016). Making decisions about childhood vaccination requires weighing the benefits and risks for the individual as well as the community (Austvoll-Dahlgren & Helseth, 2010). The process of making vaccination decisions is complex and challenging (Austvoll-Dahlgren & Helseth, 2010). Factors that can affect the method of information seeking are age, gender, country of birth, education, household income, the number of children, and vaccination status (Harmsen et al., 2013). The information most commonly searched for was related to side effects and possible adverse outcomes of vaccination (Harmsen et al., 2013). It may be that parents seek additional information when they feel they are not provided with enough information to decide (Harmsen et al., 2013). People also tend to look for information that is supportive of their beliefs with the intent of reinforcing their beliefs instead of the possibility of changing their minds (Kestenbaum & Feemster, 2016).

Vaccines prevent morbidity, mortality, and reduce public health costs from infectious disease (Olpinski, 2012). Few parents choose not to vaccinate at all or refuse, and an increasing number of parents are choosing to follow an alternative vaccination schedule that omits or delays one or more vaccines (Wheeler & Buttenheim, 2013). Wheeler and Buttenheim (2013) state that one in ten parents reported intentionally delaying vaccines, and physicians report an increased number of requests for alternative schedules. Parents with vaccine concerns are more likely to follow an alternative immunization schedule (Wheeler & Buttenheim, 2013). There is a link between parental vaccine beliefs and child's vaccination status, and the increased number of concerns increases the likelihood of an alternative schedule (Wheeler & Buttenheim, 2013). Some concerns mentioned are fears of overtaxing of the immune system, autism, mercury, aluminum, and the use or necessity of vaccines (Wheeler & Buttenheim, 2013).

The antivaccination movement formally started in the United States on April 19, 1982 (Olpinski, 2012). A television program called DPT: Vaccine Roulette, reported that the Pertussis part of the DTP vaccine causes severe brain damage, seizures, and delayed mental and motor development (Olpinski, 2012). Because of this report, parents began to refuse vaccinations for their children in the United States and throughout the world (Olpinski, 2012). Great Britain had the largest decline in vaccination causing an outbreak of pertussis and the deaths of many children (Olpinski, 2012). People are afraid of vaccines due to misinformation and antivaccine messages, and this threatens routine vaccine use (Poland & Jacobson, 2012). Parents started suing for damages related to vaccine harms which forced some vaccine manufacturers to stop producing vaccines,

increasing the threat of VPDs (Olpinski, 2012). Vaccine refusal is not new, but it is of significant concern now due to unlimited international travel (Poland & Jacobson, 2012). These concerns have been validated by the recent outbreaks of measles, mumps, rubella, and pertussis (Poland & Jacobson, 2012). Many people who refuse vaccination reject the scientific method and peer-reviewed literature (Poland & Jacobson, 2012). Antivaccine activists fear adverse effects of vaccines, praise alternative medicine as safer and equal to vaccine effectiveness, and are suspicious of profit gains from widespread vaccination (Saint-Victor & Omer, 2013).

Vaccination has declined worldwide, and the largest decrease has been with the combined MMR vaccine after Andrew Wakefield's article in The Lancet in 1998 linked the MMR vaccine and autism. Even after Wakefield's research was determined to be false, his study retracted, and his medical license revoked, parents continued to fear the possibility of this link (Saint-Victor & Omer, 2013). In 1999, the ingredient thimerosal, was removed from vaccines due to concerns regarding its safety even though there was no evidence of its harm (Olpinski, 2012). This further justified the antivaccine activists' beliefs (Olpinski, 2012). People believed if thimerosal were safe, it would not need to be removed (Olpinski, 2012). The removal of thimerosal and the link to autism significantly influenced vaccine refusal even though both concerns were proven false through a review of evidence (Olpinski, 2012). Conspiracy theories surrounding vaccination have become popular, and these theories attempt to explain events in a way that is secret, powerful, and malevolent in nature (Jolley & Douglas, 2014). Nationally, about 13% of parents chose to follow an alternative schedule (Opel, Banerjee, & Taylor, 2013). Options for alternative

vaccination schedules include reducing the number of vaccinations per visit, delaying age-specific vaccinations to an older age, and spreading out specific vaccines that should be given together (Opel, Banerjee, & Taylor, 2013). Most of the time, parents just want to weigh the risks and benefits for their children so that they know they are doing what is best for them (Poland & Jacobson, 2012).

Several celebrities and politicians publicly joined the antivaccine movement further influencing vaccination decisions (Olpinski, 2012). Groups like the National Vaccine Information Center (NVIC), the Coalition for SafeMinds, and Know Vaccines are against universal vaccination because they believe that all children are different and that parents have the right to choose whether their children get vaccinated (Shetty, 2010). Parents who choose not to vaccinate their children were four times more likely to use alternative medicine providers (Siddiqui et al., 2013). From 2001-2008, an average of 56 measles cases were reported to the CDC per year but, in the first 19 weeks of 2011, 118 cases were reported (Olpinski, 2012). Many of these cases were in unvaccinated people and those from other countries (Olpinski, 2012). Also, there were noted cases of mumps and invasive Hib disease (Olpinski, 2012). Antivaccine activists also believe that children get too many vaccines too soon resulting in antigenic overload indicating that humans are incapable of responding safely to the number of vaccines given and this is believed by 33.7% of parents according to a study by Poland and Jacobson, 2012.

There is a mistrust of science and scientists that has also contributed to skepticism about vaccination (Camargo Jr. & Grant, 2015). There was a global breakdown in the trust that the public has in science which was consistent with the deterioration of trust in

vaccination recommendations (Shetty, 2010). In the United States, it is common for people to believe conspiracy theories (Camargo Jr. & Grant, 2015). Examples of current conspiracy theories are that the United States government organized the 9/11 attacks and that the NASA moon landing was fake (Jolley & Douglas, 2014). More than 70% of Americans believe that conspiracy was involved in Present Kennedy's death and more than 20% believe that there is a link between childhood vaccines and autism (Jolley & Douglas, 2014). Some of the conspiracy theories regarding vaccinations include the idea that large pharmaceutical companies and governments are covering up information about vaccines for their benefit (Jolley & Douglas, 2014). It is believed that pharmaceutical companies bribe researchers to fake data, cover up evidence of harmful side effects, and heighten the statistics on vaccine efficacy (Jolley & Douglas, 2014). These theories strengthen mistrust in science (Jolley & Douglas, 2014). Powerful political leaders have publicly linked vaccines with autism, and so have well-known celebrities who have based their information on the article written by Andrew Wakefield (Camargo Jr. & Grant, 2015). There is research that shows a link in believing conspiracy theories and low levels of trust and distrust of medical information and vaccine hesitancy (Jolley & Douglas, 2014). Jolley and Douglas (2014), concluded that vaccination intentions are lower in people who believe in conspiracy theories.

As stated by Poland and Jacobson (2012), 31% of parents who refused vaccination did so out of concern for autism (Poland & Jacobson, 2012). About 80% of doctors in the United States. report at least one vaccine refusal per month and 8% of physicians' report that more than 10% of their patients' parents refused vaccination

(Poland & Jacobson, 2012). About 90% of doctors' report that they had at least one request to spread out vaccinations and 20% report that more than 10% of their patients' parents have asked for an alternate schedule (Poland & Jacobson, 2012).

The Role of Exemptions in Vaccine Hesitancy. Prior to the mandatory vaccination requirements for school entry, VPDs (measles, diphtheria, smallpox, and pertussis) caused 20% of childhood deaths in the United States. (Hedden et al., 2014). Immunization requirements are responsible for the elimination of almost all deaths from VPDs in the United States (Hedden et al., 2014). Vaccination is revisited when children become school age, and they must meet state vaccination requirements (Salmon et al., 2015). In the United States, each state has requirements for children starting kindergarten to have certain vaccinations, but the required vaccinations vary by state (Salmon et al., 2015). The amount and frequency of nonmedical exemptions has increased over the past two decades and they were historically seen more in states where the requirements for obtaining an exemption were easier (Phadke et al., 2016). But now, the number of exemptions in states with more difficult exemption requirements have been increasing (Phadke et al., 2016). There has also been an increase in religious exemptions in those states that do not allow philosophical exemptions (Wang et al., 2014). Medical exemptions are provided by a doctor for medical reasons and nonmedical exemptions are due to religious or philosophic reasons (Seither et al., 2016). Higher exemptions rates have also been associated with a higher incidence of measles and pertussis outbreaks which will lead to a higher number of outbreaks in nonexempt populations (Wang et al., 2014).

Mandatory vaccination laws are not new, and states have been requiring certain vaccinations for around a hundred years (Domachowske & Suryadevara, 2013). Mandatory immunization laws are restrictive to individuals, but they protect the community from VPDs (Tafuri et al., 2013). These laws are especially important for children who are too young to be vaccinated, people who have medical contraindications, as well as individuals who have been vaccinated, since vaccines are not 100% effective (Tafuri et al., 2013). In this case, it is ethical to restrict individual rights for the good of the community (Tafuri et al., 2013). Medical exemptions are allowed in all states in the United States due to severe allergies, reactions, and for those who are immunocompromised (Domachowske & Suryadevara, 2013). It is the responsibility of each state to decide which vaccines are required but the U.S. ACIP makes the recommendations (Gostin, 2015). Medical exemptions based on allergy or immune deficiency are allowed in all states with a physician's certificate (Gostin, 2015). Some parents will claim religious exemptions for reasons that are not religious in states that do not allow philosophical exemptions (Domachowske & Suryadevara, 2013). Exemptions can be due to religious beliefs, spiritual beliefs, or personal beliefs including moral or philosophical reasons and it can be difficult to determine if they are truly due to religious or philosophical reasons or if those reasons are used by parents who object due to safety concerns (Phadke et al., 2016).

Over the past 15 years, vaccine safety concerns have increased, and more parents are refusing or delaying vaccines (Wang et al., 2014). This is also contributing to the rise of nonmedical exemptions for the vaccinations required for school entry (Wang et al.,

2014). When nonmedical exemption rates are high enough to affect herd immunity, VPDs increase (Wang et al., 2014). State mandated vaccination requirements for children to start school are meant to protect children and the community against VPDs (Seither et al., 2016). The exemptions allowed by state significantly influence vaccination rates as well as incidence rates of VPDs (Gostin, 2015). Families sharing the same beliefs tend to be found in the same areas, and this affects herd immunity in those areas resulting in outbreaks that can spread (Gostin, 2015). Unvaccinated children pose a risk to the public and increase the possibility that rare, preventable diseases could become endemic again (Gostin, 2015). In 2010, there were 9000 cases of pertussis in California which was more than had been reported in the state since 1947 (Diekema, 2012). A large number (89%) of these cases were in infants younger than 6 months, and this group is too young to be vaccinated leaving them to rely on herd immunity to protect them from infection (Diekema, 2012). When looking at vaccination rates in the United States, they look to be adequate since coverage for kindergarten is higher than 90% for most recommended vaccines but when looking at the numbers closer, it is noted that there is a variation based on geographic location (Diekema, 2012). For example, in San Juan County, Washington, 72% of kindergartners, and 89% of sixth graders either do not comply or are exempt from the immunization requirements for the start of school, and 52.5% of kindergartners, and 4% of sixth graders had the appropriate vaccinations against pertussis in the 2010-2011 school year (Diekema, 2012). This location also has one of the highest numbers of pertussis cases reported (Diekema, 2012). Since outbreaks of pertussis, measles, and Hib continue, the vaccination coverage in the United States is inadequate (Diekema, 2012).

For the 2015-2016 school year, among the 50 states and the District of Columbia, MMR coverage was 94.6%, there were 22 states that had coverage of 95% or above, and three states and the District of Columbia had coverage of less than 90% (Seither et al., 2016). The NIS showed 11 states where about 4% of children starting kindergarten have an exemption from the vaccination requirements (Kestenbaum & Feemster, 2016). This leads to a longer period that children are at risk and an increased in the possibility of VPD outbreaks (Kestenbaum & Feemster, 2016). Most of the measles cases were in children who had not received the vaccine (45%), or had an unknown vaccination status (38%) and in those cases, 43% of parents had philosophical or religious objections to vaccines (Edwards et al., 2016).

The California outbreak spread to multiple states (Edwards et al., 2016). Many pediatricians admit that part of the cause of the measles outbreak was delayed or incomplete vaccination (Edwards et al., 2016). Between the years of 2004 and 2011, the rate of exemptions increased from 1.48% to 2.2% (Siddiqui et al., 2013).

Antivaccination Intervention Strategies

Countering the antivaccine movement has the potential to significantly increase voluntary vaccination which would decrease the need for mandatory vaccination (Tafuri et al., 2013). There are many studies examining interventions to encourage vaccination including online decision aids, reminder/recall systems, patient and provider education, provider communication techniques, and financial incentives (Glanz et al., 2015). There is a lack of sufficient evidence to support any intervention specifically (Glanz et al., 2015). Per Tafuri et al., (2013) the main ideas surrounding the antivaccine movement

include: the belief that vaccines cause idiopathic illness, that profit is the goal, that vaccines are poison, that facts are ignored, that vaccination laws are insulting, that vaccine immunity is temporary, and that a healthy lifestyle, personal hygiene, and diet prevent disease. To counter these beliefs, the CDC developed a booklet looking at the objections to vaccination (Tafuri et al., 2013). It is important to maintain and share authoritative, evidenced-based information about vaccines and to establish relationships that are based on trust (Domachowske & Suryadevara, 2013). The process of providers acknowledging patients and parents' concerns, steering the conversation, and knowing the facts well will help them answer questions in an authoritative and confident manner (Domachowske & Suryadevara, 2013). It is necessary for health care workers to address parents who refuse vaccinations for their children and change their minds with the goal of stopping the antivaccination movement (Tafuri et al., 2013). Good provider-patient relationships with effective communication have the potential to influence this change (Tafuri et al., 2013).

Research shows that recommendation from a healthcare provider is a key determinant of vaccine acceptance which can also be problematic because there are some vaccine-hesitant healthcare professionals, and some who do not feel comfortable answering vaccine-related questions from parents (Feemster, 2013). Non-physician sources of information tend to highlight more of the risks of vaccination rather than the benefits (Wheeler & Buttenheim, 2013). It has also been shown that health care workers who have accepted vaccinations for themselves are more likely to recommend them to their patients (Tafuri et al., 2013). Often, parents who are seeking information from their

health care providers have already sought out information elsewhere, such as from papers, websites, and media (Tafuri et al., 2013). Parents who use non-physician sources for vaccine information are more likely to have vaccine concerns and request an alternative schedule (Feemster, 2013). Parents need to be directed to accurate information so that they can make educated decisions (Williams et al., 2013) There are online tools available from the CDC and the American Academy of Pediatrics for parents and providers so that they have accurate information about childhood vaccination (Williams et al., 2013). Understanding the specific parental concerns will help match the appropriate counter action with the goal of increasing parental compliance with vaccination (Healy & Pickering, 2011).

The vaccine concerns of parents differ based on knowledge and personal experience, but generally, the fear is that they are unsafe (Healy & Pickering, 2011). It is important to take into consideration that there are a variety of concerns that need to be addressed (Healy & Pickering, 2011). The Strategic Advisory Group of Experts (SAGE) Working Group (WG) on vaccine hesitancy requested a review of strategies to address hesitancy with the goal of identifying strategies that have been implemented and evaluated for the response to and management of vaccine hesitancy (Jarrett et al., 2015). Most interventions in the United States included parents, health care workers, and the community (Jarrett et al., 2015). Most of these interventions involved individual and social group influences (Jarrett et al., 2015). Recent attempts to communicate health benefits of vaccines have not been effective in increasing public support for vaccines (van der Linden et al., 2015). Social media interventions are being used more often now

to promote health and behavior change in many different areas including weight loss, smoking cessation, physical activity, and sexual health (Glanz et al., 2015). The Internet should be used to empower and engage users by using open discussion and idea sharing (Glanz et al., 2015). In a study by Williams et al., (2013) it was concluded that an education intervention, including an eight-minute video and written information tailored to the most common concerns of vaccine-hesitant parents, could improve attitudes about childhood vaccines. Most parents want to be educated on how to best care for their children, and this includes information about vaccines (Edwards et al., 2016).

People can be influenced by socio-cultural and political ideas surrounding health beliefs, economics, and how people view the health care system (Feemster, 2013). The most effective interventions were the ones that: targeted unvaccinated or under-vaccinated populations, that were aimed to increase vaccination awareness and knowledge, improved convenience and access, targeted specific populations, mandated vaccinations or posed sanctions against non-vaccination, or engaged religious or other influential leaders to promote vaccination (Jarrett et al., 2015). Interventions that were not effective were ones that focused on quality improvement at clinics, passive interventions, and incentive-based interventions that used conditional or non-conditional cash transfers (Jarrett et al., 2015).

In 2010, the Gates Foundation called the next 10 years the "Decade of Vaccines" at the World Economic Forum (Feemster, 2013). The goal was to increase access to existing and new childhood vaccines, and it was estimated that it could save 6.4 million lives and prevent 426 million illnesses (Feemster, 2013). When a person faces the

decision to accept a vaccination, they must assess the risks associated with vaccination and the risks of not being vaccinated (Feemster, 2013). Media can be a significant contributor to parent's attitudes and beliefs (Healy & Pickering, 2011). It is difficult for parents to understand the science behind vaccines which is the biggest pro-vaccine component causing parents to become confused (Healy & Pickering, 2011). Parents usually want to make the best decisions for their children, but this is made harder by controversial sources of information (Healy & Pickering, 2011). Parents become more afraid of harming their children than of their children being harmed (Healy & Pickering, 2011). The time in which a child is susceptible to disease is significantly increased by delaying any vaccination (Edwards et al., 2016). On-time vaccination is the most effective way to prevent deadly childhood diseases (Edwards et al., 2016). In a study by Glanz et al. (2015), it was concluded that interventions with the most success will be the ones that build trust, reduce concerns about the risk of vaccines, and help parents understand that vaccinating per the recommended schedule is in the best interest of their children as well as the community.

The Internet and Vaccine Hesitance

People search for health information on the internet including vaccination information and they are more likely to encounter antivaccination messages (Guidry et al., 2015). Visiting an antivaccine website for 5 to 10 minutes can increase the belief of vaccination risks which decreases vaccination intentions (Guidry et al., 2015). If a parent does not see their provider as reliable, they are more likely to seek out information through the internet (Madden, Nan, Briones, & Waks, 2012). The internet is now a tool

used in population health because there is a wide range of information available, it is low cost, access is easy, interaction is real-time, content can be tailored, and people can remain anonymous (Jiang & Beaudoin, 2016). People often discuss their health perspectives online and the information provided online can be inaccurate or incomplete (Faasse, Chatman, & Martin, 2016). About 80% of internet users search for health information and 16% of those users search for vaccination information (Dredze, Broniatowski, Smith, & Hilyard, 2016). More than half of internet users believe that most of the information they find on the internet is credible, but the information found on vaccines uses outdated sources, misinterpretations, and unsupported statements (Olpinski, 2012). The internet now allows people to contribute any information whether it is true or not through blogging, photo-sharing, video-uploading, and social media (Tafuri et al., 2013). The use of the internet as an information source for vaccines might cause more negative attitudes about vaccines because antivaccination websites are more prevalent than others (Harmsen et al., 2013).

It is much easier now than it was in the 1800s to disseminate antivaccination ideas (Tafuri et al., 2013). In the 1800s, information was passed through posters and newspapers, and now, the internet is used (Tafuri et al., 2013). Media plays a role in keeping the negativity about vaccinations prevalent even though there is plenty of evidence showing that vaccines are safe and effective (Dube et al., 2013). There is also evidence to show that in areas where there is controversy about vaccinations is present, there is a decrease in the vaccination rates (Dube et al., 2013). Vaccine-hesitant parents are less likely to vaccinate their children after being presented with evidence-based

information from governmental health agencies (Glanz et al., 2015). Parents have said that the online resources that are supportive of vaccines are often difficult to follow and they wish they had a way to interact with people (Glanz et al., 2015). The sharing of antivaccine messages publicly has been increasing and the ideas stated are that vaccines are ineffective, useless or dangerous, children get too many vaccines at one time, and mandatory vaccination is a violation of civil liberties and parental rights (Guidry et al., 2015). Adverse effects of vaccination are often exaggerated through the media and the spread on the internet (Siddiqui et al., 2013). Inaccurate information presented online can result in hasty, ill-informed, and dangerous health decision making (Jiang & Beaudoin, 2016). This type of information can spread very quickly on the internet and it can be difficult to correct (Faasse, Chatman, & Martin, 2016). People tend to choose which groups they participate in and look for information that reinforces their current beliefs (Faasse, Chatman, & Martin, 2016).

People use the internet to share stories and their personal experiences through social networking sites like Facebook, Twitter, YouTube or Wikipedia (Dube et al., 2013). Antivaccine activists can choose only supportive evidence and discredit the other information available (Dube et al., 2013). Antivaccination activists use a different method of presenting their information and do very well with spreading misinformation through social media (Glanz et al., 2015). They tend to use narratives and personal stories that will appeal to parents' emotions which increases the perception of risk and decreases vaccination intentions (Glanz et al., 2015). There are a multitude of blogs and discussions

available to parents on the internet that have the potential to influence parents' decision-making regarding childhood vaccinations (Glanz et al., 2015).

Parents are consistently exposed to vaccine discussions on the internet, and there is evidence to show that the participation in social media reinforces a person's beliefs whether negative or positive (Edwards et al., 2016). Parents are more apt to search for vaccine information if they are undecided or have negative feelings towards vaccination especially if they have heard of or know someone claiming a vaccine injury (Austvoll-Dahlgren & Helseth, 2010). Many parents (79.6%) reference two to six sources when they are looking for information about childhood vaccination (Jones, Omer, Bednarczyk, Moulton, & Salmon, 2012). The increasing use of the internet has allowed the allegations of vaccine injury to spread worldwide very quickly (Salmon et al., 2015). Social media provides real-time access to attitudes, beliefs, and behaviors of people in varying demographics and it is a frequently used media by antivaccination activists (Dredze, Broniatowski, Smith, & Hilyard, 2016). The internet can influence people's perceptions about vaccination, and it is the main source of health information for many people (Tafuri et al., 2013). It can change parent's perception of the risk of vaccination side effects and VPDs (Tafuri et al., 2013).

Summary and Conclusions

VPDs are a significant public health concern in the United States. Routine childhood immunization is the best way to prevent outbreaks of these diseases and protect the health of children and their communities. Vaccination is considered one of the greatest contributions to public health. However, over the past 15 years, people have

become increasingly hesitant about vaccination due to safety concerns that are not based in science or medicine. Parents are afraid of harming their children and do not want to be told what to do regarding their children's health. They are becoming more vocal about their beliefs, and with the rise of the internet and social media use, it has become easier for them to spread their ideas and influence more people. It is imperative that vaccination rates remain high to prevent VPD outbreaks. In response to the need to prevent and control the spread of VPD, mandatory vaccination laws have been created requiring certain vaccinations for children before the start of school. Some parents feel that this is an intrusion on their freedom. Medical exemptions to these requirements are necessary for those who cannot be vaccinated for health reasons. Nonmedical exemptions are based on religious or philosophical reasons and are often easy to obtain. There is an increase in nonmedical exemptions and an increase in outbreaks of VPD in those communities with higher numbers of nonmedical vaccine exemptions. The incidence of VPD has been low in the United States, but the current trend of vaccine hesitancy is threatening the health of children living in the United States.

Use of the internet and social media for health information has increased in recent years. The internet is a popular tool for health information because there is a wide range of information available, the cost is low, access is easy, people can interact, people can choose what information they see, and people can be anonymous. Negative vaccine information is widespread on the internet and is more prevalent than pro-vaccine messages. A parent can use these websites to reinforce their antivaccination views and influence others to believe the same. Additionally, people have a hard time understanding

the information available on pro-vaccine internet sites. Parents have a hard time understanding the impact of VPD because they do not have any direct experience with them. They are more likely to be exposed to someone claiming a vaccine-related injury and this type of information can spread very quickly on social media. A parent with concerns related to vaccination is more likely to search the Internet for vaccine information. The internet can influence parent's perceptions and behaviors about immunization for their children. The current literature available discussed the risks of VPD, the factors related to vaccine hesitancy, immunization exemptions affecting outbreaks of VPD, and how the media has a role in influencing people's choices, but no study has examined the relationship between the increase in vaccine hesitancy and the growth in social media and internet use for vaccination information. This study sought to address the identified gap in the literature.

This chapter addressed VPD, current immunization recommendations and compliance in the United States, and the history of vaccine hesitancy as well as the present state of vaccine hesitancy. The HBM was applied as an appropriate theoretical framework to address vaccination behaviors among parents. Also, parental beliefs and contributing factors were discussed along with the role of exemptions in vaccine hesitancy, and antivaccination intervention strategies, and the role of the internet and vaccine hesitancy. Finally, this chapter presented a synthesis of the current peer-reviewed literature as well as the gap in the literature relevant to this research study. To address the gap in the literature, a quantitative research study is needed. Chapter 3 will discuss the research design and methodology, threats to validity, and the possible ethical concerns.

Chapter 3: Research Method

Introduction

The purpose of this study was to assess the beliefs that parents have regarding the recommended childhood vaccinations and evaluate the effect that social media has on parent vaccination choice. Survey data from parents of children aged 0 to 18 living in Illinois were analyzed. The dependent variable was vaccination choice, and the primary independent variables were exposure to online messages and perceived severity to disease. Chapter 3 contains an explanation of the research methodology used in the study. Major sections of Chapter 3 address the research design and rationale, methodology, sampling, operationalization of constructs and variables, data analysis plan, threats to validity, and ethical procedures, concluding with a summary.

Research Design and Rationale

A quantitative cross-sectional research design was the best method to answer the research questions and measure the relationship between social media use and parents' decisions on whether to vaccinate their children. Quantitative research is the process of explaining phenomena through the collection of numerical data analyzed with statistics. Data can take the form of frequency of responses or occurrences, or participants' verbal or written responses that are quantified into numerical values (Crosby, 2013). The cross-sectional design is one of the most commonly used study designs in health promotion (Crosby, 2013). In this design, time is fixed, and the sample or samples are taken from the population at one time point (Crosby, 2013). This design can also be used to estimate levels of knowledge about any given health threat or health-protective behavior, as well

as health-related attitudes, beliefs, opinions, and behaviors (Crosby, 2013). This study gathered data through a questionnaire because this method is an efficient, convenient, relevant, and cost-effective way to evaluate parents' beliefs, social media usage, and vaccination choices (Crosby, 2013).

Study Variables

The primary dependent variable for this study was vaccination choice made by the parent. This was operationalized by gathering data from the survey respondents about their vaccination choices. The primary independent variable was exposure to information about vaccination through social media. This was operationalized using a pre-existing survey designed to gather information about vaccination views and is discussed in more detail below.

Methodology

Population

The goal of a survey is to answer questions about a target population (Rumsey, 2011). The population of interest for this study included parents who had their own children between the ages of 0 and 18 years living with them in the state of Illinois. The total population of interest included 1,455,656 parents with their own children between the ages of 0 and 18 years living with them in Illinois, according to the most recent U.S. Census conducted in 2010 (U.S. Census Bureau, 2010).

Sampling and Sampling Procedure

The sample included 269 parents in Illinois with their own children between the ages of 0 and 18 living with them. Participants completed a voluntary electronic survey

through SurveyMonkey. To reduce the opportunity for bias, the sample of participants was selected randomly. Sample size calculations were conducted using the SurveyMonkey Sample Size Calculator, and binary logistic regression was selected as the statistical test. Input parameters selected included a 5% margin of error, a 90% confidence level, a population size of 1,455,656, and a response distribution of 50%. The margin of error is the amount of error that can be tolerated (Raosoft, Inc., 2004). A lower margin of error would require a larger sample size (Raosoft, Inc., 2004). The confidence level is how much uncertainty can be tolerated (Raosoft, Inc., 2004). A larger sample size is needed for a higher confidence level (Raosoft, Inc., 2004). The output parameters indicated that the minimum sample size needed to achieve adequate power was 269.

The inclusion criteria for this study applied to parents of children between the ages of 0 and 18 who were either native English speakers or fluent English speakers. The participants were all users of the Internet and had access to the Internet either at home or elsewhere. All parents had some level of education and could read. Exclusion criteria applied to parents who did not speak English (because the questionnaire was presented in English), those who did not have children, and those who did not live in Illinois. The inclusion and exclusion criteria were chosen to increase sample validity and ensure that the likelihood of bias from misunderstanding or those living outside the area was minimized.

Recruitment Procedures and Data Collection

Once the population of interest was identified, a SurveyMonkey questionnaire was created. The questionnaire was distributed through Facebook posts and messaging

targeted at parents in Illinois, in addition to being shared through Facebook by Facebook users. Respondents were targeted with Facebook posts and advertisements that stated the brief purpose of the study highlighting the topic of childhood vaccination. The links led to a SurveyMonkey page, where participants were informed in more detail about the nature of the study, the information being collected, and the rationale. They were then asked whether they wanted to proceed with the questionnaire.

Data were gathered through a survey designed to collect demographic information about the participants, as well as questions relevant to the research aims and objectives.

Instrumentation and Operationalization of Constructs

An electronic survey was created to answer the research questions posed in this paper. The survey content addressed parts of the HBM, and the survey questions came from the Parent Attitudes about Childhood Vaccines (PACV) survey created and used by Opel et al. (2011). This survey was developed with the purpose of accurately assessing the vaccine hesitancy of parents (Opel et al., 2011). The survey was created using an iterative approach with quantitative methodology to identify vaccine-hesitant parents with content and face validity (Opel et al., 2011). It was initially pretested with 25 parents to assess face validity, usability, and item understandability (Opel et al., 2011). All questions were input into SurveyMonkey, with questions added to answer the research questions.

Table 1

Operationalization of Variables

Name of variable	Type of variable	Description of variable
Vaccination choice (dependent)	Categorical	1 = yes 2 = no
Exposure to online messages (independent)	Categorical	1 = yes 2 = no
Perceived severity of disease (independent)	Categorical	1 = strongly agree, agree 2 = disagree, strongly disagree 3 = not sure
Age of youngest child	Categorical	1 = 0–5 years 2 = 6–10 years 3 = 11–18 years
Relationship to child	Categorical	1 = father 2 = guardian 3 = mother
Firstborn status	Categorical	1 = no 2 = yes
Education level	Categorical	1 = no college education 2 = college education
Number of children	Categorical	1 = 1 child 2 = 2 children 3 = 3 or more children
Age of parent	Categorical	1 = 40 years and under 2 = over 40 years
Marital status	Categorical	1 = married 2 = divorced, living with partner, separated, single
Frequency of antivaccine advertisement online	Categorical	1 = never, not often 2 = often, very often 3 = sometimes
Antivaccine advertisement effectiveness	Categorical	1 = no, not at all 2 = very, yes 3 = somewhat

The dependent variable was parent's vaccination choice. The attitude that parents had toward childhood vaccines, which was based on the existing PACV survey developed by Opel et al. (2011), was assessed. It consists of 17 questions, most of which are rated on a Likert scale (*strongly agree*, *agree*, *not sure*, *disagree*, and *strongly disagree*). The variable has been operationalized with reference to this previously validated survey, which was designed to obtain parental views concerning statements such as "children get more shots than are good for them" and "I trust the information I receive about shots." For this research, the attitude of a parent toward vaccination that contributes to vaccination choice was measured using this survey alone.

The independent variable was exposure to online messaging about vaccination and perceived disease severity. Operationally, this was defined using Likert scales and simple responses for the following questions/statements:

- How often do you see advertisements or messages about vaccination online?
- Do you think these messages are effective?
- I believe that many of the illnesses that shots prevent are severe.
- Have you ever decided not to have your child get a shot for reasons other than illness or allergy?

These were assessed on a 5-point scale. For the first question, response options included *very often*, *often*, *sometimes*, *not often*, and *never*. Response options for the second question were *very*, *yes*, *somewhat*, *no*, and *not at all*. Responses for the third question included *strongly agree*, *agree*, *not sure*, *disagree*, and *strongly disagree*. For the last question, response options were *yes*, *no*, and *don't know*. Demographic variables included

education level, firstborn status, number of children, age of youngest child, age of parent, parental relationship, and marital status. These data are summarized in frequency tables.

I sought to answer research questions specific to the HBM, perceived severity to disease, and online messaging related to vaccination.

Data Analysis Plan

The primary purpose of this research was to understand the association between exposure to online messaging about vaccination and the actual vaccination behaviors of parents with children living with them between the ages of 0 and 18 in Illinois. The data analysis plan allowed for statistical analysis of the data collected and was designed to ensure maximum validity. Findings were presented in frequencies and confidence intervals using descriptive statistics and through unadjusted odds ratios and *p*-values through binary logistic regression.

Research Questions

RQ1—Quantitative: Is there an association between parents' perceived disease severity for their child and whether they had their child vaccinated?

H_0: There is no association between parents' perceived disease severity for their child and their decision of whether to vaccinate.

H_A: There is an association between parents' perceived disease severity for their child and their decision of whether to vaccinate.

RQ2—Quantitative: Is there an association between exposure to messaging from social media and a parent's decision to vaccinate a child?

H_0: There is no association between exposure to messaging from social media and a parent's decision to vaccinate a child.

H_A: There is an association between exposure to messaging from social media and a parent's decision to vaccinate a child.

Statistical Analysis

Parents' perceptions of their children's disease severity were examined using responses to the questions in the PACV survey. Additionally, responses to questions regarding social media messaging and vaccination status were examined. Data on education level, firstborn status, number of children, age of youngest child, age of parent, parental relationship, and marital status were also collected as part of the research. These data were summarized in frequency tables.

Data were analyzed using SPSS version 24 (IBM, 2017). The strength of the association between each of the variables involved in the research was calculated. Binary logistic regression was used to find significant associations between each independent variable and the outcome variable. Unadjusted odds ratios and *p*-values were reported. Binary logistic regression including all independent variables and the outcome variable was used to look at the relationship between the independent variables of interest and the outcome. Unadjusted odds ratios and *p*-values were reported. Significance in all regressions was determined by a p-value < 0.05.

Threats to Validity

Validity is defined as the extent to which variables measure the constructs they are intended to measure (Crosby, 2013). There are some things that can affect the validity

of a survey. There is the possibility of parents misunderstanding the questions and not answering accurately. It is also possible that parents will want to answer the questions based on what they think they should do rather than what they do, which could influence the results. It is also possible for parents to choose to be dishonest in their responses. Further, it is possible that a targeted population of parents will not respond or will choose not to complete the survey entirely. It is important to think these things through before conducting a survey (Crosby, 2013).

Ethical Procedures

It is necessary to keep ethics at the forefront when conducting research. In this study, survey participants were anonymous, and their participation in the survey was voluntary. Simply making the choice to follow the link and respond indicated willingness to voluntarily complete the survey. There was no coercion, and there was no reward for completing the survey. No identifying information was requested; therefore, respondents remained anonymous throughout. This research was intended to contribute to generalizable knowledge; the goal was to provide benefits to others through better knowledge and understanding of the topic.

Summary

In this chapter, I have described the research design, which used a cross-sectional, electronic survey that was administered to parents of children aged 0 to 18 living in Illinois through a period of 45 days. The survey instrument was the PACV survey created by Opel et al. (2011). Questions were added to the survey instrument to gather demographic information and information related to social media messaging. Descriptive

statistics and binary logistic regression analysis were used to analyze those data and explore the association between vaccination choice, perceived disease severity, and social media messaging. The results of the data analyses and answers to the research questions are addressed in Chapter 4.

Chapter 4: Results

Introduction

The purpose of this quantitative, cross-sectional study was to explore the association between social media influence and parents' decisions to vaccinate their children. With the abundance of antivaccine messaging on various Internet and social media sites, as well as an increase in the number of parents choosing to side with the antivaccine movement, there may be a quantitative relationship between exposure to social media messages and vaccination outcomes. Other independent variables that have been found to be associated with vaccination choice that were included in the modeling of this study were education level, firstborn status, number of children, age of youngest child, age of parent, parental relationship, marital status, and parent's level of perceived disease severity. I evaluated the relationship between parents who refuse childhood vaccinations and exposure to antivaccine messaging on social media, as well as parents' perception of the severity of the diseases that childhood vaccinations prevent. A better understanding of the behaviors associated with vaccine hesitance may lead to more specific interventions aimed at countering the antivaccine movement. I sought to answer the following research questions:

RQ1—Quantitative: Is there an association between parents' perceived disease severity for their child and whether they had their child vaccinated?

RQ2—Quantitative: Is there an association between exposure to messaging from social media and a parent's decision to vaccinate?

In this section, I provide a report of the results of the pilot study, the results from data collection, and the results of the study. Included in the results are descriptive statistics, statistical analysis findings, and associated tables and figures. Lastly, a summary of answers to the research questions is provided.

Pilot Study

Prior to conducting the primary study, I conducted a pilot study with 27 respondents to test the reliability of the 12 survey questions added to the previously validated PACV survey created by Dr. Douglas Opel. The pilot study was in a survey format created on SurveyMonkey. There were open-ended questions and multiple-choice questions focused on parents' decisions regarding vaccinating their children among social media influences. The survey was sent out through my personal Facebook page as well as shared by my Facebook friends with their Facebook friends. Twenty-seven participants attempted the pilot survey, and 27 participants successfully completed the pilot survey. As a result, no modifications to the survey were made, and the survey instrument was disseminated to all potential participants.

Data Collection

After obtaining institutional review board (IRB) approval, the data for this study were collected as described in Chapter 3 within a 3-week period in the month of February 2018. Data were collected through a survey created on SurveyMonkey and distributed on Facebook. The survey was initially shared on my personal Facebook page and was shared by my Facebook friends to their Facebook friends, and to various Facebook groups. The survey was designed to disqualify any participant who did not live in Illinois and/or did

not have children under the age of 18 years. Only participants living in Illinois with children under the age of 18 years were targeted. There were 38 respondents who attempted to complete the survey but were disqualified because they either lived outside the state of Illinois or did not have children under the age of 18 years. A power analysis using the SurveyMonkey Sample Size Calculator demonstrated that with a 5% margin of error, a 90% confidence interval, the recommended adequate sample size should be at least $n = 269$ participants.

Seven demographic variables were collected in the survey: education level, firstborn status, number of children, age of youngest child, age of parent, parental relationship, and marital status. These data are summarized in frequency tables.

The research project was designed to minimize threats to internal and external validity. Demographic information was collected to verify the population of respondents in Illinois. The sample in this research project was representative of the population of parents living with Illinois with children under the age of 18 years. Generalizations should be made cautiously from the sample to the wider population. Due to the voluntary nature of this survey, volunteer bias may reduce the homogeneity of the characteristics between the sample and the general population. The population diversity of the state of Illinois may not be consistent with the population of other regions. A high number of married, college-educated, White mothers under the age of 40 years took the survey. This describes the target population well, but further research needs to be done to determine if other factors change the outcome.

Results

After data collection was completed, it was determined that the population of White participants was high. This is consistent with the population of White residents in Illinois representing 71.5% of the overall population, according to 2010 U.S. Census data. It was determined that the target sample population would consist of White parents living in Illinois with children under the age of 18 years. Per 2010 U.S. Census data, there was a total of 1,018,555 White parents with their own children living in Illinois. Another sample size calculation was completed with the SurveyMonkey Sample Size Calculator using a 90% confidence interval and a 5% margin of error. This resulted in a sample size of 269, which remained aligned with the projected sample size need. The total sample size was 269. The survey was sent out again through Facebook to gather the remaining four respondents needed; this took one day. The sample was representative of the population of the state of Illinois. The population is 51% female, and the educational attainment of 88.3% of Illinoisans is high school graduation or higher. There is a higher number of female heads of household with children (6.9%) than male heads of household with children (2.2%). The median age of Illinois residents is 37 years, which is consistent with most of the study population being under 40 years of age.

All 269 participants lived in Illinois and had children under the age of 18 years living with them. Table 2 describes the frequencies that follow.

Table 2

Descriptive Statistics of Variables in the Study

Characteristics	*n* (%)
Q3: Number of children in the HH	
1	96 (35.7)
2	106 (39.4)
3 or more	67 (24.9)
Q4: Age of the youngest child	
0–5 years	157 (58.4)
6–10 years	62 (23.0)
11–18 years	50 (18.6)
Q5: Firstborn child	
Yes	73 (27.1)
No	196 (72.9)
Q6: Parental relationship	
Mother	252 (93.7)
Other	17 (6.3)
Q24: Age of respondents	
40 years and under	191(71.0)
Over 40 years	78 (29.0)
Q25: Marital status	
Married	208 (77.3)
Other	61 (22.7)
Q26: Educational level	
No college education	19 (7.1)
College education	250 (92.9)

Note. $n = 269$.

Many respondents had two children living in the household (39.4%), followed by one child in the household (35.7%), and three or more children in the household (24.9%). Many of the respondents had children who ranged in age from 0 to 5 years (58.4%), followed by 6 to 10 years (23%) and 11 to 18 years (18.6%). More respondents were mothers (93.7%) than fathers or guardians (“other”; 6.3%).

Respondents' ages ranged from 22 to 69 years. The majority were 40 years of age or under (71%); the rest were over 40 years of age (29%). Most of the respondents were married (77.3%); collectively, respondents who indicated that they were divorced, living with a partner, separated, or single constituted 22.7% of the sample. Most participants had a college education (92.9%).

Table 3 describes frequencies regarding vaccination behaviors.

Table 3

Descriptive Statistics of All Vaccination Behaviors

Characteristics	*n* (%)
Q9: Refused other than illness/allergy	
No	237 (88.1)
Yes	32 (11.9)
Q13: Shot-preventable illnesses are severe	
Strongly agree, agree	114 (42.4)
Disagree, strongly disagree	149(55.4)
Not sure	6 (2.2)
Q29: Frequency of seeing antivaccine ads on Internet	
Very often, often	102 (37.9)
Sometimes	82 (30.5)
Not often, never	85 (31.6)
Q30: Antivaccine ads effective	
Very, yes	20 (7.4)
Somewhat	102 (37.9)
No, not at all	147 (54.6)

Note. $n = 269$.

To approach RQ1— (Is there an association between parents' perceived disease severity for their child and whether they had their child vaccinated?) a binary logistic regression analysis was conducted to evaluate the dependent variable, vaccination choice, and the independent variable, perceived severity. The results of the first binary regression model showed that a parent's perceived severity of the disease prevented by the shot $p =$

0.06 for those answering either *strongly agree* or *agree* and $p = 0.01$ for those answering *disagree* or *strongly disagree* was associated with parent's vaccination choice (Table 5). The null hypothesis (H_0: There is no association between a parent's perceived disease severity for a child and the parent's decision of whether to vaccinate) is rejected. The alternative hypothesis (H_A: There is an association between a parent's perceived disease severity for their child and their decision of whether to vaccinate) is accepted. Binary regression showed that parents who refused vaccination also indicated that they either *disagreed* or *strongly disagreed* with the idea that shots prevent severe illness.

To approach RQ2— (Is there an association between exposure to antivaccine messaging from social media and a parent's decision to vaccinate a child?), a binary logistic regression analysis was conducted to evaluate the dependent variable, vaccination choice, and the independent variable, exposure to antivaccine messaging from social media. The results of the second binary logistic regression model showed that exposure to antivaccine advertisements on social media $p = 0.61$ for those answering *very often* or *often*, and $p = 0.13$ for those answering *not often* or *never*, was not associated with parent's vaccination choice (Table 5). The null hypothesis (H_0: There is no association between exposure to messaging from social media and a parent's decision to vaccinate a child) is accepted. The alternative hypothesis (H_A: There is an association between exposure to messaging from social media and a parent's decision to vaccinate a child) is rejected.

Independent variables considered in both RQ1 and RQ2 were number of children, age of youngest child, firstborn status, relationship to child, parent's level of education,

age of parent, marital status, and antivaccine advertisement effectiveness. The results of the binary logistic regression for each demographic predictor variable (Table 4) were as follows: number of children (1 child) $p = 0.26$ and (2 children) $p = 0.25$, age of youngest child (0-5 years) $p = 0.03$ and (6-10 years) $p = 0.44$, firstborn child (no) $p = 0.48$, relationship to child (mother) $p = 0.14$, parent's highest education (high school or less) $p = 0.85$, age of parent (40 years and under) $p = 0.13$, and marital status (married) $p = 0.57$. Table 4 illustrates the results of the binary logistic regression for each demographic predictor variable by vaccination status. Table 5 illustrates the results of the binary logistic regression analysis of vaccination behavioral predictor variables by vaccination status. Table 6 illustrates the binary logistic regression unadjusted odds ratios for each demographic predictor variable used. Table 7 illustrates the binary logistic regression unadjusted odds ratios for each vaccination behavior.

Table 4

Binary Logistic Regression Analysis of Demographic Predictor Variables

Variable	Unvaccinated vs. vaccinated Unadjusted OR (95% CI)
Q3: Number of children in the HH	
1	0.26 (0.24-1.49)
2	0.25 (0.24-1.45)
3 or more	1.00[b]
Q4: Age of the youngest child	
0–5 years	0.03 (0.15-0.88)
6–10 years	0.44 (0.25-1.83)
11–18 years	1.00[b]
Q5: Firstborn child	
Yes	0.48 (0.57-3.34)
No	1.00[b]
Q6: Parental relationship	
Mother	0.14 (0.12-1.33)
Other	1.00[b]
Q24: Age of respondents	
40 years and under	0.13 (0.26-1.18)
Over 40 years	1.00[b]
Q25: Marital status	
Married	0.57 (0.51-3.34)
Other	1.00[b]
Q26: Educational level	
No college education	0.85 (0.19-3.92)
College education	1.00[b]

Note. n = 269. 1.00[b]: reference variable.

Table 5

Binary Logistic Regression Analysis of Vaccination Behavioral Predictor Variables

Variable	Unvaccinated vs. vaccinated Unadjusted OR (95% CI)
Q13: Shots prevent severe illness	
Strongly agree, agree	0.06 (0.04-1.07)
Disagree, strongly disagree	0.01 (0.01-0.40)
Not sure	1.00[b]
Q29: Frequency of seeing antivaccine ads on Internet	
Not often, never	0.13 (0.81-5.54)
Often, very often	0.61 (0.48-3.51)
Sometimes	1.00[b]
Q30: Antivaccine ads effective	
No, not at all	0.45 (0.19-0.98)
Very, yes	0.32 (0.57-5.63)
Somewhat	1.00[b]

Note. n = 269. 1.00[b]: reference variable.

Table 6

Binary Logistic Regression Odds Ratios of Demographic Predictor Variables

Variable	Unvaccinated vs. vaccinated Unadjusted OR (95% CI)
Q3: Number of children in the HH	
1	0.59 (0.24-1.49)
2	0.59 (0.24-1.45)
3 or more	1.00[b]
Q4: Age of the youngest child	
0–5 years	0.36 (0.15-0.88)
6–10 years	0.68 (0.25-1.83)
11–18 years	1.00[b]
Q5: Firstborn child	
Yes	1.38 (0.57-3.34)
No	1.00[b]
Q6: Parental relationship	
Mother	0.41 (0.12-1.33)
Other	1.00[b]
Q24: Age of respondents	
40 years and under	0.55 (0.26-1.18)
Over 40 years	1.00[b]
Q25: Marital status	
Married	1.31 (0.51-3.34)
Other	1.00[b]
Q26: Educational level	
No college education	0.86 (0.19-3.92)
College education	1.00[b]

Note. n = 269. 1.00[b]: reference variable.

Table 7

Binary Logistic Regression Unadjusted Odds Ratios

Variable	Unvaccinated vs. vaccinated Unadjusted OR (95% CI)
Q13: Shots prevent severe illness	
Strongly agree, agree	0.20 (0.04-1.07)
Disagree, strongly disagree	0.07 (0.01-0.40)
Not sure	1.00[b]
Q29: Frequency of seeing antivaccine ads on Internet	
Very often, often	2.11 (0.81-5.54)
Sometimes	1.30 (0.48-3.51)
Not often, never	1.00[b]
Q30: Antivaccine ads effective	
Very, yes	0.44 (0.19-0.98)
Somewhat	1.80 (0.57-5.63)
Not at all	1.00[b]

Note. n = 269. 1.00[b]: reference variable.

Summary

The results of the study support the hypothesis that there is an association between parents' perceived disease severity and vaccination choice and that there is no association between exposure to antivaccine advertisements on social media and vaccination choice. The results of the study do not support the hypothesis that there is not an association between parents' perceived disease severity and vaccination choice and that there is an association between exposure to antivaccine advertisements on social media and vaccination choice.

The presence of vaccine hesitance among parents is growing. This has become a significant concern for the maintenance of herd immunity as well as the potential resurgence of previously eradicated VPDs (Domachowske & Suryadevara, 2013). It is

important to explore the factors associated with these behaviors and seek effective solutions for countering the antivaccine movement. If the population of unvaccinated children continues to grow, herd immunity will fail, and communities will be at significant risk for contracting VPDs. Further discussions related to this study and its findings, limitations, and recommendations are presented in Chapter 5.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this study was to assess the beliefs that parents have regarding recommended childhood vaccinations and evaluate the association between social media and parent vaccination choice. Survey data completed by White parents of children aged 0 to 18 years living in Illinois were analyzed. The dependent variable was vaccination choice, and the primary independent variables were exposure to online messages and perceived severity of disease. Chapter 5 explains the interpretation of the findings. Major sections of Chapter 5 contain interpretations of the findings as they relate to the theoretical framework, limitations of the study, recommendations for further research, potential contributions of the study to positive social change, and a conclusion.

Interpretation of the Findings

There is much research regarding vaccine hesitance and the reasons that parents choose to delay or refuse childhood vaccinations for their children. Following the childhood vaccination schedule according to APIC guidelines is accepted as a safe and effective method of preventing the resurgence of VPDs and maintaining herd immunity (National Center for Immunization and Respiratory Diseases, 2017). In a thorough literature review, I found no information on social media messaging and its influence on parents' vaccination decisions. More information is needed to understand the relationship between exposure to antivaccine social media messaging and parents' vaccination choices. In this study, I sought to determine whether such a relationship exists as well as identify parents' perceived disease severity to provide a better understanding of risk

factors related to vaccine hesitance and provide a baseline of information to inform interventions to counter the antivaccine movement.

The alternative hypothesis for RQ1 is accepted. There is an association between a parent's perceived disease severity for a child and the parent's decision of whether to vaccinate. The null hypothesis is accepted for RQ2. There is no association between exposure to messaging from social media and a parent's decision to vaccinate a child.

There was one other significant finding during the binary logistic regression to note. Regarding age of youngest child, respondents answered 0–5 years ($p = 0.03$). This means that those respondents who answered *yes* to Question 9 indicating that they chose not to vaccinate also indicated that their youngest child was between the ages of 0 and 5 years. More parents with younger children chose not to vaccinate than those with older children. This is significant because the antivaccine movement has been growing in prevalence in recent years. Those with older children would not be as affected.

The HBM indicates that messages will result in positive behavior change if perceived barriers, benefits, self-efficacy, and threats are targeted (Jones et al., 2015). The theory behind the HBM suggests that an individual's likelihood of engaging in a health-related behavior is determined by his or her perception of four variables: perceived susceptibility, perceived severity, perceived benefit, and perceived barrier (Orji et al., 2012). These variables can be considered on their own or in combination to explain certain health behaviors (Orji et al., 2012). *Perceived severity* involves how serious a person considers the consequences of a health condition to be, and *perceived barrier*

refers to a person's subjective evaluation of the difficulties or hindrances associated with the behavior (Orji et al., 2012).

In this study, it was found that parents who refused childhood vaccinations for their children either disagreed or strongly disagreed with the notion that shots prevent severe illness ($p = 0.01$). This is consistent with perceived severity in the HBM. If parents do not perceive diseases as severe, they will not act to prevent them. According to a study by Smith et al. (2011), there is a significant association between vaccine hesitancy and all four of the psychosocial domains of the HBM, and parents who had vaccine safety concerns and perceived fewer benefits associated with vaccines chose to delay and refuse vaccines. Parents who delayed or refused vaccinations for their children, compared to those who did not, were significantly less likely to believe that vaccines were necessary to protect the health of their children, indicating a low perceived benefit (Smith et al., 2011). They also had low perceived susceptibility, as evidenced by a lower likelihood of believing that their children might get a disease if they were not vaccinated and that vaccines are safe (Smith et al., 2011).

Limitations of the Study

The data were collected in the state of Illinois. Illinois does not have a very diverse population. Most of the population is White, female, and has attained more than a high school education. The median age is 37 years. While these factors are consistent with the study population, they may not be consistent with other states and with the United States as a whole. These demographic factors may affect the generalizability of

the results to a larger population. More research and data collection are needed to include a more diverse population.

Recommendations

This study filled a research gap noted in the problem statement by investigating quantitatively parents' decisions on whether to vaccinate their children when exposed to messaging about vaccination on social media. The results of this study provide information, knowledge, and insight that could help public health professionals understand the factors that affect parents' decision making. This added knowledge can be applied to the implementation of effective interventions to counter exposure to antivaccine messaging on social media and ultimately increase vaccine acceptance.

Additional research is recommended to analyze variables outside the scope of this study. This study was a cross-sectional survey, and data were collected during a period of 20 days. Responses may change over time. Conducting this survey in a different geographic location with a larger and more diverse sample might produce more generalizable results. Additional confounders and follow-up surveys may need to be considered. Future studies may need to include larger sample sizes to better understand the variables associated with parents' decision making regarding childhood vaccinations.

Implications

This study promotes positive social change by informing the audience about how social media affect parents' decision making regarding childhood vaccinations and how parents perceive disease severity for their children. The study may help to decrease VPD in children once parental vaccination behaviors are explored, understood, and countered.

Understanding why parents make decisions about vaccination may help in finding effective interventions to counter the reasons that some choose not to vaccinate. Health policymakers may be influenced by the study results and may thus move to change vaccination laws.

Conclusion

This study is supportive of the HBM as a suitable framework to address the gap in literature surrounding exposure to antivaccine messaging online and parents' decisions about childhood vaccinations. VPDs are a significant public health concern in the United States. Routine childhood immunization is the best way to prevent outbreaks of these diseases and protect the health of children and their communities. Vaccination is considered one of the greatest contributions to public health. However, over the past 15 years, people have become increasingly hesitant about vaccination due to safety concerns that are not based in science or medicine.

Use of the Internet and social media for health information has increased in recent years. The Internet is a popular tool for health information because there is a wide range of information available, the cost is low, access is easy, people can interact, people can choose what information they see, and people can be anonymous. However, negative vaccine information is widespread on the Internet and is more prevalent than provaccine messages.

Although this study provides some insight into the growing use of social media for information on healthcare and the spread of vaccine hesitance, further efforts are needed to address this rapidly increasing and potentially deadly trend among parents of

young children. Unless effective ways to counter the antivaccine movement are developed, VPDs may begin to re-emerge that this country has not seen in decades, resulting in an increase in childhood mortality.

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