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# Relationship Between Media Coverage and Child Measles Vaccination Uptake

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
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Abstract

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MBA, Capella University, 2013

MPH, Walden University, 2009

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Doctoral Study Submitted in Partial Fulfillment

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## Abstract

Childhood vaccines have been a source of heated debates between both opponents and proponents of vaccination. Childhood immunizations have proven to be effective and save lives, but antivaccine movements continue. The purpose of this retrospective cross-sectional quantitative study was to determine if there was a significant difference in child measles vaccine uptake based on provider facility type and census region, after adjusting for age and education of mother, for the years 2003–2012, pre-and-post 2007 media coverage deeming vaccines unsafe, and for the years 2013–2017, pre-and-post exposure to measles at Disneyland in 2014–2015 for children aged 19–35 months. The social ecological model served as the framework for this study. The population that was used in the ChildVaxView database were children 19–35 months of age. Ordinal logistic regression and odds ratio were used for statistical analyses and to identify associations with child vaccine uptake and media coverage. Results showed a significant relationship between facility type (AOR 0.70, $p = .011$), census region (OR < .001 and AOR < .001), and mothers with higher education were more likely to vaccinate (OR = 2.24); age of mother (OR = 2.56, $p = .022$) and post media coverage had a significantly lower odds of vaccination (OR 0.81, $p = .009$). Findings suggest that more education is needed for parents/guardians regarding immunization safeness to achieve herd immunity. This research could potentially benefit stakeholders in creating interventions that target the variables examined in this study. Positive social change implications include the increase of childhood immunization rates, to increase the herd immunity of children in the United States.

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# Dedication

This study is dedicated to my Lord and Savior Yeshua Hamashiach; my mother, Alberta Ward; and my older brothers who helped raise me. I would also like to dedicate this to my 92-year-old grandmother and her 12 siblings who shaped me as a woman.

Acknowledgments

I would like to thank my committee for helping me get to the finish line. Thank you, Dr. Diana Naser, for taking me on as a student and giving guidance in such an arduous process. Thank you, Timothy S. Allison-Aipa, for your continual assistance in this process.

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Section 1: Foundation of the Study and Literature Review

## Introduction

Childhood vaccines have been a source of heated debates among opponents and proponents. Prior to the development of vaccines for communicable diseases, millions of people died from exposure to these diseases. Many individuals living in the last century contracted diseases like measles, whooping cough, polio, and other communicable diseases. People died every year from communicable diseases (CDC, 2018e). The development of childhood vaccines aided in preventing the population from contracting these potentially deadly communicable diseases. The incidence rates of individuals contracting communicable diseases declined in the United States and most vaccine-preventable communicable diseases were practically eliminated from society (CDC, 2018e). For example, in 1921 a vaccine for diphtheria did not exist. According to the CDC (2018a), approximately 15,000 people died in 1921 from diphtheria, whereas the United States only had two cases of diphtheria between 2004 and 2014. Although childhood vaccination rates have been stable, there has been a slight decline in vaccination rates. The under immunized rates for children in the United States is 15%, mainly due to parents' skepticism about vaccine safety (Rabinowitz et al., 2016).

The proponents of childhood vaccinations purport that vaccines have saved lives. Parents who support childhood vaccines believe in the safety of vaccines and perceive that vaccines prevent communicable diseases that they do not want their child to become infected with (Rabinowitz et al., 2016). The opponents of childhood vaccines purport that immunizations are not safe and could cause side effects and neurological disorders like

autism. Opponents of childhood vaccines are not influenced by their pediatrician's recommendations to vaccinate (Rabinowitz et al., 2016). These parents are more influenced by their peers and other outside sources (Rabinowitz et al., 2016). A review of literature identified a gap in analyzing if the opponents of childhood vaccines were influenced by media coverage. Gidengil et al. (2019) sought to identify and summarize the beliefs of parents around childhood vaccines. The researchers analyzed parents' responses to open-ended questions to gain a better understanding of belief systems regarding childhood immunizations. A search of PubMed, Embase, and PsychInfo for studies that posed open-ended questions to parents about childhood vaccines uncovered 1,727 studies identified, but Gidengil et al. (2019) only included 71 studies in their analysis. Themes that were consistent across the studies included: (a) parents' mistrust, (b) perceived lack of necessity, (c) pro-vaccine opinions, (d) skepticism about effectiveness, (e) desire for autonomy, and (f) morality concerns (Gidengil et al., 2019). Gidengil et al. concluded that parents' greatest concern was the safety of childhood vaccines. There was no mention of the media's influences on the beliefs of parents related to childhood vaccines.

The results of this study could help address the gap by reviewing childhood measles uptake rates reported by the CDC spanning 2003–2017, to assess if media coverage in 2007 and the Disneyland outbreak in 2014-2015 affected uptake rates. Positive social change could result from efforts by organizations such as the CDC and the World Health Organization (WHO) promoting more aggressive nationwide health campaigns that specifically target parents of young children about the safeness and

necessity of the uptake of childhood immunizations. The results of this study could foster positive change by informing society about the ways that media coverage affects the decision making of parents regarding their children receiving childhood vaccines. The findings of this study could assist parents in understanding the importance of childhood vaccines and could educate parents about the safety of vaccines. In this study, Section 1 will include an overview of childhood vaccination, the purpose of the study, research questions, theoretical foundation, nature of study, and the literature review.

## Problem Statement

The current antivaccination movement in the United States has led to a reduction of vaccine acceptance rates and an increase in outbreaks that could have otherwise been prevented through immunizations (Dube et al., 2014). According to Olive et al. (2018), nonmedical exemptions have risen across 12 states in the United States. The researchers found that various metropolitan areas across the United States have higher rates of nonmedical vaccine exemptions. Olive et al. (2018) tested for a correlation between vaccine coverage and nonmedical exemption rates in the United States and investigated if there was an inverse relationship between nonmedical exemption rates and vaccine coverage for children in kindergarten. In areas with higher rates of nonmedical exemption rates, the vaccination coverage for children in kindergarten was low (Olive et al., 2018). Olive et al. concluded that antivaccine movements spread through major metropolises, leaving these areas vulnerable.

Vaccination programs have helped many people in the United States. According to Roush et al. (2007), vaccines have made a major contribution to the United States by

protecting society from preventable diseases, thereby reducing the likelihood of outbreaks. Smallpox is a communicable disease that has been eradicated both globally and domestically. Smallpox was a highly contagious disease caused by the variola virus (WHO, 2018). After a lengthy global immunization campaign, in 1980 the WHO declared smallpox eradicated. According to the CDC (2019), children should receive the following vaccines: chicken pox (varicella), diphtheria, Hepatitis A, Hepatitis B, Haemophilus influenzae Type B (Hib), measles, meningococcal, mumps, pneumococcal, polio (poliomyelitis), rotavirus, rubella (German measles), shingles (herpes zoster), tetanus (lockjaw), and whooping cough (pertussis).

Vaccination hesitation has increased in recent years, leading to diminished herd immunity and outbreaks of diseases such as measles (Yang et al., 2015). Furthermore, vaccine hesitation from parents can lead to children's acquisition of and exposure to communicable diseases. McClure et al. (2017) examined vaccine rates spanning from 1999 to 2017. The purpose of their study was to analyze the cause of widespread vaccination hesitancy in the United States. According to McClure et al. (2017), pediatricians who work in community-based facilities tend to have lower job satisfaction due to parental vaccination hesitation or refusal; this dissatisfaction affects health providers' ability to influence parents who exhibit vaccination hesitancy. Vaccination hesitancy or refusal impacts vaccination rates and can cause an economic burden and stress on local hospitals, thus leading to morbidities and mortalities (McClure et al., 2017).

In recent years, some parents have increasingly been concerned about vaccine safety due to increased safety movements and due to prominent individuals using media sources to voice their concerns about autism, seizures, and certain types of cancers being linked to child vaccinations. Vasconcellos-Silva et al. (2015) stated that increasing rates of certain diseases in the middle-class in developed nations may be a result of an increase in infectious diseases that can be prevented with the uptake of vaccines. One main reason for the decline in uptake of vaccines is the belief that immunizations are dangerous. These perceptions are permeating globally due to the influence of social media and the voices of prominent members of society (Vasconcellos-Silva et al., 2015). For example, in 2007, actor Jenny McCarthy made the claim that vaccinations caused her son's autism diagnosis. McCarthy, along with other public figures, were credited with starting the antivaccine movement in the United States. Bazzano et al. (2012) sought to assess the frequency with which parents changed or discontinued their child's vaccine schedule after an autism spectrum disorder (ASD) diagnosis and if the beliefs were based on ideas that vaccines caused autism. Half of the parents in the study who prolonged or discontinued immunization believed childhood vaccines were the cause of their child's ASD diagnosis (Bazzano et al., 2012).

In 2014, a measles outbreak occurred at Disneyland in Anaheim, California. The outbreak continued into 2015 and spread across several states, Mexico, and Canada (Broniatowski et al., 2016). Public health officials linked the Disneyland outbreak to a decline in herd immunity in the United States. The reduction in herd immunity created a pathway for the Disneyland outbreak in 2014–15.

Scholarly literature is limited to mostly researchers analyzing the increase of exemption rates for child immunizations. There are some known reasons that explain parental refusal of immunizations, including religion, safety concerns, adverse immune responses, autism, and certain cancers (McKee & Bohannon, 2016). Overall, parents' refusal to immunize is rooted in a desire to protect their children. Thus, a misconception about immunizing could be parents viewing their child's body as perfect and healthy, thus needing no protection from communicable diseases. Bianco et al. (2018) sought to examine parental attitudes about child vaccine refusal or delay; they conducted a cross-sectional study on parents who had children in kindergarten. To analyze parental attitudes the Parent Attitudes About Child Vaccines (PAV) survey was conducted to screen for vaccine hesitancy (VH; Bianco et al., 2018). The results indicated that 7.7% of the participants were VH parents, and 24.6% refused or delayed allowing their child at least one dose of a vaccine (Bianco et al., 2018). Bianco et al. also found that VH parents usually obtained antivaccine information from the mass media and members of the antivaxxer community. The researchers also found that VH parents felt that vaccination recommendations were a ploy for pharmaceutical companies to gain more profits and that children do not need vaccines to prevent communicable diseases (Bianco et al., 2018). The researchers concluded that health providers could provide scientific and epidemiological evidence to improve parents' trust regarding childhood vaccines (Bianco et al., 2018). There is a gap in the literature about antivaccine movements, media coverage, and the media's effect on vaccination rates. While overall national vaccine rates are stable, exemption rates and vaccination hesitation/refusal continue to rise in

individual states (Wagner et al., 2018). Previous researchers attribute rising vaccine exemption rates mostly to religious beliefs of parents or children having an allergy to certain vaccines. This study could determine the extent to which media coverage impacts vaccine uptake by raising safety concerns regarding child immunizations after the release of these media stories. In this study, I focused mainly on measles as there have been recent measles outbreaks in the United States.

## Purpose of the Study

The purpose of this retrospective quantitative study was to determine if there was a significant difference in child measles vaccine uptake based on provider facility type and census region, after adjusting for age and education of mother, for the years 2003–2012, pre-and-post 2007 media coverage deeming vaccines unsafe and for the years 2013–2017, pre-and-post exposure to measles at Disneyland in 2014–2015 for children ages 19–35 months. These variables were used to identify the effect that media has on child vaccine uptake rates. The variables age and education of mother are important because age of the parent at the time of the survey could have an influence on whether the mother decided to vaccinate the child or children. Education level is also an important variable because health literacy and health decision-making can be determinants in whether a child is vaccinated. The definition of *health literacy* is one's capacity to retrieve, process, and understand health information and the ability to make appropriate health decisions (Yin et al., 2015). The variable *provider facility* is an important variable due to vaccine accessibility. For example, private practices may not have enough vaccines for children who frequent these facilities. However, clinics usually have enough

vaccines for children who frequent these facilities. The *census region* variable was used to indicate whether a certain geographical region in the United States tended to have lower uptake of child vaccines. To my knowledge, there are no studies in which researchers examined such variables to see whether measles outbreaks can be linked to the variables in this study.

## Research Questions and Hypotheses

RQ1: Is there a significant difference in child measles vaccine uptake (number of measles containing shots) based on provider facility type and census region, after adjusting for age and education of mother, for the years 2003–2012, pre-and-post media coverage in 2007, deeming vaccines unsafe for children ages 19–35 months?

$H_0$1: There is no significant difference in child measles vaccine uptake (number of measles containing shots) based on provider facility type and census region, after adjusting for age and education of mother, for the years 2003–2012, pre-and-post media coverage in 2007, deeming vaccines unsafe for children ages 19–35 months.

$H_a$1: There is a significant difference in child measles vaccine uptake (number of measles containing shots) based on provider facility type and census region, after adjusting for age and education of mother, for the years 2003–2012, pre-and-post media coverage in 2007, deeming vaccines unsafe for children ages 19–35 months.

RQ2: Is there a significant difference in child measles vaccine uptake (number of MMR only shots) based on provider facility type and census region, after adjusting for

age and education of mother, for the years 2013–2017, pre-and-post exposure to measles at Disneyland in 2014–2015 for children ages 19–35 months?

$H_0$2: There is no significant difference in child measles vaccine uptake (number of MMR only shots) based on provider facility type and census region, after adjusting for age and education of mother, for the years 2013–2017, pre-and-post exposure to measles at Disneyland in 2014–2015 for children ages 19–35 months.

$H_a$2: There is a significant difference in child measles vaccine uptake (number of MMR only shots) based on provider facility type and census region, after adjusting for age and education of mother, for the years 2013–2017, pre-and-post exposure to measles at Disneyland in 2014–2015 for children ages 19–35 months.

## Theoretical Foundation for the Study

The social ecological model (SEM) was created by Bronfenbrenner and later redeveloped by other researchers McLeroy, Bibeau, Steckler, and Stokols (Nyambe et al., 2016). SEM was created to understand how environments can influence health behaviors. SEM has five tenets that could influence health behaviors: (a) individual level, (b) interpersonal level, (c) community level, (d) organizational, and (e) policy level. The individual level addresses one's beliefs and attitudes about a health issue or problem (Nyambe et al., 2016). The interpersonal level focuses on the individual and their family, friends, and health providers (Nyambe et al., 2016). The individual's behavior can be influenced by these interpersonal relationships. The community level explores the ways that different environments are associated in individuals deciding to embrace health behaviors or choosing not to do so (Nyambe et al., 2016). The organizational level can

influence the behavior of the individual by one having access to clinics, health systems, and health insurance. The policy level can influence the individual's behavior by implementation of governmental policies that encourage or even mandate better health behaviors (Nyambe et al., 2016).

For this study, SEM was used. The key constructs of SEM are the individual level, interpersonal level, community level, and societal level (WHO, 2019). At the individual level, one can identify the reasons that parents do not vaccinate their children. The interpersonal level could assist with examining how close relationships with family and friends affect the likelihood of parents not vaccinating their children. The community level explores settings that can encourage or discourage parents from vaccinating their children. For the focus of this study, I used the construct *societal level* to assist in answering the research questions. It was not feasible to attempt to use the other constructs without collecting qualitative data. The societal level construct can be addressed by data sets provided by the CDC. The societal level can be operationalized as childhood measles uptake rates being affected by media coverage deeming immunizations unsafe.

Most people in the United States are exposed to the media via television, computers, or phones. The mass media disseminates through multiple channels, and these channels can alter how health information is disseminated (DeJesus, 2013). Thus, this exposure could relate to the societal level of SEM in that individuals could be influenced by media coverage in deciding to immunize their children.

## Nature of the Study

In this study, I used a quantitative retrospective cross-sectional study design using secondary data. Retrospective study designs are conducted to look back in time to examine suspected exposures to diseases at a point in time or to analyze trends (CDC, 2013a). This type of methodology aligned with the research questions and hypotheses because it could illustrate if/when the vaccinations rates decreased or increased after the masses were exposed to media stories about childhood vaccines. In this study, a secondary data set called ChildVaxView was used for data analysis of both research questions. For this study, the dependent variable was vaccine uptake, and the independent variables were provider facility type and census region. Confounding variables were age and education of mother. The population used in the ChildVaxView database was children ranging from 19 to 35 months old. Ordinal logistic regression was used to analyze data.

## Literature Search Strategy

A comprehensive literature review was conducted to retrieve key information regarding media coverage, rates of vaccine retrieval in the United States, childhood vaccine safeness, alleged links to autism and other neurological disorders, alleged immunological side effects from childhood immunizations, vaccine exemption reasons, and the history of vaccines and communicable diseases. These key terms were used in a thorough search of several databases: *United States childhood vaccination rates*, *vaccination hesitancy and exemptions*, *measles outbreaks in the United States*, *autism*

*and childhood vaccines*, *communicable diseases before vaccines*, *antivaccination movement*, and *media influence on health issues*.

An extensive search was initiated with regards to childhood vaccination rates and differences in trends with these rates across the United States. There was a focus on peer-reviewed studies conducted to examine the effects of the antivaccine movements on childhood vaccine uptake. There was also a special focus on the various media outlets that affected parental decisions in vaccinating their children.

These databases were used for the search: EBSCO, PubMed, ProQuest, and the CINAHL Plus with Full Text; the College of Physicians of Philadelphia website was used to attain an extensive history of communicable diseases and the breakthrough of various vaccines. The databases were filtered to only retrieve peer-reviewed literature published between 2015 and 2020. The literature review for this study was a culmination of information from scholarly articles and national data obtained from the CDC and the College of Physicians of Philadelphia.

## Literature Review

### Communicable Disease and Vaccination

*Communicable diseases* can be defined as diseases spread from one individual to another (WHO, 2017). These infectious diseases are caused by microorganisms that are transmitted both directly and indirectly (WHO, 2017). The CDC (2016a) recommends that infants, children, teens, and adults be vaccinated to prevent these dangerous communicable diseases. The recommended vaccines are: chickenpox (varicella), mumps, diphtheria, pneumococcal, influenza, polio, Hepatitis A, rotavirus, Hepatitis B, rubella

(German measles), Hib, shingles (herpes zoster), human papillomavirus (HPV), tetanus (lockjaw), measles, and whooping cough (pertussis).

### *History of Communicable Diseases and Development of Vaccines*

**Early 1000s–17th century**. Vaccines play a vital role in protecting members of society. Prior to the invention of vaccines, the morbidity and mortality rates were high across the world due to the spread of communicable diseases. Thus, the life expectancy of adults was terse. According to the CDC (2017a), smallpox outbreaks started thousands of years ago, causing the death of many throughout the world. The earliest account of smallpox dated back in the early 1000s. Smallpox spread through Africa, Asia, and the Middle East. Chinese people are credited with the first inoculation of smallpox; Chinese emperor K'ang survived smallpox during childhood and later had his own children inoculated (College of Physicians of Philadelphia, 2019). During that time, inoculation consisted of retrieving scabs of smallpox victims and putting the scabs in contact with uninfected individuals to build immunity. In 1545, India experienced a smallpox outbreak. According to the College of Physicians of Philadelphia (2019), approximately 8,000 Indian children died from this smallpox outbreak. The outbreak was thought to have come from Portuguese people colonizing India. In the 17th century, smallpox arrived in North America, believed to have been brought by European settlers (College of Physicians of Philadelphia, 2019). Native American villages were ravaged by smallpox along with deaths of European settlers. During this period, the city of Boston responded to the outbreaks of yellow fever by quarantining incoming cargo ships. The quarantine prevented cargo ships from the West Indies to unload goods for a period (College of

Physicians of Philadelphia, 2019). At the same time, Boston had a measles outbreak that led to minimal deaths (College of Physicians of Philadelphia, 2019). In 1661, Chinese emperor K'ang supported smallpox inoculation for members of the community. By the end of the 17th century, physicians noticed that wealthy individuals had better health outcomes than the poor after smallpox exposure.

**The 18th Century**. In 1792, the state of Virginia passed a public health law regarding smallpox. This law mandated that individuals receive smallpox inoculation or receive a fine, imprisonment if caught spreading this potentially deadly disease (College of Physicians of Philadelphia, 2019). A year after Virginia passed this law, the city of Philadelphia experienced a yellow fever outbreak, affecting approximately 11,000 people, of which 11% died (College of Physicians of Philadelphia, 2019). In the late 1790s, Dr. Edward Jenner sought to test a hypothesis regarding cowpox and smallpox: Exposure to cowpox would protect individuals from a smallpox infection (College of Physicians of Philadelphia, 2019). Jenner inoculated a child with cowpox to test this hypothesis. The child was sick for a few days, but eventually recovered. Jenner later exposed the child to smallpox and waited for a reaction. The child never contracted smallpox and remained healthy. Jenner's discovery spread throughout the world.

**The 19th Century**. In London, deaths were kept track of by the London Bills of Mortality. Thus, between the years 1791 and 1800, the London Bills of Mortality cataloged that deaths due to smallpox went from 18,447 to 7,858 (College of Physicians of Philadelphia, 2019). In 1855, the state of Massachusetts became the first state to enact a child vaccination law that forced parents to vaccinate their children (College of

Physicians of Philadelphia, 2019). After this law was enacted, the state of California experienced a diphtheria outbreak. Communicable diseases raged on despite small victories.

The early 1870s changed the trajectory of vaccines in the United States. The first animal vaccine for smallpox arrived in the United States by a Boston physician named Henry Martin (College of Physicians of Philadelphia, 2019). Dr. Martin had push-back from the local community; some did not believe that vaccines were healthy or effective. However, Martin was able to effectively vaccinate the local population. Martin was able to provide the vaccine to health providers across the United States.

As noted previously, the idea of mandating vaccine uptake came with opposition. In 1882, the Anti-Vaccination League of America surfaced. This organization opposed the mandating of immunizations of the masses, citing that communicable disease contraction came from filth not a contagion (College of Physicians of Philadelphia, 2019). The ideology of antivaccination has continued throughout history. The same year that the Anti-Vaccination League of America arose, German physician Robert Koch discovered the microorganism that caused tuberculosis (TB). Koch was able to isolate the bacterium called Mycobacterium tuberculosis (cause of TB) and began working toward a vaccine to prevent this lung disease (College of Physicians of Philadelphia, 2019).

By 1898, diseases like smallpox had low incidence rates. The United States began passing laws to regulate the safety of vaccines. The field of microbiology helped in increasing the safeness of vaccines as well (College of Physicians of Philadelphia, 2019). While vaccines were becoming safer, Great Britain passed its first exemption law. The

British Vaccination Act allowed some individuals exemptions from receiving the smallpox vaccination (College of Physicians of Philadelphia, 2019). At the end of 1898, over 200,000 people in Great Britain filed applications to be exempt from mandated smallpox vaccinations.

**The 20th Century**. In 1902, the United States passed a law to regulate the sale of biologics. The Biologics Control Act regulated the safety of serums, toxins, and viruses being dispensed to the public (College of Physicians of Philadelphia, 2019). The government also created the Hygienic Laboratory of the United States Public Health service to ensure the safety of manufactured biologics (College of Physicians of Philadelphia, 2019).

As researchers continued to understand the transmission of communicable diseases and combat such with vaccines, anti-vaccine movements continued to prevail. According to the College of Physicians of Philadelphia (2019), in 1905, the U.S. Supreme Court heard motions regarding mandated vaccinations, including *Jacobson v. Massachusetts*. Jacobson was suing the state of Massachusetts for mandating citizens to be immunized. The court ruled in favor of the state of Massachusetts, citing that mandatory vaccinations protected the health of the public (College of Physicians of Philadelphia, 2019).

A few years later, an Australian physician named Norman Greg discovered that many infants were born with cataracts. These babies had been exposed to rubella during gestation. The mothers had contracted rubella during pregnancy. It was later noted that

many babies that were exposed to rubella while in the womb, were born with deafness, brain damage, and heart problems (College of Physicians of Philadelphia, 2019).

WHO was organized in 1948. The same year, WHO endorsed vaccines that were created by the Vaccine Institute in Paris. This organization developed a freeze-dried vacuum version of vaccines (College of Physicians of Philadelphia, 2019). This became a standard for vaccine development throughout the world. That same year, the first triple-dose vaccine became available to those living in the United States (College of Physicians of Philadelphia, 2019). The triple-dose vaccine consisted of diphtheria, tetanus, and pertussis (DTP) to eliminate children from having to bear multiple painful shots.

In 1952, the United States government reported that 57,628 individuals contracted polio (College of Physicians of Philadelphia, 2019). Thus, many of those infected with poliovirus became paralyzed. More tests on the poliovirus ensued as researchers rushed to develop a vaccine that would prevent more incidences of the poliovirus. A breakthrough in combating the poliovirus occurred in 1954. Dr. Jonas Salk a virologist had worked tirelessly to create a safe polio vaccine. The Vaccine Advisory Committee agreed to allow Dr. Salk to run a clinical trial on school-aged children (College of Physicians of Philadelphia, 2019). The clinical trial included over 1 million children; it was a randomized double blinded study (College of Physicians of Philadelphia, 2019). The results took one year to analyze. In 1955, the results illustrated that the polio vaccine was almost 90% effective. The U.S. government immediately licensed this version of the poliovirus vaccine and it was later mass produced.

In 1962, an American microbiologist named Maurice Hilleman utilized attenuated measles virus to create a vaccine. Dr. Hilleman tested the vaccines against 80 different types of cells looking for the cells to create antibodies (College of Physicians of Philadelphia, 2019). Dr. Hilleman found success with the attenuated measles and called the vaccine Rubeovax (College of Physicians of Philadelphia, 2019). The following year a team led by John Enders had their measles vaccine licensed. This measles vaccine was initially tested in monkeys and humans. It was found safe and effective. The United States licensed their Edmonston-B strain of the measles vaccine (College of Physicians of Philadelphia, 2019). Over the following decade, almost 20 million dosages were dispensed (College of Physicians of Philadelphia, 2019). The Rubeovax measles vaccine was also licensed by the United States along with the Edmonston-B strain of the measles.

Rubella continued to ravage through nations. In 1964, the United States experienced a rubella outbreak. The most vulnerable group for contracting the disease were pregnant women. Approximately, 50,000 pregnant women were infected with rubella, which caused a massive number of miscarriages (College of Physicians of Philadelphia, 2019). Infected women gave birth to babies with congenital disorders, deafness, and blindness (College of Physicians of Philadelphia, 2019). This outbreak infected approximately 12 million individuals and killed at least 2,000 (College of Physicians of Philadelphia, 2019). The same year the American Academy of Pediatrics suggested that health providers should utilize the aluminum precipitated version of the Diphtheria-Tetanus-Pertussis (DTP) vaccine (College of Physicians of Philadelphia, 2019). This version of DTP vaccine induced an immediate antibody response.

In 1967, Dr. Hilleman developed and received a license for the mumps vaccine (College of Physicians of Philadelphia, 2019). Years after the mumps vaccine was licensed, well over 11 million doses were dispensed. A year later, Dr. Hilleman developed a modified version of the rubella vaccine. This modification was created by utilizing the rubella virus version created by Paul Parkman and Harry Meyer (College of Physicians of Philadelphia, 2019).

The 1970s came with much progression against communicable diseases. In 1971, Dr. Hilleman was able to receive a license for a trivalent vaccine. The trivalent vaccine was for the measles, mumps, and rubella, known as MMR (College of Physicians of Philadelphia, 2019). The development of the trivalent vaccine served a few purposes. Children that retrieved the MMR vaccine were injected one time to combat the three diseases. Health providers could also stock the trivalent vaccine using less space and uptake of the vaccine would be higher due to receiving minimum injections (College of Physicians of Philadelphia, 2019).

By 1974, developed countries experienced herd immunity against communicable diseases. However, undeveloped countries continued to experience outbreaks from infectious diseases. Thus, WHO expanded immunization campaigns to children living in undeveloped countries to reduce incidence rates of preventable diseases.

In 1976, the incidence rates of whooping cough (Pertussis) had declined due to the uptake of the DTP vaccine (College of Physicians of Philadelphia, 2019). In 1934, the incidences of whooping cough cases were well over a quarter of a million of individuals infected. The incidences for cases of whooping cough by 1976 were 1,010 infected

(College of Physicians of Philadelphia, 2019). The same year, there was a swine influenza outbreak. Dr. Hilleman developed a vaccine to prevent further incidences. The vaccine was dispensed but caused a condition called Guillain-Barre Syndrome. This disorder causes the immune system to attack the peripheral nerves. This vaccine never received much support from the American people. In 1977, the pharmaceutical company Merck licensed 14 different vaccines to combat the many pneumococcal bacterium (College of Physicians of Philadelphia, 2019). Years later, Merck was able to create more vaccines to address strains of pneumococcal.

In 1980, the announced that smallpox had been eradicated worldwide. This came after a worldwide campaign to eradicate the disease by the uptake of the vaccine. The following year the CDC created the Measles Elimination Program to eradicate the measles by 1982. While this goal was not met, the statistics indicated that the measles was down 80% in the United States (College of Physicians of Philadelphia, 2019). Dr. Hilleman was able to create a vaccine for Hepatitis B. Historically, viral vaccines proved to be difficult to develop. Dr. Hilleman developed the first viral vaccine to address the growing concerns regarding incidences of Hepatitis B (College of Physicians of Philadelphia, 2019). The vaccine was effective in preventing Hepatitis B.

In 1985, an American physician named David Smith created a vaccine to prevent Haemophilus influenzae type b (College of Physicians of Philadelphia, 2019). This vaccine was especially important because Hib was the known cause of many diseases: meningitis, cellulitis, and pneumonia. The same year that the Hib vaccine was developed, the Pan American Health Organization (PAHO) derived a goal to eradicate polio from the

Americas (College of Physicians of Philadelphia, 2019). The PAHO's goal was to have the disease eradicated by 1990 in the Americas. The Americas declared the region polio-free in 1994 (College of Physicians of Philadelphia, 2019).

Despite the many advances in vaccines, the United States had a decline in the uptake of the measles vaccines. According to College of Physicians of Philadelphia (2019) from 1989-1991 over 50,000 individuals contracted the measles: killing well over 100 people. Most of the children that contracted measles had not been vaccinated prior to infection.

By the mid 1990s, a retired Dr. Hilleman developed a vaccine for hepatitis A. The vaccine was effective in preventing this disease. Health providers adopted this vaccine as a recommended immunization for children (College of Physicians of Philadelphia, 2019). In 1997, WHO became aggressive in creating immunization campaigns in the country of India. Poliovirus was still a major public health issue in India. WHO vaccinated approximately 26 million children with the poliovirus vaccine (College of Physicians of Philadelphia, 2019).

Safety concerns have always been an issue with regards to vaccine uptake. In 1998, a British researcher published an article claiming that the measles vaccine could cause autism in children (College of Physicians of Philadelphia, 2019). The researcher suggested the discontinuation of the trivalent MMR vaccine and recommended that single doses were better. The researcher also linked the trivalent vaccine MMR to autism. This article caused many to stop vaccinating their children in England (College of Physicians of Philadelphia, 2019). It was later reported that the researcher recruited subjects for his

research through a lawyer that was suing vaccine manufacturers (College of Physicians of Philadelphia, 2019). Since 1998, many studies have proven that autism is not linked to any of the childhood vaccines.

Overall, the worldwide poliovirus cases were down by 99% by the year 2000. The same year, the endemic measles was completely eradicated from the United States (College of Physicians of Philadelphia, 2019). In 2002, threats of biological warfare occurred on United States soil. The bacterium anthrax reemerged in a very threatening manner. Anthrax was sent to the governmental officials who caused panic. Smallpox also becomes a threat and the United States military required that all staff be immunized for smallpox.

By 2008, the United States experienced a surge in measles outbreaks (College of Physicians of Philadelphia, 2019). The same year, both Pennsylvania and Minnesota had a Hib outbreak. The Hib outbreak was due to children not being vaccinated. In both states, a few of the children died after contracting Hib. The year 2009, was the 5th year anniversary of the United States experiencing no cases of diphtheria. This disease was once the deadliest disease in children that lived in the United States.

By 2011, the United States and France continued to struggle with measles outbreaks (College of Physicians of Philadelphia, 2019). In 2014, Ebola reemerged in West Africa killing thousands of people (College of Physicians of Philadelphia, 2019). There was no vaccine to combat the disease (College of Physicians of Philadelphia, 2019).

At the end of 2014 into 2015, a measles outbreak occurred. This outbreak was linked to Disneyland in California (College of Physicians of Philadelphia, 2019). There were 188 cases linked to this outbreak, most of the infected were never immunized for the measles. In 2016, the Americas were able to eliminate the measles (College of Physicians of Philadelphia, 2019). However, Europe continued to fight against this deadly disease. In 2017, WHO reported that 35 individuals in Europe died from the measles, and thousands were sickened by the disease (College of Physicians of Philadelphia, 2019). The same year, the Middle East experienced a small poliovirus outbreak; countries in this area were tasked with vaccinating the masses against polio (College of Physicians of Philadelphia, 2019).

**Controlling Communicable Diseases in School/Childcare Settings**

School settings are an easy vehicle for the spreading of disease from one child to the next. It is imperative that the incubation period of communicable diseases is well understood. This could provide time for children to be kept home to lessen the rates at which the disease is spread. According to the CDC (2015), the incubation period of the measles is 10-12 days including exposure and prodrome. With a long incubation period, the infected can easily unknowingly spread the measles to others, which in some cases can lead to an outbreak. Czumbel et al. (2018) sought to analyze information on the incubation of diseases and the time at which the onset of infection occurred for childhood communicable diseases. The researchers' sample group was children that were aged 1 month to 18 years. The methodology was to conduct a systematic review of incubation factors both experimental and observational. This study was directed at 8 infectious

diseases that are common in children. The selected diseases for this study were measles, mumps, rubella, varicella, pertussis, meningococcal disease, hepatitis A, and seasonal influenza (Czumbel et al., 2018). For data extraction, the researchers operationalized the following: incubation, time that the diseases shed, exclusion periods defined as a starting point in time to another point in time, variation in measurements, and retrieval of individual infectious agents (Czumbel et al., 2018). The researchers also extracted other miscellaneous data: inclusion and exclusion criteria, age, and gender. The investigators were able to retrieve 112 peer-reviewed articles to base their study upon.

The results from Crumbel et al. (2018) covered data concerning all 8 infectious diseases that were studied. As it related to measles, the investigators found that outbreaks occurred in various settings. Measles outbreaks occurred in local communities and schools. In most of the articles observed, the ages of those exposed to measles was 1 month to adolescent. The categories of the sample group were unvaccinated, vaccinated, or it was unknown if child had been vaccinated. In some of the cases, laboratories were able to confirm that measles was indeed the culprit for infected children. In this study, the overall incubation period for the measles was 6-21 days for those unvaccinated. Vaccinated children had an incubation period on average of 2 days less than unvaccinated children. On average, most of the children started the viral shedding 2 to 6 days after rashes occurred. The researchers found that each case examined provided enough information for school officials and day care centers to take the necessary precautions to contain outbreaks from communicable diseases to prevent children from missing days of school (Czumbel et al., 2018).

**Impact of Child Vaccination Laws**

According to Cawkwell and Oshinsky (2015) the state of Mississippi leads the United States in having the highest child MMR uptake rates for children that enter kindergarten. Historically, Mississippi has not always led the country with children retrieving their necessary vaccines to enter school.

Over many decades some Mississippi parents have fought against the requirement of children being mandated to uptake 5 vaccinations before kindergarten. The antivaccination movement spread through the United States during the early 20th century. At the time, states begun to mandate child vaccination for children to enter school. The antivaccination movement pushed back against states by fighting for exemption laws. Many states created both philosophical and religious exemption laws because of such. Under such laws, parents have the right to reject the mandating of the uptake of childhood vaccines. Outbreaks continued to plague the United States. In the 1970s, the United States pushed for states to have more uniformed laws with regards to childhood immunizations for children entering school. Joseph Califano, the Secretary of the Department of Health and Human Services at the time, recommended that all 50 states mandate childhood vaccination by kindergarten (Cawkwell & Oshinsky, 2015).

The state of Mississippi came to be the leading state for the child vaccine uptake by creating a strict state code (Cawkwell & Oshinsky, 2015). Mississippi passed a code that stated, “it shall be unlawful for any child to attend any school, kindergarten, or similar type of facility intended for the instruction of children, unless they shall first have been vaccinated against those diseases specified by the state Health Officer” (Cawkwell

& Oshinsky, 2015, p. 5885). In 1979, a parent by the name of Charles Brown opted to not vaccinate his son. Brown sued the local school system for not allowing his child to matriculate into kindergarten. Brown opted not to vaccinate due to deep religious beliefs. The case made it to the Mississippi State Supreme court. Charles Brown lost the case as the court upheld the state code. This court case was important because the judge decided that some parents were abusing religious exemption laws which discriminated against children whose parents did not have religious convictions (Cawkwell & Oshinsky, 2015). The court ruled that this violated the 14th amendment; this law gave children the right of equal protection of the laws (Cawkwell & Oshinsky, 2015). This case had led to some parents unsuccessfully fighting against child vaccination laws in Mississippi. To date, Mississippi has a 99% MMR vaccination uptake rate for children entering kindergarten. The state of Mississippi's last known case of the measles was in 1992; due to strict child immunization laws (Mississippi State Department of Health, 2019).

**The Measles**

Papachrisanthou and Davis (2019) provided an overview on the resurgence of the diseases: measles, mumps, and pertussis. By the year 2000, the measles was virtually eliminated from the United States. This was due to herd immunity. Most of the population was vaccinated leaving cases of measles under 60 per year. However, by 2014, various measles outbreaks emerged across the United States. According to the CDC (2019a), the first measles outbreak in 2014 occurred in an Amish community in the state of Ohio. This community was unvaccinated, and the disease infected 383 people. The source of this outbreak was two Amish men that had previously travelled to the

Philippines to do missions work. In the Philippines, they contracted the measles. Upon returning to the United States these men infected their community. By the end of 2014, a measles outbreak occurred at Disneyland in California. This outbreak was also linked to the Philippines based upon the genotype collected from the blood of some infected individuals (CDC, 2015a). The Disneyland outbreak had a total of 147 cases of those infected with the measles. In 2017, another measles outbreak occurred in the United States (Papachrisanthou & Davis, 2019). This time, the outbreak occurred in the state of Minnesota. This outbreak was linked to a hospitalized toddler. Altogether over 8,200 individuals were exposed to the measles across various settings (Hall et al., 2017). The majority of the exposed were not vaccinated. These outbreaks illustrated the dangers of the measles and its ability to spread swiftly through a community (Papachrisanthou & Davis, 2019). A year after the Minnesota outbreak, the state of New York experienced a measles outbreak as well. Counties in upstate New York had over 40 cases of measles. The cases were linked to a small Jewish community. Specifically, a child that returned from a trip to Israel, contracted measles and brought the disease to upstate New York (Papachrisanthou & Davis, 2019). The children living in the school district that were not vaccinated were quarantined at home for at least 21 days, after the last known measles case within the district. By the end of 2018, many outbreaks of measles occurred across over two dozen states. Most of these outbreaks were linked to unvaccinated Americans traveling internationally and unknowingly contracting the disease and spread it upon arrival to the states (Papachrisanthou & Davis, 2019).

**Vaccine Hesitancy**

According to Papachrisanthou and Davis (2019), vaccine hesitancy is one of the reasons that vaccination rates are declining. Vaccination hesitancy can be defined as a parent that alters the recommended vaccine schedule, delay, immunizing, or refusal to immunize altogether (Papachrisanthou & Davis, 2019). Vaccine hesitancy threatens the health of local communities and disrupts herd immunity. Herd immunity occurs due to enough of the population being immune to disease thus protecting the unvaccinated from contracting these infectious diseases (CDC, 2016b). The lack of vaccination can leave an individual susceptible to becoming infected with a communicable disease. Herd immunity occurs when a large portion of the population is vaccinated (College of Physicians of Philadelphia, 2019). This protects the under-and-unvaccinated from contracting certain communicable diseases. As communicable diseases spread, it is difficult for the infection to become an official outbreak if herd immunity is high (College of Physicians of Philadelphia, 2019). Some diseases only need 40% of population vaccinated for herd immunity to be effective. However, a population should maintain 80%-95% vaccinate to maintain the herd immunity threshold (College of Physicians of Philadelphia, 2019). As it relates to the measles, mumps, and rubella, (MMR), it recommended that children over the age of one receive both doses by age six (CDC, 2019). With regards to the measles, herd immunity is achieved when 93% of the population is vaccinated (CDC, 2019). It should also be noted that states participating in vaccine exemptions also threaten the herd immunity of their local communities.

Many parents refused to vaccinate their children because of safety concerns. In the past, some of the child vaccines contained thimerosal. Thimerosal is a preservative utilized with mercury to protect the vaccines from bacterium (CDC, 2015b). Some parents that refused to vaccinate feared that thimerosal could cause dangerous side effects. Many studies proved that thimerosal was safe (Papachrisanthou & Davis, 2019). In 1999, the United States government decreased and even removed thimerosal from some vaccines in question (Papachrisanthou & Davis, 2019). Though, thimerosal was decreased or removed from the child vaccines, some parents still refuse to vaccinate their children. It should be noted that the MMR vaccine never contained thimerosal (CDC, 2015b). These parents still believe that the child vaccines are linked to autism. Many studies have debunked these claims however, some parents remain suspicious and refuse to vaccinate (Papachrisanthou & Davis, 2019; Offit PA, 2015). Some parents refuse to vaccinate because of the ideology that the immune system will be overloaded (Papachrisanthou & Davis, 2019). A case-control study by Glanz et al. (2018) had a sample of 944 children. The researchers found there was no correlation between infections that were not prevented by child vaccines in both non-vaccinated and vaccinated to children (Glanz et al., 2018).

Papachrisanthou and Davis (2019) suggested that early intervention with parents could prevent vaccine hesitancy and refusal. One way to intervene early is by educating parents during health care visits. The health-provider can use this time to explain the importance of child vaccines, along with explaining the health risk that can occur if the child is not fully vaccinated (Papachrisanthou & Davis, 2019). Papachrisanthou and

Davis (2019) also suggested that health providers can utilize patient recall. This method utilizes different sources to remind parents about scheduled vaccine visits. For instance, health providers could use emails, post cards, calls, and text messages to remind parents to vaccinate their children according to recommended schedules (Papachrisanthou & Davis, 2019). A study done by Jacobson et al. (2018) analyzed the efficacy of patient recall. The study analyzed approximately 138,000 subjects from 55 studies. Jacobson et al. (2018) concluded that patient recall efforts were strongly effective in vaccine uptake.

Papachrisanthou and Davis (2019) also suggested that health providers should utilize motivational interviewing (MI). MI is a patient-centered communicative approach that allows one to find strategies that assist in changing unhealthy behaviors (CDC, 2013). The MI strategy allows patients to voice their concerns regarding child vaccines. MI is also a negotiating strategy that motivates change of bad behavior with subtle directives from health providers. Studies have shown that this approach can lead to uptake of vaccines. A study done by Gagneur et al. (2018) utilized motivational interviewing techniques to assist in educating post-partum parents on the necessity of children retrieving childhood vaccines. The MI technique was used in hopes that parents would choose to vaccinate their infants. The study concluded that targeting parents at maternity wards could possibly increase the likelihood of infants receiving child vaccinations (Gagneur et al., 2018).

Papachrisanthou and Davis (2019) concluded that vaccination preventable diseases are rising in the United States due misinformation about child vaccine safety and negative side effects. Health providers are the first line of defense in providing

information to help address issues causing low uptake of child vaccines. Health providers can also provide information by giving recommended vaccine schedules and risk factors if parents decide to refuse vaccinations. Lastly, Papachrisanthou and Davis (2019) suggested that health providers address parent vaccine concerns early to increase the likelihood of child vaccine uptake.

**Children at Risk of Contracting the Measles**

While child vaccines uptake remains high in the United States, outbreaks continue to occur. According to the CDC (2019c), during the years of 2013-2014 there were many measles outbreaks. These outbreaks were linked to the measles being imported from other countries. The timing of the measles first dosage could put children at risk for contracting the disease. The first MMR dosage is recommended between the ages of 12 to 15 months for children (CDC, 2019b). Thus, if an outbreak occurs, a baby that is not old enough for the MMR vaccines is vulnerable in contracting measles. Some of the factors that lead children to not retrieve the MMR vaccine and become vulnerable for the measles: a) the parents desire to vaccinate the child later in life, b) immunity could have been altered due to cancer treatments, and c) the child may have not developed immunity post immunization (Bednarczyk et al., 2016).

A study done Bednarczyk, Orenstein, and Omer (2016) sought to examine children in the United States that are susceptible to contracting the measles. For this study, the investigators utilized the National Immunization Survey (NIS) Teen version to gain data on the sample population. The age of the sample population was set to 17 years and under. The teen version of the NIS gave the following information: a) the teen's

vaccine history as it related to the measles, and b) the age the teen received the MMR vaccine which was verified via health providers (Bednarczyk et al., 2016).

The methodology of Bednarczyk et al. (2016) study was to utilize the ages at which the sample population received their first and second dosages of the measles vaccine. The birth years of the sample group ranged from 1990-2001, the ages of the teens investigated were 13-17 years. The birth cohort for the sample size was too large for assessment. Instead, the researchers chose the smallest cohort, which was adolescents that were born in 1997, with the sample size number being 3,880, 894 (Bednarczyk et al., 2016). The researchers then estimated the number of children vaccinated by the age parameter that was set. This allowed the investigators to determine the number of children that were not vaccinated by the recommended time. The investigators found that the number of children that were vaccinated by their third birthday was lower than national average found in the NIS. Since the measles vaccine usually protects the child that are 12-15 months, the investigators found that cancer treatments for children aided in destroying antibodies from the uptake of immunizations (Bednarczyk et al., 2016). The researchers also concluded, children that had received cancer treatments were very vulnerable in contracting communicable diseases.

Bednarczyk et al. (2016) used a sensitivity analysis. In this study the sensitivity analysis consisted of a) vaccine coverage, b) the effectiveness of vaccines, and b) period of maternal antibody protection. The researchers calculated the number of children that were susceptible to the measles and the number of children that were immune to the disease. The investigators then calculated and mapped the geographic distribution of

adolescents that had never been vaccinated. The results yielded that of the adolescents born between 1990-2001 (69,856,092 births), 8,714,275 (12.4%) of the children lacked immunity to the measles. The researchers found that the older adolescent groups in the cohort had high cases of not being immunized with the measles vaccine. Approximately, 1.5 million adolescents from the sample population were not immune to the measles. The results from the sensitivity analysis found that vaccination coverage slightly decreased. For the measles vaccine dosage 1, it decreased from 93% to 92% decrease in the sample group; for dosage 2 the vaccine coverage went from 97% to 96%. This means that 9,330,809 or 13.4% children aged 17 and under were measles susceptible (Bednarczyk et al., 2016).

With regards to the geographical distribution of the sample being unvaccinated for the measles, the researchers found that 6% of adolescents across 10 different states and Washington D.C. never received the MMR immunization (Bednarczyk et al., 2016). The investigators also found the states with a very high population seem to have more vaccination coverage. They also found that there were six states that had high cases of unvaccinated adolescents; specifically, these adolescents did not receive either dose of MMR. The study concluded that measles vaccine coverage needs to increase to decrease the likelihood of outbreaks due to indigenous measles in the United States (Bednarczyk et al., 2016).

**Child Vaccine Uptake**

The covariates for this study will be the following: a) age, b) education of mother, c) provider facility type, and d) census region. The covariates age and education of

mother were chosen because each could affect health outcomes of a child. For example, a teen mother may not possess the necessary reasoning skills to make informed decisions about child immunizations. Researchers have found that individuals under the age of thirty, usually have an underdeveloped frontal lobe (Arain et al., 2013). During this period in life, the glutamatergic neurotransmitter predominates, and the gamma-aminobutyric acid neurotransmitter remains underdeveloped; it contributes to some of the impulsive behavior displayed by many individuals under the age of thirty (Arain et al., 2013). Education level of the mother can also affect decision-making regarding the vaccination of children. Mensch (2019) stated that there is a link in female education level to maternal-child health outcomes and health decisions. The provider facility type is an important variable because health care settings can affect health outcomes. Reiling (2008) stated that the architectural design of a provider facility, technology, and equipment can affect patient outcomes. As it relates to provider facility type in this study, this variable could determine whether a child receives immunizations. For instance, some provider facilities may not have up-to-date records regarding the children that utilize their health care services. Providers have a complex job in assuring public and private data collections, administrative enrollment, billing, and up-to-date medical records (Agency for Healthcare Research and Quality, 2018). According to AHRQ (2018), while providers have a range of data collection methods, updating patient information does not always flow in a cohesive or standardized way. Another issue that could arise are smaller provider facilities may lack enough vaccines for children to receive. The census region is

important because it illustrates areas that possess high or low child vaccine rates in the United States.

## Anti-Vaccination Movements, Measles, and the Media

A study conducted by Calderon et al. (2019) examined the influence the antivaccination movements has on the reemergence of measles. The researchers' methodology was a systematic review of measles outbreaks, uptake of vaccines, and the current antivaccine movement. Though the MMR vaccine has been around for decades, the measles continues to plague the unvaccinated or under vaccinated. In the early 2000s, with the help of health campaigns, the Americas' managed to abate the measles to an acceptable coverage rate. Throughout the world many organizations have participated in measles health campaigns, to vaccinate children with both dosages of MMR. Despite efforts to eliminate the measles worldwide, the disease prevails. For instance, in 2013 the mortality rates were high for those that contracted the measles. According to Aparicio-Rodrigo (2015), approximately 145,000 individuals worldwide died from the measles.

### *Reasons Vaccine Coverage Decreased*

There are a few factors that have contributed to the reemergence of the measles around the world. Demographic growth in both developed and undeveloped countries attributes to the spread of disease. Both immigrants and emigrants have the potential to be source of disease spread as populations grow (Calderon et al., 2019). Antivaccination movements have been around since the days of inoculations and the development of early vaccines. In the current time, antivaxxers usually attribute neurological disorders in children to the uptake of vaccines (Calderon et al., 2019). Vaccination avoidance is

rooted in misinformation and unsubstantiated claims that immunizations are not safety, thus a major reason for the return of the once-eradicated diseases “the measles” in the United States (Hospital Employee Health, 2019). Thus, these parents promote antivaccine rhetoric within the media or groups in agreement with the cause.

The fuel for the present antivaccine movement is linked to Dr. Andre Wakefield’s claims in a study that linked the MMR vaccine to autism (Calderon et al., 2019). The article was later deemed false. Dr. Wakefield falsified the study to get parents to embrace his new version of the MMR vaccine (Calderon et al, 2019). There are some parents in the United States that still believe that vaccines are linked to autism.

***Myths and Vaccines***

There are myths that contribute to parents refusing to vaccinate their children. While the United States discontinued mercury in most child vaccines, some parents believe that mercury is still an ingredient in these vaccines causing autism and other neurological disorders (Calderon et al., 2019). To counter parents that refused to vaccinate due to beliefs mercury ingredient, in the mid-2000s a physician named Mark Geier and his son created a fake child vaccine that was marketed as an immunization that did not contain mercury. The fake vaccine contained a drug called leuprolide. Leuprolide is a drug that is used to treat certain cancers and can chemically castrate sex offenders (Calderon et al., 2019). Dr. Geier lied to parents by claiming that the “vaccine” was FDA approved; he also charged families over $5000 a month for the treatments (Calderon et al., 2019). The side effects from the usage of Leuprolide are damage to bone, the heart,

and exacerbation of seizures (Calderon et al., 2019). The treatments were ineffective and Dr. Geier was later revoked from practicing medicine in Maryland.

Some parents delay vaccinating due to the myth that too many immunizations can overwhelm the immune system. The parents feel that overloading the immune system with too many antigens can lead to neurological disorders. Scientists have combated this myth by proving that humans are exposed to thousands of foreign pathogens each day and the immune is still equipped to handle such (Calderon et al., 2019). To combat these myths, Calderon et al., (2019) suggested that health providers use every opportunity to educate parents about the safety of child vaccines. Health providers can also use the media campaigns to educate local communities (Calderon et al., 2019).

In conclusion, the antivaccine movement poses a threat to eradicating preventable diseases. It is pivotal that public health organizations, leaders, and health providers demystify the claims of antivaccine movements by using all forms of media (Calderon et al., 2019). There also must be an overhaul in the way that the health care systems operate and major investments to ensure that the entire population has access to immunizations.

**Politics, Conspiratorial Beliefs, and Vaccines**

Featherstone et al. (2019) sought to examine a link between individuals' political ideology, ways that they retrieve health information about vaccine safety, and conspiracy theories that arise from different media outlets. These suspicions about vaccine safety have attributed to vaccine hesitancy and in some cases vaccine refusal. A study done by Funk et al. (2017) found that 43% of the parents of young children in the United States believe that the MMR vaccine poses some sort of risk to health. Furthermore, another

study found that 27% of United States citizens believed conspiracy theories regarding the safety of child vaccines were true (Freemont & Bentall, 2017). Misinformation and the endorsement of conspiracy theories can cause harm to the population and interrupt herd immunity.

The study by Featherstone et al. (2019) concentrated on two specific sources that individuals rely upon for health information (online and offline). The offline sources were operationalized as health information from health providers or public health entities. The online sources were operationalized as blogs, social media, and groups. Online media outlets can disseminate unscientific information regarding the safety of vaccines. Many individuals that have access to the internet retrieve health information from various websites. The problem in retrieving health information from certain websites regarding vaccine safety lies in the lack of quality of the information. More dangerous for spreading vaccine safety concerns are social media outlets. The bilateral nature of social media allows false information on vaccine safety to swiftly spread (Featherstone, Bell, & Ruiz, 2019). However, the internet can give one access to truthful information regarding vaccine safety. Featherstone et al. (2019) hypothesized that those who believe in conspiracy theories regarding the safety of vaccines retrieved such information from unauthoritative online health sources. The second hypothesis was those that do not believe vaccine safety conspiracies are truthful, usually retrieved health information from health providers or reliable online health sites.

The researchers also sought to examine the relationship between political views and the acceptance of conspiracy beliefs (Featherstone et al., 2019). The methodology

was to use an online survey for eligible participants. Amazon's Mechanical Turk (MTurk) was used to recruit participants for the study (Featherstone et al., 2019). MTurk is designed to have a nonprobability sample which allows the researchers to determine the relationships amongst variables. The measurements of the respondents' political views and conspiracy beliefs were on a 7-item scale. For health information, the researchers created categories based upon online and offline retrieval of information. For data analysis the researchers ran descriptive statistics. The results indicated that the subjects who believed conspiracy theories about child vaccine safety retrieved these beliefs from social media. There was also an inverse relationship with regards to reading quality online health information. However, the participants rarely utilized the opinions of health providers offline. The results also indicated that the participants with liberal ideologies tended to disregard conspiracy theories concerning child vaccines. The study concluded that health providers must understand their patients' views on vaccine safety and the sources of such views in order combat these ideologies (Featherstone et al., 2019). Finally, those considered to be conservative tended to be more susceptible to online media outlets claiming that child vaccines are dangerous.

### *The Antivaccination Movement*

The media is a strong vehicle in providing health information that is pivotal to the health decisions of the masses. According to Criss et al. (2015) health providers are trusted resources of health information however individuals still utilize media sources for health information. Celebrities also can influence the public as it relates to health information and decisions. In 2007, actor Jenny McCarthy made claims that childhood

vaccines caused her son to develop autism. McCarthy claimed that autism developed in her young son after the uptake of the MMR vaccine. In 2008, McCarthy appeared on the Oprah Show to promote a book on raising an autistic child (Gottlieb, 2016). During the interview, McCarthy questioned the medical community's legitimacy in claiming that child vaccines were safe (Gottlieb, 2016). The anti-vaccination community gained momentum after McCarthy's claims linking autism to child vaccines (Gottlieb, 2016). Some parents began to opt out of vaccinating their children. Though, scientific research has not found such a link, some parents remain skeptical about child vaccines. According to Gottlieb (2016), rates of children that are unvaccinated have risen, which could possibly mean that research rejecting the vaccine-autism link is being ignored along with health campaigns that promote these immunizations.

The antivaxxer movement is not a new concept. Such movements could be linked to the era at which the first vaccines were developed. Since Jenny McCarthy's vaccine-autism claims in 2007, there has been an increase of measles outbreaks throughout the United States. The CDC stated that there were: a) 11 measles outbreaks in 2013, b) 23 measles outbreaks in 2014, c) 2 measles outbreaks in 2015 (including the Disneyland Outbreak), d) 2 measles outbreaks in 2016, e) 1measles outbreak in 2017, and f) 17 measles outbreaks in 2018 (CDC, 2020). Thus, these outbreaks can be linked back to either under vaccinated or unvaccinated individuals in the United States. The measles spread and causes outbreaks in communities that have groups of unvaccinated individuals (CDC, 2020). These outbreaks have seemingly increased in the years of social media being popularized and celebrities voicing safety concerns. Chan et al. (2018) stated that

media, television, and social media are important, yet individuals may misunderstand information in the face of outbreaks and emerging public health crises. The literature does not explain how the media can influence parents' decision-making with regards to the uptake of child vaccines. The lack of studies on this topic reveals a gap in the literature.

Mass media can disseminate health information to large groups of people thus influencing population health decisions (DeJesus, 2012). Mass media has given individuals the power to make health-related decisions based upon supplemented information from online sources and the news. A study done by DeJesus (2012) sought to examine whether media channels influenced a Hispanic population. The researcher conducted a quantitative study based upon surveys conducted by the Pew Research Center. The Pew Research Center conducts national surveys that retrieve the opinions and attitudes of Latinos about various topics including health care (Pew Research Center, 2012). The hypothesis for this study was: Mass media communication is likely to influence the health decision-making of the Hispanic sample and medical advice-seeking this population retrieves in comparison to language proficiency and health literacy variables (DeJesus, 2012). The results indicated that media communication positively influenced the health-decisions of the Hispanic population. The results also indicated that language proficiency and health literacy variables did not affect the populations' health decision-making. The study concluded that media communication is changing the dynamics of patient to doctor relationships. Patients that used media-communication in these cases seem more empowered to discuss health concerns with their health provider.

Social media is a powerful means to disseminate information including those related to health. Social media outlets like WhatsApp, Twitter, and Facebook, have become agents in providing individuals an avenue to share health-related information, even when the information is not authentic (Iftikhar & Abaalkhail, 2017).

Iftikhar and Abaalkhail (2017) studied the demographic traits of a sample of patients to analyze if the belief and attitudes about health information is shaped after exposure to social media posts about a particular health message. The researchers sought to examine the ways that social media affected the health decisions of the sample of patients and whether people would continue or discontinue medication(s) after retrieving health information from social media (Iftikhar & Abaalkhail, 2017). Iftikhar and Abaalkhail (2017) conducted a cross-sectional survey of outpatients at various clinics in Middle Eastern country. The survey utilized both close-ended and multiple-choice questions to analyze the social media outlets that patients used to retrieve health information (Iftikhar & Abaalkhail, 2017). The researchers also asked questions about patients being influenced to make certain health decisions after reading health information on social media outlets. The results indicated that most of the sample used some form of social media to retrieve health information. The study concluded that the dissemination of health information through social media must be regulated (Iftikhar & Abaalkhail, 2017).

Increased concerns over the safety of childhood vaccines continue to be a source of debate amongst the masses. There has also been an increase in the amount of vaccine-related information through various online sources (Hwang & Shah, 2019). A study

conducted by Hwang and Shah (2019) examined associations between parents retrieving online sources for child vaccine information, parents' beliefs, online sources for child vaccine information, and whether parents maintain the recommended child vaccines schedule for their children. The researchers of this study sought to examine social media as one of the online sources that parents retrieved child vaccine information from and differentiated between households that had a child diagnosed with autism and households with children not diagnosed with autism (Hwang & Shah, 2019). The study was conducted utilizing 4,174 parents that resided in the United States. The study included 138 parents with at least one child that had an autism diagnosis (Hwang & Shah, 2019). The results revealed that parents looked toward their interpersonal relationships and various magazines to assist in learning about the benefits of childhood vaccinations. These parents also relied heavily on health information disseminated through television to keep vaccination schedules for their child (Hwang & Shah, 2019).

## Definitions

*Child Vaccine Coverage Rates*: Defined as child vaccine retrieval at the recommended schedules as stated by the CDC (2017b).

*Immunity*: Defined as a person that has protection from a specific disease; this individual can be exposed and will not become infected (CDC, 2018b).

*Immunization*: Defined as a process at which an individual retrieves immunity from a particular disease by the uptake of vaccination (CDC, 2018b).

*Measles*: A viral childhood infection that can cause serious illness or fatalities (Mayo Clinic, 2020).

*Medical Vaccine Exemption*: Defined as children allowed by states and the District of Columbia to not retrieve vaccines due to medical issues (CDC, 2017b).

*Nonmedical Exemption*: Defined as parents that do not vaccinate their children for reasons such as religious or the ideology that the child's body can fight foreign pathogens without the utilization of vaccines (CDC, 2017b).

*Vaccination Uptake*: Defined as the introduction of a vaccine into the human body, to produce an immune response thus building immunity to a specific disease (CDC, 2018b).

*Vaccine*: A product produced with the sole reason to cause a person's immune system to create a specific protection from that disease (CDC, 2018b).

*Vaccine Hesitancy*: Defined as a delay in the uptake of vaccines though vaccines are readily available for retrieval (Facciola et al., 2019).

## Assumptions

This study makes several assumptions that may be true but cannot be demonstrated. The nonmedical exemptions in most of the states are for religious reasons only. Some states allow parents to claim exemption based upon philosophical ideologies. This study assumes that parents may use the religious reason in states with stricter exemption laws for vaccination exemption, though their real reason for exemption could have been philosophical. This study also assumes that parents utilize various forms of media to retrieve health information and sometimes serious health concerns. This study also assumes that parents who participate in the NIS are being truthful in their responses. The NIS is conducted by the CDC at which parents are contacted regarding information

about their children receiving childhood vaccinations. The CDC also asks for parental consent to contact their child's health providers. After consent, the CDC then collects the vaccination records of the target children. This study assumes that the health providers have both accurate and up-to-date vaccination records on the targeted children. This should provide accurate vaccination coverage rates for a particular state. The chosen theoretical framework for this study was the SEM. The assumption about the SEM is that the environment of an individual influences one's health decisions. This study assumes that health decisions are based upon the: a) individual level, b) interpersonal level, c) community level, and d) society level. The data analysis methodology that will be used ordinal logistic regression. The assumption that can be made about ordinal logistic regression are the effects of explanatory variables have consistency or proportionality across different thresholds (National Center for Research Methods, n.d.).

## Scope and Delimitations

The study is delimited to a specific target group. The target group consisted of vaccine coverage rates for children as collected from the Centers of Disease Control via the National Immunization Survey (NIS). The parameters of the NIS are limited to initial phone surveys conducted by the CDC to parents of children aged 19-35 months and teenagers aged 13-17 years (CDC, 2018c). The CDC then attains health provider information from parents to examine the child's vaccine retrieval. This data is collected in all 50 states, including the District of Columbia; this data includes: current, population-based, both local and state vaccination coverage rates amongst U. S. children (CDC, 2018c). The population that was excluded was children between the ages of 3-12;

because this age group should have retrieved the first set of vaccines recommended by the CDC right before year 3 of life. The final set of vaccines starts around the age of 12 years. It should be noted that children between the ages of 4-6 are expected to receive the 5th dosage of the DTaP vaccine. It can also be generalized that the information retrieved from the NIS from the sample is true for vaccination rates across the entire population of children in the United States.

Initially, the social cognitive theory (SCT) was considered for the theoretical framework of this current study. The SCT is a model that aims to describe reasons as to why certain behaviors develop, the ways those behaviors are maintained, and ways to modify such behaviors (Wulfert, 2019). The key precepts of this model are observational learning, reinforcement, self-control, and self-efficacy (Wulfert, 2019). This theory was not chosen for the current study because the self-efficacy precept heavily depends on the individual putting in a lot of effort to change the health behavior. This current study cannot track the subjects due to confidentiality and there is no way to determine if the health behavior (opting to not vaccinate child) changed in the future. Finally, a parent/guardian that believes in the antivaccination movement may continue to model the behavior of being an "antivaxxer."

The NIS conducts telephone surveys to retrieve data on child vaccines. A limitation to telephone surveys could respondents being hard to contact. Respondents could also have time restraints that may interrupt the quality of the survey. It should be noted that there were missing United States territories in the codebook (CDC, 2018).

## Significance, Summary, and Conclusions

This research could make an original contribution to the literature by adding knowledge about the extent to which media coverage impacts vaccine uptake rates. This study could provide health providers and stakeholders a foundation to build upon when addressing vaccine hesitancy or refusal in local communities. This study could also contribute to positive change by highlighting that media stories may have power in changing the perceptions of society on matters of health thus, urging parents to do more scientific research on the history of vaccines and the safeness of immunizing their children when considering vaccination. This could enable parents to make a more informed decision when prompted by health providers to vaccinate. The findings of this study could support professional practice by examining the change in vaccination rates from a different perspective than previously investigated. More research about the safety of child vaccination could also aid in preventing outbreaks as well as decreasing morbidity, and mortality in children.

In summary, the CDC has issued recommendations that illustrate the schedule that children should be used to uptake childhood vaccines. These recommendations serve as a baseline to encourage parents to vaccinate their children. However, some parents choose to hesitate or refuse the immunization of their children, despite the history of the effectiveness and safeness regarding the vaccines that prevent various communicable disease. Though, vaccination coverage rates remain stable nationally, exemption rates continue to rise. This poses a threat to herd immunity and places the under vaccinated members of society at risk of being exposed to infectious diseases. Parents that question

the safeness of childhood vaccine usually base this on the following premises: a) There is an alleged link to autism, and b) The immune system may become overwhelmed by the uptake of too many vaccines thus causing effects. There are many conspiracy theories regarding childhood vaccines being unsafe. Many individuals utilize various media outlets to retrieve health information, which could be dangerous. Most of this information is not based on findings from previous studies. This could cause misinformation and hysteria to spread amongst parents of young children. The power of media coverage in brands and marketing are well known. However, what is not well known is the direct effects that the media has on health issues such as child vaccination. This study could help fill a gap in the literature and could extend knowledge about the ways the media impacts health outcomes by influencing the decision-making of the targeted groups. No empirical research that examined the effects that media could have on parents' decisions to vaccinate their children or otherwise has been found. The next chapter of this study will provide a comprehensive description of the research questions, research design, and methodology.

## Section 2: Research Design and Data Collection

The purpose of this retrospective quantitative study was to determine if there was a significant difference in child measles vaccine uptake based on provider facility type and census region, for the years 2003–2012, after adjusting for age and education of mother, pre-and-post 2007 media coverage deeming vaccines unsafe and for the years 2013–2017, pre-and-post exposure to measles at Disneyland in 2014–2015 for children ages 19-35 months. Section 2 includes information about the research design, data collection, and data analysis.

### Research Design and Rationale

In this quantitative study, I used a cross-sectional retrospective study design. This study design was observational in nature. The cross-sectional study design has many advantages. This study design can be used to prove or disprove assumptions (Rivers, 2020). The cross-sectional study is cost effective, can capture a point in time, and allows multiple outcomes to be investigated (Rivers, 2020). This study was quantitative, and I used an extensive sample size to base inferences on and generalize about the population being studied. This study design is connected to the research questions because it can be used to review the outcome after exposure to a disease or event. For this study, the dependent variable was child vaccine uptake, which is the number of doses of measles containing shots or number of MMR only shots. The independent variables were provider facility type and census region. Confounding variables were age and education of mother.

In this study, I attempted to look at the vaccine coverage before, during, and after media coverage deeming immunizations unsafe. I used a retrospective study design.

Retrospective study designs allow researchers to develop a hypothesis about possible associations between a particular outcome after an exposure (Sage Research Methods, 2020). This study had no time or resource constraints related to this design. The ChildVaxView database was used, as it has collected national vaccine coverage rates for child vaccinations in the United States. This research design is consistent with research designs needed to advance knowledge in the field due to its ability to use quantitative data to identify exposures to a certain risk factor before the outcome occurred. This study design is also adaptable to the field of public health that sometimes depends heavily on quantitative data for conducting studies. The advantage to using quantitative data is its descriptive nature; it allows researchers to capture a snapshot of a population (Madrigal & McClain, 2012). Another advantage of quantitative data is the ease with which it can be retrieved. Quantitative data is also based on mathematical calculations, which makes the data more objective and reliable (Jovancic, 2019).

## Methodology

### Population

In this study, I focused on childhood measles vaccine coverage rates in the United States. These data were collected by the CDC via the National Immunization Survey (NIS) conducted every year. The collected data from the NIS are converted into data sets. These data sets become the database called ChildVaxView. The population size for this study was 1,515 subjects. The selection process for the NIS is random; NIS personnel call parents/guardians of eligible children and ask questions regarding the child's health provider and permission to contact the provider for the child's vaccination records (CDC,

2018). The provider is mailed a survey to collect the data regarding administration of vaccines, the number of doses, the types of vaccinations, and the administrative information about the health facility (CDC, 2018). Lastly, the vaccination coverage rate for children in the United States is calculated by the CDC.

**Sampling and Data Collection**

The NIS uses phone surveys to analyze the coverage rates for childhood vaccines in the United States. The target population is children between the ages of 19–35 months and teens from 13–17 years (CDC, 2018). The survey is conducted by the National Center for Immunization and Respiratory Disease. The onset of the survey started in 1994 to monitor the coverage rates for measles in children. The surveys conducted by the NIS are population-based and current data include state and local area estimates regarding child vaccine coverage using a standard survey methodology (CDC, 2018). The collection of the surveys occurs through telephone (landlines and cell phones) interviews with parents/guardians. The geographic location of the parents/guardians spans across 50 states, the District of Columbia, and some U.S. territories (CDC, 2018). Participants are randomly selected. Researchers ask eligible parents/guardians for permission to contact their child's health provider to attain vaccination data.

The NIS survey can be split into two categories: (a) NIS-Child and (b) NIS-Teen. The NIS-Child survey targets young children for the uptake of recommended vaccines within their age group. The ages for this group range between 19 and 35 months. These data are collected to monitor the rates at which children at the target ages of 18–35 months receive child immunizations (CDC, 2018). These coverage rates are retrieved at

the local, state, and national levels. The recommended immunizations for children in this age group are (a) diphtheria, (b) tetanus, (c) pertussis, (d) poliovirus, (e) measles, (g) mumps, (h) rubella, (i) Hib, (j) Hepatitis B, (k) varicella zoster (chickenpox), (l) pneumococcal conjugate, (m) rotavirus, (n) Hepatitis A, and (o) influenza (CDC, 2018).

The collection of data for the NIS-Child survey is done in two parts. Initially, a household telephone survey is conducted in which parents/guardians are prescreened for eligibility. To qualify for the NIS Survey, parents/guardians must have children or teens in the household under the age of 18. The eligible parent/guardian parents are asked voluntary questions about their child's immunization history. After the interviewer collects these data from the parents/guardians, the interviewer then asks for information regarding the child's health provider. The purpose of requesting the child's health provider information is to retrieve the vaccination uptake information for the child. The next step is to send the health providers an immunization history questionnaire that requests the types of vaccines and doses the child has received, along with the dates of administration (CDC, 2018).

The NIS-Teen survey was created in 2006 to target teens 13–17 years and their uptake of vaccines. The teens must live in the 50 states, District of Columbia, or U.S. territories to qualify for the survey. The immunization coverage for teens include (a) tetanus, diphtheria, acellular pertussis (Tdap), (b) meningococcal conjugate (Men ACWY), (c) HPV, and (d) influenza vaccine (CDC, 2018). The same steps are taken for NIS-Teen as with the NIS-Child surveys. Parents complete a household survey with an interviewer, including permission to contact the teen's health providers (CDC, 2018). A

survey is mailed to health providers to retrieve the teen's immunization records, including dosages and dates of administration (CDC, 2018).

**G-Power Analysis**

The sample size was calculated using G* Power Version 3.1. The priori power analysis was also used to aid in validating that the sample size was adequate. The parameters for the G-Power analysis were (a) the significance value was set to an alpha of 0.05, (b) power was set to .95, (c) the effect size was set to 0.114. The sample size needed to achieve adequate status was calculated as N = 989. The study's sample size exceeded this sample size.

**Inclusion/Exclusion Criteria**

Participation in the NIS has minimum factors in determining eligibility. The criteria for the NIS are that children must be part of one of two different age groups: 19–35 months or 13–17 years. The final criterion is the residence of the child or teen. The physical residence of the target population is: the 50 states, District of Columbia, and some U.S. territories. Cases with missing data were excluded from the analysis.

**Recruitment and Participation**

The recruitment process was initialized by the CDC randomly selecting cell phones and landlines to seek eligibility for the NIS. The next step in the recruitment process was to speak to the parent/guardian to retrieve information about the child's vaccine history. In the case that a child is eligible, parents are asked to complete the voluntary NIS. If the parent agrees, the next step is to collect the child's health provider information and to collect health records on the child's vaccine history. The data

collected from the NIS are then interpreted into estimates of vaccination coverage in the United States for each year (CDC, 2018). The vaccination coverage rate is calculated by the number of doses that a child received divided by the number of children in the sample, multiplied by 100%. These estimates are calculated by the Advisory Committee on Immunization Practices and the vaccine coverage records are kept up-to-date based upon the committee's recommended numbers of doses for each vaccine (CDC, 2018).

**Dataset and Permission to Access**

The dataset was available for public access by the CDC. Researchers seeking to use the NIS datasets do not need to request permission from the CDC, as this information is open to the public for the purpose of conducting quantitative studies. Finally, the CDC did not use any historical or legal document as sources of data about creating datasets based on child vaccine coverage estimates in the United States.

**Instrumentation and Operationalization of Constructs**

The key variables of this study were: a) child measles vaccine uptake, b) provider facility, c) census region, and d) age and education of mother. The child vaccine uptake was defined as the estimates of vaccine coverage rates in local and state municipals. The provider facility was operationalized as a) private facilities, b) military or other facilities, c) mixed facilities (CDC, 2018). The census region was operationalized as the true state of residence for the child (CDC, 2018). The census regions were: a) Northeast, b) Midwest, c) South, and, d) West. The age and education of mother were defined as age and education levels of the mother at the time the survey was conducted. The education of the mother was operationalized as the mother completing: a) less than 12 years of

formal education, b) 12 years of formal education completed, c) more than 12 years of formal education, noncollege graduate, and d) college graduate.

**Table 1**

*Operationalization of Variables by Survey Question, Coding, and Variable Type*

| Variables | Survey questions | Data code | Variable type |
|---|---|---|---|
| Census region | Census region | 1 = Northeast<br>2 = Midwest<br>3 = South<br>4 = West | Independent variable<br>Nominal |
| Provider facility type | All public facilities<br>All hospital facilities<br>All private facilities<br>All military/other facilities<br>Mixed | 1 = All public facilities<br>2 = All hospital facilities<br>3 = All private facilities<br>4 = All military/other facilities<br>5 = Mixed<br>6 = Type of facility unknown<br>7 = All WIC clinic providers | Independent variable<br>Nominal |
| Age of mother | Age of mother | 1 = 29 years or younger<br>2 = 29 years or older | Confounding variable<br>Nominal |
| Education of mother | < 12 years<br>12 years<br>> 12 years, noncollege graduate<br>college graduate | 1 = < 12 years<br>2 = 12 years<br>3 = > 12 years, noncollege graduate<br>4 = college graduate | Confounding variable<br>Ordinal |
| RQ1: Number of measles-containing shots by 36 months of age determined from provider info, excluding any vaccinations after household interview date | How many combos of measles-containing shots by 36 months of age, excluding any vaccinations after the household interview date? | 0 = Did not receive any combos of measles shots<br>1 = Received one combo of measles containing shots<br>2 = Received two combos of measles containing shots<br>3 = Received three combos of measles containing shots<br>4 = Received four combos of measles containing shots | Dependent variable<br>Ordinal |
| RQ2: Number of MMR-only shots by 36 months of age determined from provider info, excluding any vaccinations after the household interview date | How many combos of MMR-only shots retrieved by 36 months of age determined from provider info, excluding any vaccinations after household interview date> | 0 = Did not receive any combos of MMR-only shots<br>1 = Received one combo of MMR-only shots<br>2 = Received two combos of MMR-only shots<br>3 = Received three combos MMR-only shots | Dependent variable<br>Ordinal |

## Data Analysis Plan

The study utilized a quantitative retrospective design. The subjects included in this study were located through databases at the CDC. This data is open to the general public for usage of studies; the data is also de-identified to protect the subjects from privacy concerns. For the purposes of statistical testing, the SPSS software version 26 will be used in this study. Statistical analyses will be utilized to answer the following research questions and hypotheses:

RQ1: Is there a significant difference in child measles vaccine uptake (number of measles containing shots), based on provider facility type, and census region, after adjusting for age and education of mother, for the years 2003-2012, pre-and-post media coverage in 2007, deeming vaccines unsafe for children aged 19-35 months?

H1o: There is no significant difference in child measles vaccine uptake (number of measles containing shots), based on provider facility type and census region, after adjusting for age and education of mother, for the years 2003-2012, pre-and-post media coverage in 2007, deeming vaccines unsafe for children aged 19-35 months.

H1a: There is a significant difference in child measles vaccine uptake(number of measles containing shots), based on provider facility type and census region, after adjusting for age and education of mother, for the years 2003-2012, pre-and-post media coverage in 2007, deeming vaccines unsafe for children aged 19-35 months.

RQ2: Is there a significant difference in child measles vaccine uptake (number of MMR only shots), based on provider facility type, and census region, after adjusting for

age and education of mother, for the years 2013-2017, pre-and-post exposure to measles at Disneyland in 2014-2015 for children aged 19-35 months?

H2o: There is no significant difference in child measles vaccine uptake (number of MMR only shots), based on provider facility type and census region, after adjusting for age and education of mother, for the years 2013-2017, pre-and-post exposure to measles at Disneyland in 2014-2015 for children aged 19-35 months.

H2a: There is a significant difference in child measles vaccine uptake (number of MMR only shots), based on provider facility type and census region, after adjusting for age and education of mother, for the years 2013-2017, pre-and-post exposure to measles at Disneyland in 2014-2015 for children aged 19-35 months.

For this study, ANOVA and ANCOVA were used for both research questions. ANOVA is used in statistical analyses to assist in determining the difference between two or more independent groups (Laerd, 2018a). ANCOVA is used to determine whether there is an interaction effect between two independent variables with regards to a continuous dependent variable after adjusting for a continuous covariate (Laerd, 2018b). Missing data were coded and included in the study. To clean the data, a frequency distribution was run to analyze whether the data falls within an expected range. To examine outliers, a scatter plot was used. Scatter plots make it easier to analyze points furthest from the regression line.

## Threats to Validity

Threats to validity are of great concern in this study. Such threats can occur, due to the sample size being studied. This study utilized enough statistical tests to aid in

minimizing threats to external validity. However, it is difficult to ensure that external validity will occur. A major risk to the external validity of this study was parents providing inaccurate information to the surveyors. This could be categorized as social desirability bias-parents responding in a more socially acceptable manner. Social desirability bias is an individual's tendency to present reality to align it with perceived social acceptability (Bergen & Labonte, 2020). This study may possess less external validity due to health providers possibly not providing accurate patient information with regards to the sample population. For instance, if a health facility neglects to keep patient files updated, this could affect the validity of the results of this study. Another threat to external validity is sample features. Sample features can be defined as features that caused the effect, which limits one's ability to generalize regarding the findings (Cuncic, 2019). In this study, an example of sample feature that affects the findings could be lack of health insurance. Parents/Guardians that lack health insurance to cover their children may affect the overall child immunization rates. Another sample feature resides in the fact that this sample is collected from 50 states-this study runs the risk of the sample size being too small which can affect generalizations made based upon the findings. The low response rates to the NIS and no access to households without a phone could create a sample bias (Hill et al., 2018). This could affect the quality of the dataset and generalizability of the sample.

## Ethical Procedures

Ethical procedures are imperative when conducting research studies. The utilization of ethical procedures is pivotal in developing effective health interventions.

The ethical advantage that this study possessed was the use of archival data. The NIS created the datasets which were collected by the CDC. The measures to collect data and recruit subjects were done randomly by the CDC. The CDC ensures that all data collection is publicly accessible with de-identified information to protect the privacy and confidentiality of the participants. The CDC ensures that parents/guardians have a choice to voluntarily or decline participating in the on-the-phone survey. As it relates to the retrieval of the child's health record, the CDC recorded informed consent from the parent/guardian to release such. The Centers for Disease also provides parents with a copy of the form sent to the child's health provider in the event the parent/guardians chose this option. After all the data is collected, the CDC de-identified that information. This protects the child's confidentiality. The approval for this study was received from Walden University's Institutional Review Board before the onset of data analysis for this study. I have also completed human subject protection training. The data will be kept on a MacBook Air computer for a period of 5 years, which is protected by a password. I am the owner of this computer and the only one with access to the password. This data will also be shared with members of the dissertation committee.

## Summary

The purpose of this retrospective quantitative study was to determine if there a significant difference in child measles vaccine uptake, based on age of mother, education of mother, provider facility type, and census region, for the years 2003-2012, pre-and-post 2007 media coverage deeming vaccines unsafe and for the years 2013-2017, pre-and-post exposure to measles at Disneyland in 2014-2015. A secondary dataset called

ChildVaxView was used for data analysis of both research questions. For this study, the dependent variable was vaccine uptake measured by the number of measles containing vaccines a child has obtained and the independent variables were age and education of mother, provider facility type, year, and census region. The population that was utilized in the ChildVaxView database was children ranging from infancy to age 5 years old. Section 3 will provide the results of the data analysis for this study.

## Section 3: Presentation of the Results and Findings

The purpose of this retrospective quantitative study was to determine if there was a significant difference in child measles vaccine uptake, based on provider facility type and census region, after adjusting for age and education of mother, for the years 2003–2012, pre-and-post 2007 media coverage deeming vaccines unsafe, and for the years 2013–2017, pre-and-post exposure to measles at Disneyland in 2014–2015 for children ages 19–35 months. Two research questions and hypotheses guided this study that targeted child immunization data sets from 2003–2017. This section will include information about data collection and provide results of the statistical analysis.

### Data Collection

A total of 272,474 participants were included in this study. A random assignment design was used to produce a high level of internal validity to accurately represent changes in childhood immunization rates. Most of the sample were from the South census region, 101,645 (37.3%); college graduate, 118,542 (43.5%); 30 years of age or older, 168, 540 (61.9%), and associated with a private facility.

### Results

The research questions and hypotheses that guided this study were:

RQ1: Is there a significant difference in child measles vaccine uptake (number of measles-containing shots) based on provider facility type and census region, after adjusting for age and education of mother, for the years 2003–2012, pre-and-post media coverage in 2007, deeming vaccines unsafe for children ages 19-35 months?

$H_0$1: There is no significant difference in child measles vaccine uptake (number of measles-containing shots) based on provider facility type and census region, after adjusting for age and education of mother, for the years 2003–2012, pre-and-post media coverage in 2007, deeming vaccines unsafe for children ages 19-35 months.

$H_a$1: There is a significant difference in child measles vaccine uptake (number of measles-containing shots) based on provider facility type and census region, after adjusting for age and education of mother, for the years 2003–2012, pre-and-post media coverage in 2007, deeming vaccines unsafe for children ages 19-35 months.

RQ2: Is there a significant difference in child measles vaccine uptake (number of MMR-only shots) based on provider facility type and census region, after adjusting for age and education of mother, for the years 2013–2017, pre-and-post exposure to measles at Disneyland in 2014–2015 for children ages 19-35 months?

$H_0$2: There is no significant difference in child measles vaccine uptake (number of MMR-only shots) based on provider facility type and census region, after adjusting for age and education of mother, for the years 2013–2017, pre-and-post exposure to measles at Disneyland in 2014–2015 for children ages 19-35 months.

$H_a$2: There is a significant difference in child measles vaccine uptake (number of MMR-only shots) based on provider facility type and census region, after adjusting for age and education of mother, for the years 2013–2017, pre-and-post exposure to measles at Disneyland in 2014–2015 for children ages 19-35 months.

Descriptive statistics were performed to determine frequencies of the variables used in this study (Table 2).

**Table 2**

*Participant Characteristics for Measles-Only Shots (2003–2012)*

| Variable (N = 272,474) | Frequency | % |
|---|---|---|
| Census region | | |
| Northeast | 46,150 | 16.9 |
| Midwest | 60,184 | 22.1 |
| South | 101,645 | 37.3 |
| West | 62,689 | 23.0 |
| Missing | 1,806 | 0.7 |
| Education of mother | | |
| Less than 12 years | 31,947 | 11.7 |
| More than 12 years, noncollege graduate | 63,678 | 23.4 |
| 12 years | 58,307 | 21.4 |
| College graduate | 118,542 | 43.5 |
| Age of mother | | |
| 19 years or younger | 5,556 | 2.0 |
| 20–29 years | 98,378 | 36.1 |
| 30 years or older | 168,540 | 61.9 |
| Provider facility type | | |
| All public facilities | 20,782 | 7.6 |
| All hospital facilities | 18,814 | 6.9 |
| All private facilities | 111,178 | 40.8 |
| All military/other facilities | 4,655 | 1.7 |
| Mixed facilities | 18,760 | 6.9 |
| Type of facility unknown | 13,980 | 5.1 |
| All WIC clinic providers | 107 | 0.0 |
| Missing | 84,198 | 30.9 |
| Year of Interview | | |
| 2003 | 30,930 | 11.4 |
| 2004 | 30,987 | 11.4 |
| 2005 | 27,627 | 10.1 |
| 2006 | 29,880 | 11.0 |
| 2007 | 24,807 | 9.1 |
| 2008 | 25,948 | 9.5 |
| 2009 | 25,241 | 9.3 |
| 2010 | 24,013 | 8.8 |
| 2011 | 27,305 | 10.0 |
| 2012 | 25,736 | 9.4 |
| Media coverage | | |
| Premedia coverage | 119,424 | 43.8 |
| Postmedia coverage | 153,050 | 56.2 |

| | | |
|---|---|---|
| Child measles vaccine uptake | | |
| Not vaccinated | 189,075 | 69.4 |
| Vaccinated | 652 | 0.2 |
| Missing | 82,747 | 30.4 |

Table 3 illustrates the baseline demographics of the sample subgroup. A random assignment design was used to produce a high level of internal validity to accurately represent changes in childhood immunization rates. A total of 132,498 participants were used. Most of the sample were from the South census region, 49,021 (37.0%); a college graduate, 61,030 (46.1%); 30 years of age or older, 54,630 (41.2%); and associated with a private facility, 41,061 (31.0%).

**Table 3**

*Participant Characteristics for MMR-Only Shots (2013–2017)*

| Demographic (N = 132,498) | Frequency | % |
|---|---|---|
| Census region | | |
| Northeast | 25,935 | 19.6 |
| Midwest | 26,624 | 20.1 |
| South | 49,021 | 37.0 |
| West | 28,208 | 21.3 |
| Missing | 2,710 | 2.0 |
| Education of mother | | |
| Less than 12 years | 13,450 | 10.2 |
| 12 years | 23,744 | 17.9 |
| More than 12 years, noncollege graduate | 34,274 | 25.9 |
| College graduate | 61,030 | 46.1 |
| Age of mother | | |
| 19 years or younger | 37,770 | 28.5 |
| 20–29 years | 40,098 | 30.3 |
| 30 years or older | 54,630 | 41.2 |
| Provider facility type | | |
| All public facilities | 8,191 | 6.2 |
| All hospital facilities | 11,342 | 8.6 |
| All private facilities | 41,061 | 31.0 |
| All military/other facilities | 1,995 | 1.5 |
| Mixed facilities | 11,512 | 8.7 |
| Type of facility unknown | 3 | 0.002 |
| All WIC clinic providers | 2 | 0.002 |
| Missing | 58,392 | 44.1 |
| Year of interview | | |
| 2013 | 23,248 | 17.5 |
| 2014 | 24,897 | 18.8 |
| 2015 | 27,592 | 20.8 |
| 2016 | 28,296 | 21.4 |
| 2017 | 28,465 | 21.5 |
| Media coverage | | |
| Preexposure | 23,248 | 17.5 |
| Postexposure | 109,250 | 82.5 |
| Child MMR vaccine uptake | | |
| Not vaccinated | 12,797 | 9.7 |
| Vaccinated | 62,330 | 47.0 |
| Missing | 57,371 | 43.3 |

A series of Chi-square tests of independence were performed to determine the relationship between measles-only shot (vaccinated vs. not vaccinated) versus variables of interest from 2003 through 2012.

In support of $H_a1$, there is a significant association between the measles-only shot (vaccinated vs. not vaccinated) and facility type (Table 4). The only facility type that was significantly more likely to vaccinate at alpha < .05 was all private at 66.0% versus 58.6%; the only facility type that was significantly more likely to not vaccinate at alpha < .05 was mixed at 9.9% versus 6.9% (Table 4).

**Table 4**

*Pearson's Chi-square Measles-Only Shot (Vaccinated vs. Not Vaccinated), Facility Type*

| Variables ($N$ = 189727) | Observed Vaccinated Count | Expected Vaccinated Count | Observed Unvaccinated Count | Expected Unvaccinated Count | | | |
|---|---|---|---|---|---|---|---|
| Facility | $n$ (%) | | $n$ (%) | | $\chi^2$ | $df$ | $p$ |
| All public | 62 (9.5) | 71.4 | 20720 (11.0) | 20710.6 | 1.40 | 1 | 0.237 |
| All hospital | 53 (8.1) | 64.7 | 18761 (9.9) | 18749.3 | 2.34 | 1 | 0.126 |
| **All private** | **430 (66.0)** | **382.1** | **110748 (58.6)** | **110795.9** | **14.58** | **1** | **<.001** |
| All military/other | 15 (2.3) | 16.0 | 4640 (2.5) | 4639.0 | 0.06 | 1 | 0.800 |
| **Mixed** | **45 (6.9)** | **64.5** | **18715 (9.9)** | **18695.5** | **6.55** | **1** | **0.011** |
| Unknown | 45 (6.9) | 48.0 | 13935 (7.4) | 13932.0 | 0.21 | 1 | 0.648 |
| All WIC providers | 2 (0.3) | 0.4 | 105 (0.1) | 106.6 | 7.28 | 1 | 0.053 * |
| | $n$ = 652 | | $n$ = 189075 | | | | |

*Note.* * $p$-value is a result of Fisher's exact test due to expected frequency less than 5.

In support of $H_a1$, there is a significant association between the measles-only shot (vaccinate vs. not vaccinate) and census region (Table 5). The only census region that was significantly more likely to vaccinate at alpha < .05 was the Northeast at 25.8% versus 16.5%, while the remaining census regions were significantly more likely to not vaccinate at alpha < .05 with the Midwest at 22.5% versus 18.7, the South at 37.0% versus 32.8%, and the West at 23.4% versus 22.1%).

**Table 5**

*Pearson's Chi-square Measles-Only Shot (Vaccinated vs. Not Vaccinated), Census Region*

| Variables ($N$ = 189727) | Observed Vaccinated Count | Expected Vaccinated Count | Observed Unvaccinated Count | Expected Unvaccinated Count | | | |
|---|---|---|---|---|---|---|---|
| Census region | $n$ (%) | | $n$ (%) | | $\chi^2$ | $df$ | $p$ |
| **Northeast** | **168 (25.8)** | **107.8** | **31212 (16.5)** | **31272.2** | **40.35** | **1** | **<.001** |
| **Midwest** | **122 (18.7)** | **146.5** | **42518 (22.5)** | **42493.5** | **5.32** | **1** | **0.021** |
| **South** | **214 (32.8)** | **241.1** | **69952 (37.0)** | **69924.9** | **4.86** | **1** | **0.027** |
| West | 144 (22.1) | 152.6 | 44250 (23.4) | 44241.4 | 0.63 | 1 | 0.428 |
| | $n$ = 652 | | $n$ = 189075 | | | | |

In support of $H_a1$, there is a significant association between the measles-only shot (vaccinated vs. not vaccinated) and year (Table 6). The years that were significantly more likely to vaccinate at alpha < .05 were 2008 at 12.6% versus 9.7% and 2009 at 14.1% versus 9.2% (Table 6).

**Table 6**

*Pearson's Chi-Square Measles-Only Shot (Vaccinated vs. Not Vaccinated), Year of Interview*

| Variables ($N$ = 189727) | Observed Vaccinated Count | Expected Vaccinated Count | Observed Unvaccinated Count | Expected Unvaccinated Count | | | |
|---|---|---|---|---|---|---|---|
| Year | $n$ (%) | | $n$ (%) | | $\chi^2$ | $df$ | $p$ |
| 2003 | 68 (10.4) | 74.5 | 21618 (11.4) | 21611.5 | 0.65 | 1 | 0.421 |
| 2004 | 61 (9.4) | 76.6 | 22242 (11.8) | 22226.4 | 3.63 | 1 | 0.057 |
| 2005 | 49 (7.5) | 61.1 | 17737 (9.4) | 17724.9 | 2.66 | 1 | 0.103 |
| 2006 | 74 (11.3) | 72.8 | 21106 (11.2) | 21107.2 | 0.02 | 1 | 0.880 |
| 2007 | 68 (10.4) | 58.9 | 17084 (9.0) | 17093.1 | 1.54 | 1 | 0.215 |
| **2008** | **82 (12.6)** | **63.6** | **18433 (9.7)** | **18451.4** | **5.90** | **1** | **0.015** |
| **2009** | **92 (14.1)** | **59.9** | **17329 (9.2)** | **17361.1** | **19.06** | **1** | **<.001** |
| 2010 | 54 (8.3) | 58.8 | 17065 (9.0) | 17060.2 | 0.44 | 1 | 0.508 |
| 2011 | 59 (9.0) | 67.5 | 19590 (10.4) | 19581.5 | 1.21 | 1 | 0.272 |
| 2012 | 45 (6.9) | 58.1 | 16871 (8.9) | 16857.9 | 3.27 | 1 | 0.071 |
| | $n$ = 652 | | $n$ = 189075 | | | | |

In support of hypothesis 1, there is a significant association between the measles-only shot (vaccinate v. not vaccinate) and education of mother (Table 7). Only college-

educated mothers were significantly more likely to vaccinate at alpha < .05 at 59.5% v. 43.7% (Table 7). Non-college-educated mothers were significantly more likely to not vaccinate at alpha < .05 with those with more than 12 years (no college) with the highest non vaccination rate at 23.3% v. 17.6% (Table 7).

**Table 7**

*Pearson's Chi-Square Measles-Only Shot (Vaccinated vs. Not Vaccinated), Education of Mother*

| Variables ($N$ = 189727) | Observed Vaccinated Count | Expected Vaccinated Count | Observed Unvaccinated Count | Expected Unvaccinated Count | | | |
|---|---|---|---|---|---|---|---|
| Education of Mother | *n* (%) | | *n* (%) | | $\chi^2$ | *df* | *p* |
| **< 12 years** | **47 (7.2)** | **77.2** | **22419 (11.9)** | **22388.8** | **13.45** | **1** | **<.001** |
| **12 years** | **102 (15.6)** | **137.4** | **39875 (21.1)** | **39839.6** | **11.59** | **1** | **0.001** |
| **> 12 years, non college graduate** | **115 (17.6)** | **152.0** | **44114 (23.3)** | **44077.0** | **11.78** | **1** | **0.001** |
| **College graduate** | **388 (59.5)** | **285.4** | **82667 (43.7)** | **82769.6** | **65.8** | **1** | **<.001** |
| | *n* = 652 | | *n* = 189075 | | | | |

In support of hypothesis 1, there is a significant association between the measles-only shot (vaccinate v. not vaccinate) and age of mother (Table 8). Only mothers aged 30 years or older were significantly more likely to vaccinate at alpha < .05 at 74.4% v. 62.1% (Table 8). Younger mothers were significantly more likely to not vaccinate at alpha < .05 with the highest at 35.9% v. 24.7% for mothers aged 20-29 years of age (Table 8).

**Table 8**

*Pearson's Chi-Square Measles-Only Shot (Vaccinated vs. Not Vaccinated), Age of Mother*

| Variables ($N$ = 189727) | Observed Vaccinated Count | Expected Vaccinated Count | Observed Unvaccinated Count | Expected Unvaccinated Count | | | |
|---|---|---|---|---|---|---|---|
| Age of Mother | *n* (%) | | *n* (%) | | $\chi^2$ | *df* | *p* |
| 19 years or younger | 6 (0.9) | 12.8 | 3723 (2.0) | 3716.2 | 3.71 | 1 | 0.054 |
| **20-29 years** | **161 (24.7)** | **234.0** | **67944 (35.9)** | **67871.0** | **35.69** | **1** | **<.001** |
| **30 years or older** | **485 (74.4)** | **405.1** | **117408 (62.1)** | **117487.9** | **41.72** | **1** | **<.001** |
| | *n* = 652 | | *n* = 189075 | | | | |

In support of hypothesis 1, there is a significant association between the measles-only shot (vaccinate v. not vaccinate) and media coverage (pre v. post) (Table 9). Participants from the post media coverage group were significantly more likely to vaccinate at alpha < .05 at 61.3% v. 56.3% (Table 9).

**Table 9**

*Pearson's Chi-Square Measles-Only Shot (Vaccinated vs. Not Vaccinated), Media Coverage (Pre vs. Post)*

| Variables ($N$ = 189727) | Observed Vaccinated Count | Expected Vaccinated Count | Observed Unvaccinated Count | Expected Unvaccinated Count | | | |
|---|---|---|---|---|---|---|---|
| Pre-and-post media coverage in 2007, deeming vaccines unsafe for children aged 19-35 months | *n* (%) | | *n* (%) | | $\chi^2$ | *df* | *p* |
| **Pre** | **252 (38.7)** | **285.1** | **82703 (43.7)** | **82669.9** | **6.84** | **1** | **0.009** |
| **Post** | **400 (61.3)** | **366.9** | **106372 (56.3)** | **106405.1** | **6.84** | **1** | **0.009** |
| | *n* = 652 | | *n* = 189075 | | | | |

A series of Chi-square tests of independence were performed to determine the relationship between measles, mumps, and rubella (vaccinate v. not vaccinate) versus variables of interest from 2013 thru 2017.

In support of hypothesis 2, there is a significant association between the MMR shot (vaccinate v. not vaccinate) and facility type (Table 10). The only facility types that were significantly more likely to vaccinate at alpha < .05 are all private at 56.5% v.

45.4% and mixed at 15.4% v. 14.8%, while the remaining facility types (except for all military/other, unknown and all WIC providers) were significantly more likely to not vaccinate at alpha < .05 (Table 10).

**Table 10**

*Pearson's Chi-Square MMR Shot (Vaccinated vs. Not Vaccinated), Facility Type*

| Variables ($N$ = 75127) | Observed Vaccinated Count | Expected Vaccinated Count | Observed Unvaccinated Count | Expected Unvaccinated Count | | | |
|---|---|---|---|---|---|---|---|
| Facility | $n$ (%) | | $n$ (%) | | $\chi^2$ | $df$ | $p$ |
| **All public** | **6592 (10.6)** | **6795.8** | **1599 (12.5)** | **1395.2** | **40.26** | **1** | **<.001** |
| **All hospital** | **9237 (14.8)** | **9410.0** | **2105 (16.4)** | **1932.0** | **22.00** | **1** | **<.001** |
| **All private** | **35246 (56.5)** | **34066.7** | **5815 (45.4)** | **6994.3** | **528.51** | **1** | **<.001** |
| All military/other | 1628 (2.6) | 1655.2 | 367 (2.9) | 339.8 | 2.69 | 1 | 0.101 |
| **Mixed** | **9624 (15.4)** | **9551.1** | **1888 (14.8)** | **1960.9** | **3.86** | **1** | **0.049** |
| Unknown | 3 (0.0) | 2.5 | 0 (0.0) | 0.5 | 0.62 | 1 | 1.000 * |
| All WIC providers | - | - | - | - | - | - | - |
| | $n$ = 12797 | | $n$ = 62330 | | | | |

*Note.* * $p$-value is a result of Fisher's Exact Test due to expected frequency less than 5. Dashes indicate no cases.

In support of hypothesis 2, there is a significant association between the MMR shot (vaccinate v. not vaccinate) and census region (Table 11). The only census regions that were significantly more likely to vaccinate at alpha < .05 are Northeast at 20.2% v. 14.0% and Midwest at 20.9% v. 20.0%, while the remaining census regions were significantly more likely to not vaccinate at alpha < .05 (Table 11).

**Table 11**

*Pearson's Chi-Square MMR Shot (Vaccinated vs. Not Vaccinated), Census Region*

| Variables ($N$ = 75127) | Observed Vaccinated Count | Expected Vaccinated Count | Observed Unvaccinated Count | Expected Unvaccinated Count | | | |
|---|---|---|---|---|---|---|---|
| Census region | $n$ (%) | | $n$ (%) | | $\chi^2$ | $df$ | $p$ |
| **Northeast** | **12584 (20.2)** | **11922.2** | **1786 (14.0)** | **2447.8** | **266.64** | **1** | **<.001** |
| **Midwest** | **13049 (20.9)** | **12952.7** | **2563 (20.0)** | **2659.3** | **5.31** | **1** | **0.021** |
| **South** | **22506 (36.1)** | **22712.8** | **4870 (37.0)** | **4663.2** | **17.40** | **1** | **<.001** |
| **West** | **13268 (21.3)** | **13800.6** | **3366 (26.3)** | **2833.4** | **154.98** | **1** | **<.001** |
| | $n$ = 12797 | | $n$ = 62330 | | | | |

In support of hypothesis 2, there is a significant association between the MMR shot (vaccinate v. not vaccinate) and year of interview (Table 12). The only years of interview that were significantly more likely to vaccinate at alpha < .05 are 2013 at 20.1% v. 12.0% and 2014 at 20.6% v. 17.6%, while the remaining years of interview were significantly more likely to not vaccinate at alpha < .05 (Table 12).

**Table 12**

*Pearson's Chi-Square MMR Shot (Vaccinated vs. Not Vaccinated), Year*

| Variables ($N$ = 75127) | Observed Vaccinated Count | Expected Vaccinated Count | Observed Unvaccinated Count | Expected Unvaccinated Count | | | |
|---|---|---|---|---|---|---|---|
| Year | $n$ (%) | | $n$ (%) | | $\chi^2$ | $df$ | $p$ |
| **2013** | **12529 (20.1)** | **11655.0** | **1531 (12.0)** | **2395.0** | **462.14** | **1** | **<.001** |
| **2014** | **12812 (20.6)** | **12493.9** | **2247 (17.6)** | **2562.1** | **59.48** | **1** | **<.001** |
| **2015** | **12591 (20.2)** | **12769.3** | **2800 (21.9)** | **2621.7** | **18.39** | **1** | **<.001** |
| **2016** | **12205 (19.6)** | **12680.6** | **3079 (24.1)** | **2603.4** | **131.44** | **1** | **<.001** |
| **2017** | **12193 (19.6)** | **12721.2** | **3140 (24.5)** | **2611.8** | **161.77** | **1** | **<.001** |
| | $n$ = 12797 | | $n$ = 62330 | | | | |

In support of hypothesis 2, there is a significant association between the MMR shot (vaccinate v. not vaccinate) and education of mother (Table 13). Only college-educated mothers were significantly more likely to vaccinate at alpha < .05 at 48.3% v. 36.4% (Table 13). Non-college-educated mothers were significantly more likely to not

vaccinate at alpha < .05 with those with more than 12 years (no college) with the highest non vaccination rate at 28.1% v. 24.7% (Table 13).

**Table 13**

*Pearson's Chi-Square MMR Shot (Vaccinated vs. Not Vaccinated), Education of Mother*

| Variables ($N$ = 75127) | Observed Vaccinated Count | Expected Vaccinated Count | Observed Unvaccinated Count | Expected Unvaccinated Count | | | |
|---|---|---|---|---|---|---|---|
| Education of Mother | *n* (%) | | *n* (%) | | $\chi^2$ | *df* | *p* |
| **< 12 years** | **6347 (10.2)** | **6755.9** | **1796 (14.0)** | **1387.1** | **162.98** | **1** | **<.001** |
| **12 years** | **10429 (16.7)** | **10930.8** | **2746 (21.5)** | **2244.2** | **163.99** | **1** | **<.001** |
| **> 12 years, non college graduate** | **15422 (24.7)** | **15776.0** | **3593 (28.1)** | **3239.0** | **62.44** | **1** | **<.001** |
| **College graduate** | **30132 (48.3)** | **28867.3** | **4662 (36.4)** | **5926.7** | **605.94** | **1** | **<.001** |
| | *n* = 12797 | | *n* = 62330 | | | | |

In support of hypothesis 2, there is a significant association between the MMR shot (vaccinate v. not vaccinate) and age of mother (Table 14). Only mothers aged 30 years or older were significantly more likely to vaccinate at alpha < .05 at 41.8% v. 36.1% (Table 14). Younger mothers were significantly more likely to not vaccinate at alpha < .05 (Table 14).

**Table 14**

*Pearson's Chi-Square MMR Shot (Vaccinated vs. Not Vaccinated), Age of Mother*

| Variables ($N$ = 75127) | Observed Vaccinated Count | Expected Vaccinated Count | Observed Unvaccinated Count | Expected Unvaccinated Count | | | |
|---|---|---|---|---|---|---|---|
| Age of Mother | *n* (%) | | *n* (%) | | $\chi^2$ | *df* | *p* |
| **19 years or younger** | **17290 (27.7)** | **17886.7** | **4269 (33.4)** | **3672.3** | **163.88** | **1** | **<.001** |
| 20-29 years | 19016 (30.5) | 19017.5 | 3906 (30.5) | 3904.5 | 0.00 | 1 | 0.975 |
| **30 years or older** | **26024 (41.8)** | **25425.8** | **4622 (36.1)** | **5220.2** | **139.54** | **1** | **<.001** |
| | *n* = 12797 | | *n* = 62330 | | | | |

In support of hypothesis 2, there is a significant association between the MMR shot (vaccinate v. not vaccinate) and media coverage (pre v. post) (Table 15). Participants

from the pre-exposure group were significantly more likely to vaccinate at alpha < .05 at 20.1% v. 12.0% (Table 15).

**Table 15**

*Pearson's Chi-Square MMR Shot (Vaccinated vs. Not Vaccinated), Media Coverage (Pre vs. Post)*

| Variables ($N$ = 75127) | Observed Vaccinated Count | Expected Vaccinated Count | Observed Unvaccinated Count | Expected Unvaccinated Count | | | |
|---|---|---|---|---|---|---|---|
| Exposure to measles at Disneyland 2014-2015 | *n* (%) | | *n* (%) | | $\chi^2$ | *df* | *p* |
| **Pre** | **12529 (20.1)** | **11665.0** | **1531 (12.0)** | **2395.0** | **462.14** | **1** | **<.001** |
| **Post** | **49801 (79.9)** | **50665.0** | **11266 (88.0)** | **10402.0** | **462.14** | **1** | **<.001** |
| | *n* = 12797 | | *n* = 62330 | | | | |

**Measles-Only Shot**

Table 16 shows that within the unadjusted model, none of the facility types had significant odds of vaccination. Table 16 also shows that within the adjusted model, patients from all private had significantly lower odds of vaccination compared to all military/other facility types, (AOR = 0.70, p = .011). Table 16 also shows that within the adjusted model, none of the facility types had significant odds of vaccination.

**Table 16**

*Unadjusted and Adjusted Odds Ratios of Measles-Only Shot Stratified by Facility Type*

| | Measles-only shot | |
|---|---|---|
| Facility type | Non vaccination v. Vaccination | Non vaccination v. Vaccination |
| | Unadjusted OR, [CI], p-value | Adjusted AOR, [CI], p-value |
| All military | Reference group | Reference group |
| All public | 0.93, [0.53-1.63], .789 | 0.71, [0.49-1.02], .065 |
| All hospital | 0.87, [0.49-1.55], .645 | 0.91, [0.63-1.32], .626 |
| All private | 1.20, [0.72-2.01], .486 | 0.70, [0.53-0.92], .011 |
| Mixed | 0.74, [0.41-1.34], .322 | -a |
| Unknown | -a | -a |
| All WIC providers | -a | -a |

*Note.* OR, unadjusted odds ratio; AOR, adjusted odds ratio; Covariates adjusted for include mother's age, educational level, census region, and time of exposure to measles. CI, confidence interval. [a]Excluded due to small sample size.

Table 17 shows that mothers from the Midwest (OR = 0.53, p <.001), South (OR = 0.57, p <.001), and West census regions (OR = 0.61, p <.001), had significantly lower odds of vaccination compared to mothers from the Northeast census region. Table 17 also shows that within the adjusted model, mothers from the Midwest (AOR = 1.84, p <.001), South (AOR = 1.62, p <.001), and West census regions (AOR = 1.53, p <.001), had significantly higher odds of vaccination compared to mothers from the Northeast census region.

**Table 17**

*Unadjusted and Adjusted Odds Ratios of Measles-Only Shot Stratified by Census Region*

| | Measles-only shot | |
|---|---|---|
| Census region | Non vaccination v. Vaccination | Non vaccination v. Vaccination |
| | Unadjusted OR, [CI], p-value | Adjusted AOR, [CI], p-value |
| Northeast | Reference group | Reference group |
| Midwest vs. Northeast | 0.53, [0.42-0.67], <.001 | 1.84, [1.44-2.35], <.001 |
| South vs. Northeast | 0.57, [0.46-0.70], <.001 | 1.62, [1.31-2.00], <.001 |
| West vs. Northeast | 0.61, [0.48-0.76], <.001 | 1.53, [1.21-1.93], <.001 |

*Note*. OR, unadjusted odds ratio; AOR, adjusted odds ratio; Covariates adjusted for include mother's age, educational level, facility type, and time of exposure to measles. CI, confidence interval.

Table 18 shows that mothers who are college graduates had significantly higher odds of vaccination compared to those with less than 12 years of education, (OR = 2.24, p <.001). Table 18 also shows that within the adjusted model, mothers who are college graduates had significantly lower odds of vaccination compared to those with less than 12 years of education, (AOR = 0.61, p = .003).

**Table 18**

*Unadjusted and Adjusted Odds Ratios of Measles-Only Shot Stratified by Education of Mother*

| | Measles-only shot | |
|---|---|---|
| Education of mother | Non vaccination v. Vaccination | Non vaccination v. Vaccination |
| | Unadjusted | Adjusted |
| | OR, [CI], p-value | AOR, [CI], p-value |
| < 12 years | Reference group | Reference group |
| 12 years vs. < 12 years | 1.22, [0.86-1.72], .260 | 0.88, [0.62-1.25], .477 |
| > 12 years, non-college graduate vs. < 12 years | 1.24, [0.89-1.75], .209 | 0.97, [0.68-1.38], .865 |
| College graduate vs. < 12 years | 2.24, [1.65-3.03], <.001 | 0.61, [0.44-0.84], .003 |

*Note.* OR, unadjusted odds ratio; AOR, adjusted odds ratio; Covariates adjusted for include mother's age, facility type, census region, and time of exposure to measles. CI, confidence interval

Table 19 shows that mothers 30 years of age or older had significantly higher odds of vaccination compared to mothers 19 years or younger, (OR = 2.56, p = .022). Table 19 shows that within the adjusted model, none of the other age groups had significant odds of vaccination.

**Table 19**

*Unadjusted and Adjusted Odds Ratios of Measles-Only Shot Stratified by Age of Mother*

| | Measles-only shot | |
|---|---|---|
| Age of mother | Non vaccination v. Vaccination | Non vaccination v. Vaccination |
| | Unadjusted | Adjusted |
| | OR, [CI], p-value | AOR, [CI], p-value |
| 19 years or younger | Reference group | Reference group |
| 20-29 years | 1.47, [0.65-3.32], .354 | 0.89, [0.39-2.02], .777 |
| 30 years | 2.56, [1.15-5.74], .022 | 0.65, [0.29-1.48], .307 |

Note. OR, unadjusted odds ratio; AOR, adjusted odds ratio; Covariates adjusted for include facility type, educational level, census region, and time of exposure to measles. CI, confidence interval.

Table 20 shows that mothers during pre-media coverage in 2007, deeming vaccines unsafe for children aged 19-35 months, had significantly lower odds of vaccination compared to mothers during post-media coverage in 2007, deeming vaccines unsafe for children aged 19-35 months, (OR = 0.81, p = .009). Table 20 shows that within the adjusted model, mothers during the post-media coverage in 2007 did not have significant odds of vaccination.

**Table 20**

*Unadjusted and Adjusted Odds Ratios of Measles-Only Shot Stratified by Time of Media Coverage in 2007, Deeming Vaccines Unsafe for Children Ages 19–35 Months*

| | Measles-only shot | |
|---|---|---|
| | Non vaccination v. Vaccination | Non vaccination v. Vaccination |
| | Unadjusted<br><br>OR, [CI], p-value | Adjusted<br><br>AOR, [CI], p-value |
| Pre media coverage in 2007, deeming vaccines unsafe for children aged 19-35 months | Reference group | Reference group |
| Post media coverage in 2007, deeming vaccines unsafe for children aged 19-35 months vs. pre | 0.81, [0.69-0.95], .009 | 1.18, [1.00-1.39], .051 |

*Note.* OR, unadjusted odds ratio; AOR, adjusted odds ratio; Covariates adjusted for include mother's age, educational level, census region, and time of exposure to measles. CI, confidence interval.

**Measles, Mumps, and Rubella**

Table 21 shows that patients from all private (OR = 1.37, p <.001), and mixed facility types (OR = 1.15, p = .027) had significantly higher odds of vaccination compared to all military/other facility types. Table 21 also shows that within the adjusted model, all private facility types had significantly higher odds of vaccination compared to all military/other facility types (AOR = 1.28, p <.001).

**Table 21**

*Unadjusted and Adjusted Odds Ratios of MMR Shot Stratified by Facility Type.*

| | MMR shot | |
|---|---|---|
| Facility type | Non vaccination v. Vaccination | Non vaccination v. Vaccination |
| | Unadjusted OR, [CI], p-value | Adjusted AOR, [CI], p-value |
| All military | Reference group | Reference group |
| All public | 0.93, [0.82-1.05], .253 | 1.00, [0.87-1.13], .938 |
| All hospital | 0.99, [0.88-1.12], .863 | 0.93, [0.82-1.05], .239 |
| All private | 1.37, [1.22-1.54], <.001 | 1.28, [1.14-1.46], <.001 |
| Mixed | 1.15, [1.02-1.30], .027 | 1.13, [1.00-1.29], .053 |
| Unknown | -b | -b |
| All WIC providers | -b | -b |

*Note*. OR, unadjusted odds ratio; AOR, adjusted odds ratio; Covariates adjusted for include mother's age, educational level, census region, and time of exposure to measles.CI, confidence interval. [a]Excluded due to small sample size.

Table 22 shows that mothers from the Midwest (OR = 0.72, p <.001), South (OR = 0.66, p <.001), and West census regions (OR = 0.56, p <.001), had significantly lower odds of vaccination compared to mothers from the Northeast census region. Table 22 also shows that within the adjusted model, mothers from the Midwest (AOR = 0.74, p <.001), South (AOR = 0.67, p <.001), and West census regions (AOR = 0.57, p <.001), had significantly lower odds of vaccination compared to mothers from the Northeast census region.

**Table 22**

*Unadjusted and Adjusted Odds Ratios of MMR Shot Stratified by Census Region*

| | MMR shot | |
|---|---|---|
| Census region | Non vaccination v. Vaccination | Non vaccination v. Vaccination |
| | Unadjusted | Adjusted |
| | OR, [CI], p-value | AOR, [CI], p-value |
| Northeast | Reference group | Reference group |
| Midwest | 0.72, [0.68-0.77], <.001 | 0.74, [0.69-0.79], <.001 |
| South | 0.66, [0.62-0.70], <.001 | 0.67, [0.63-0.71], <.001 |
| West | 0.56, [0.53-0.60], <.001 | 0.57, [0.54-0.61], <.001 |

*Note.* OR, unadjusted odds ratio; AOR, adjusted odds ratio; Covariates adjusted for include mother's age, educational level, facility type, and time of exposure to measles. CI, confidence interval.

Table 23 shows that mothers with exactly 12 years of education (OR = 1.08, p = .036), more than 12 years, non-college graduate (OR = 1.22, p < .001) and college graduates (OR = 1.83, p <.001) had significantly higher odds of vaccination compared to mothers with less than 12 years of education. Table 23 also shows that within the adjusted model, mothers with more than 12 years, non-college graduate (AOR = 1.20, p < .001) and college graduates (AOR = 1.75, p <.001) had significantly higher odds of vaccination compared to mothers with less than 12 years of education.

**Table 23**

*Unadjusted and Adjusted Odds Ratios of MMR Shot Stratified by Education of Mother*

| | MMR shot | |
|---|---|---|
| Education of mother | Non vaccination v. Vaccination | Non vaccination v. Vaccination |
| | Unadjusted<br><br>OR, [CI], p-value | Adjusted<br><br>AOR, [CI], p-value |
| < 12 years | Reference group | Reference group |
| 12 years | 1.08, [1.01-1.15], .036 | 1.06, [0.99-1.14], .099 |
| > 12 years, non-college graduate | 1.22, [1.14-1.29], <.001 | 1.20, [1.12-1.28], <.001 |
| College graduate | 1.83, [1.72-1.94], <.001 | 1.75, [1.64-1.87], <.001 |

*Note.* OR, unadjusted odds ratio; AOR, adjusted odds ratio; Covariates adjusted for include mother's age, facility type, census region, and time of exposure to measles. CI, confidence interval.

Table 24 shows that mothers 29-29 years of age (OR = 1.20, p <.001) and 30 years of age or older (OR = 1.39, p <.001) had significantly higher odds of vaccination compared to mothers 19 years or younger. Table 24 also shows that within the adjusted model, mothers 29-29 years of age (AOR = 1.22, p <.001) and 30 years of age or older (AOR = 1.44, p <.001) had significantly higher odds of vaccination compared to mothers 19 years or younger.

**Table 24**

*Unadjusted and Adjusted Odds Ratios of MMR Shot Stratified by Age of Mother.*

| | MMR shot | |
|---|---|---|
| Age of mother | Non vaccination v. Vaccination | Non vaccination v. Vaccination |
| | Unadjusted | Adjusted |
| | OR, [CI], p-value | AOR, [CI], p-value |
| 19 years or younger | Reference group | Reference group |
| 20-29 years vs. 19 years or younger | 1.20, [1.15-1.26], <.001 | 1.22, [1.16-1.28], <.001 |
| 30 years or older vs. 19 years or younger | 1.39, [1.33-1.46], <.001 | 1.44, [1.37-1.51], <.001 |

*Note.* OR, unadjusted odds ratio; AOR, adjusted odds ratio; Covariates adjusted for include facility type, educational level, census region, and time of exposure to measles. CI, confidence interval.

Table 25 shows that mothers after the time of exposure to measles at Disneyland in 2014-2015 had significantly lower odds of vaccination compared to mothers before the time of exposure to measles at Disneyland in 2014-2015 (OR = 0.54, p <.001). Table 25 also shows that within the adjusted model, mothers after the time of exposure to measles at Disneyland in 2014-2015 had significantly lower odds of vaccination compared to mothers before the time of exposure to measles at Disneyland in 2014-2015 (AOR = 0.48, p <.001).

**Table 25**

*Unadjusted and Adjusted Odds Ratios of MMR Shot Stratified by Time of Exposure to Measles at Disneyland in 2014–2015*

| | MMR shot | |
|---|---|---|
| | Non vaccination v. Vaccination | Non vaccination v. Vaccination |
| | Unadjusted OR, [CI], p-value | Adjusted AOR, [CI], p-value |
| Pre exposure to measles at Disneyland in 2014-2015 | Reference group | Reference group |
| Post exposure to measles at Disneyland in 2014-2015 vs. Pre exposure to measles at Disneyland in 2014-2015 | 0.54, [0.51-0.57], <.001 | 0.48, [0.45-0.51], <.001 |

*Note.* OR, unadjusted odds ratio; AOR, adjusted odds ratio; Covariates adjusted for include mother's age, educational level, census region, and time of exposure to measles. CI, confidence interval.

## Summary

The CDC ChildVaxView secondary dataset was used to determine if there was a significant difference in child measles vaccine uptake, based on provider facility type and census region, after adjusting for age and education of mother, for the years 2003-2012, pre-and-post 2007 media coverage deeming vaccines unsafe and for the years 2013-2017, pre-and-post exposure to measles at Disneyland in 2014-2015 for children aged 19-35 months. A total of 73,964 participants were included in this study. A random assignment design was used to produce a high level of internal validity to accurately represent changes in childhood immunization rates. Most of the sample were from the South census region, 101,645 (37.3%); college graduate, 118,542 (43.5%); 30 years of age or older, 168, 540 (61.9%) and associated with a private facility. There was a significant association with pre-and-post media coverage since the qualitative confounding was not

statistically significant after adjusting. For MMR shot, a significant relationship was shown between facility type (private and mixed) <.05, census region (Northeast and Midwest) <.05, years of interview 2013 and 2014 <.05, college educated mothers <.05, age of mother 30 years or older <.05 and pre-media coverage exposure group <.05. The fourth and final section describes the application of this study to professional practice, the inferences for social change, which will include the interpretation of findings, limitations, and recommendations.

## Section 4: Application to Professional Practice and Implications for Social Change

### Introduction

The purpose of this retrospective quantitative study was to determine if there was a significant difference in child measles vaccine uptake based on provider facility type and census region, after adjusting for age and education of mother, for the years 2003–2012, pre-and-post 2007 media coverage deeming vaccines unsafe, and for the years 2013-2017, pre-and-post exposure to measles at Disneyland in 2014–2015 for children ages 19–35 months. I used SEM to explain ways that environment can influence health behaviors. This led to the development of two research questions and hypotheses regarding child measles immunization rates in the United States. The key findings of this study are that there is a significant relationship ($p < .05$) in child measles vaccine uptake (number of MMR shots) based on provider facility type and census region, after adjusting for age and education of mother, for the years 2013–2017, pre-and-post exposure to measles at Disneyland in 2014–2015 for children ages 19–35 months, after adjusting for age and education of mother, for the years 2003–2012, pre-and-post media coverage in 2007, deeming vaccines unsafe for children ages 19–35 months.

### Interpretation of the Findings

In this study, I examined the core determinants of risk factors that can cause a trend in the decrease of the uptake of child measles immunizations and measles outbreaks throughout the United States. The reemergence of the antivaxxer movement coupled with media coverage could be a contributing factor to changes in the uptake of child measles

immunizations. The results of my study confirmed some previous findings and provide a foundation for future research on this topic.

The findings from this study add new knowledge regarding vaccination characteristics. For example, in this study the age of mother was associated with the likelihood of the child being vaccinated or not. Salmon et al. (2009) associated maternal age and preschool child vaccination coverage rates. The researchers aimed to determine whether maternal age had any influence in children ages 19–35 months receiving immunizations. The study concluded that children born to mothers under 26 years of age had a higher chance of being under immunized. I found that mothers age 30 and up were more likely to vaccinate their children. Maturity in age and or life experience could be a reason that older mothers choose to vaccinate. The mother's education level was also associated with the likelihood of the child being vaccinated. Vikram et al. (2012) claimed that the education status of a mother could empower women to play a more assertive role in the health care of their children. I found that the mothers' education level may have influenced their decision to immunize the child. The results of my study add new information showing the significance of the census region as it relates to child vaccine uptake. Census region could possibly predict areas vulnerable for future measles outbreaks. Statistically, I found that the Northeast was associated with the likelihood that children would uptake the MMR vaccine. It remains unclear why the Northeast has the highest MMR coverage rates and why media coverage could have negatively affected the coverage rates of other census regions. This is an area where further research could shed light.

Czumbel et al. (2018) sought to analyze information on the incubation of diseases and the time at which the onset of infection occurred for childhood communicable diseases. The results of the study found that children contracted measles in various settings. Measles outbreaks occurred within the school setting and local communities. The findings from Czumbel et al. (2018) confirmed that in my study the vulnerable (under-or unvaccinated) have the potential to contract and spread measles; posing a threat to public health. The current study also provided evidence that the measles outbreaks can occur in any setting, especially in those under-or-not vaccinated against this disease. Disneyland is an amusement park at which families tend to vacation. Many would not expect to contract a communicable disease in a setting such as Disneyland. This study showed that - after the time of exposure of measles at Disneyland in 2014-15 there was a significantly lower odds of vaccination compared to the before the time of exposure to measles at Disneyland. This could indicate that the negative media that surrounded this event could have influenced the parents' decisions to vaccinate their children.

The results of my study indicated that the facility type could be a predicter in whether children received the MMR vaccine. The results of this study showed that children receiving care at private facilities were most likely to get the MMR. A study done by Bednarczyk et al. (2016) examined children that are susceptible to contract the measles. The investigators utilized the NIS Teen version to examine immunization data. The methodology was to examine the ages at which the sample population received their first and second MMR dosages for the measles vaccine (Bednarczyk et al., 2016). The results indicated that the MMR coverage rate slightly decreased due to many in the

sample being unimmunized for the measles. This supports my study in that it illustrates the vulnerability that will continue to plague children unless interventions are made to ensure both dosages of the MMR vaccine are retrieved.

Though, the measles is preventable in the United States through vaccination, this disease continues to be a public health issue. Thus, risk factors that would cause parents/guardians to refuse the measles vaccine for their children must be considered to stabilize the child measles uptake rates in the United States. The results of this study support Knopf's (2019) theory that myths about child vaccinations may have led to parental immunization refusal. Knopf (2019) also stated that in 2019 more than 700 measles cases in the United States occurred; the highest since the virus was eliminated 20 years ago. Most of the measles cases in the United States occurred in individuals that were not vaccinated (CDC, 2021). Measles outbreaks usually occur in the United States communities that are unvaccinated (CDC, 2021). According to Patel et al. (2019) under or unimmunized subpopulations in the United States have a potential risk of large outbreaks that could possibly be hard to contain. As stated prior, this current study illustrated that the facility type was pivotal in children uptaking the MMR vaccine. As such, communication about the effectiveness of child vaccines can start at different facility types. Hence, facility type can play a major role in both parents being educated on child vaccines and children retrieving their MMR immunizations. Patel et al. (2019) stated that pediatricians are in the best position to communicate to parents the need to immunize their children.

SEM was the chosen theory for the current study. This model allows researchers to move beyond analyzing the behavior of the individual but toward an understanding that other influences are complex with multifaceted. SEM has five tenets that could influence health behaviors: a) individual level, b) interpersonal level, c) community level, d) organizational, and e) policy level. The current study used the tenet societal level. Societal level was addressed in the current study by utilizing the NIS datasets provided by the CDC. For this study, societal level was operationalized as child measles uptake rates being influenced by media coverage deeming immunizations unsafe.

The connection between the tenet societal level and this study was that were significant variations in vaccine uptake by year and this could possibly correlate to media coverage deeming vaccines unsafe. SEM was befitting for the research questions in that there are other factors separate from the individual behavioral factors that could influence parents to reject child measles immunizations. A social change outcome should consist of increasing MMR uptake rates, early intervention of educational strategies, and early identification of parents at risk for vaccination refusal. SEM was utilized to explain the relationship of the independent variables, covariates, with the dependent variable in this study. The current study's findings indicated that SEM was able to explain that the covariates a) education of mother b) age of mother and c) census region were better predictors regarding a child retrieving the MMR vaccine.

## Limitations of the Study

There are pros and cons to using secondary datasets, for example limitation of trustworthiness, validity, reliability, and generalizability. There were several limitations

to this study. The estimation of the MMR uptake data according to provider facility could be subject to errors. As most of society has transitioned from having landlines to cellular phones, the new datasets retrieved by the NIS may not be as representative of the population. Complete information about both dosages of the MMR may not be accurate in cases that a child did not receive both dosages by the same health provider.

There was a lot of missing data in the datasets. To address this, for tables 16-20 and 21-25 the listwise deletion was used in regression tables and for the chi-square tables 4-15 the pairwise deletion was used. Thus, missing data was excluded from the regression and chi-square tables. For the Table series 16-20 that examined the factors that affected measles only shot uptake, there was the presence of qualitative confounding. This phenomenon occurred due to the covariates competing with the exposure of interest in explaining outcome which is uptake of the measles-only shot. With regards to overadjustment and specifically the missing data from the measles-only vaccines, the results could have been affected. Over adjustment came from an excessive number of covariates which obscured the true impact of the exposures on the measles-only shot by biasing results towards the null hypothesis (e.g., exposures not significantly impacting vaccination). Finally, the unadjusted tables 16-20 and 21-25 are clearer in answering the research questions in comparison to the adjusted tables in comparison to the adjusted tables 4-10. This could be due to the bivariate relationship between the dependent and independent variables, which does not control for confounders nor covariates.

## Recommendations

Future quantitative studies should include different independent variables and covariates to address the decline in the uptake of the MMR vaccine in the United States. Due to privacy and confidentiality laws in public health and health care it would be challenging to conduct a qualitative study utilizing the data from the NIS. With regards to future quantitative studies, more knowledge is needed about other factors that have led to parents rejecting vaccine uptake; researchers could use the current study findings with census region, age of mother, and education level of mother; to examine additional information on how these variables affect the MMR uptake rates in the United States. SEM could also provide a framework to leverage new quantitative research on this topic. Health communication is very important in parents deciding to vaccinate their children. Thus, the power of effective communication between health providers and parents regarding child immunization; is paramount in preventing the measles in children.

To support the field of public health the CDC recommends that local health departments continue to monitor and surveil measles cases. Prompt investigation and response can limit the spread of the measles coupled with vaccinations and quarantines (CDC, 2018b). Finally, the CDC recommend that health providers familiarize themselves with symptoms and signs of the measles. A swift recognition could limit threats to the health of the masses.

## Implications for Professional Practice and Social Change

Historically, most childhood vaccines have been proven to prevent deadly communicable diseases like the measles. Though breakthroughs with vaccines have

prevented many morbidities and mortalities, the antivaxxer movement continues to prevail. As such communicable diseases that were eradicated or contained have reemerged. This is mostly due to misinformation about the history of communicable diseases prior to the creation of such vaccines and false ideology regarding the safety of child immunizations like MMR. Behavior has the potential to be modifiable. Thus, education of vaccine safety and knowledge regarding the dangers of living in a society that lacks herd immunity is important. Multiple studies have validated the safeness of child immunizations and the minimal adverse effects of such vaccines. However, more work must be done to foster positive change specifically, to ensure that the overall vaccination rates stay well over 90% to protect the population.

The implications for social change based on this study's findings provides an understanding that many variables on a societal level in conjunction to media coverage deeming MMR vaccines unsafe have led to some parents refusing to vaccinate their children. This yields an opportunity for legislative officials to pass policies that even restrict states from allowing philosophical or religious exemptions (like the codes passed in the state of Mississippi). Such laws may seem to infringe upon the right of the individual; however, the health and protection of the masses outweighs one's personal ideologies regarding child vaccination.

## Conclusion

The measles was once contained worldwide but has reemerged. The results of this study point to a relationship between census region, age of mother, and education of mother combined with media coverage (point-in-time). More education is needed for

parents/guardians regarding immunization safeness to achieve herd immunity. Interventions are needed to prevent measles and potential outbreaks. Positive change could emerge from this study by the increasing number of children throughout the United States receiving the MMR vaccine. This study was important because one measles outbreak has the potential to cause many to suffer or even die from this preventable disease.

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