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Comparison of Factors Influencing Maternal Vaccine Hesitancy among Pregnant Women Living in Atlanta and Denver

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Abstract

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Background: Influenza and pertussis are respiratory diseases that are endemic in the United States. Pregnant women and infants are even more vulnerable to these diseases, with the potential of adverse health outcomes leading to hospitalization and death. Studies have shown that immunization is the most effective strategy in the prevention of these diseases. Despite efforts to increase uptake of influenza and pertussis vaccination, national vaccination coverage of these vaccines remained low. The states of Georgia and Colorado are among the states with the highest burden of these diseases, with vaccination coverage below national coverage rates.

Goal: This research aimed to identify primary hesitancy factors, compare them between states, and translate the findings into programmatic interventions to improve vaccine coverage not only for these diseases but also other vaccine preventable diseases.

Methods: Eligible study participants were pregnant women age 18 to 50 years between 20-27 weeks of gestation or first pregnancy at any gestation. Data was collected from a convenience sample size of a total of 45 participants who were classified into three groups: vaccine acceptors, vaccine-hesitant, and vaccine refusers. Interviews were transcribed, analyzed and coded using NVivo 11.0. The nodal correlation assessment for validation of coding and thematic convergence using Pearson's R measurement across major codes was conducted, with codes that met high correlation coefficient standards (e.g., $R \geq 0.80$) validating the identified code relationships. Thematic findings were then summarized.

Results: Some complex social-economic factors (hesitant factors) such as social networks, unsubstantiated vaccines myths, vaccine safety, communication with providers, and beliefs and attitudes were identified as the primary causes of influenza and pertussis vaccines hesitancy. Some similarities on these factors affect vaccine hesitancy were observed among these states. However, there was some striking difference as well such as knowledge on child and pregnant women vaccination, safety and efficaciousness of vaccines.

Conclusion: Many women of childbearing age (18-50 years) are unaware on the importance of and recommendations for vaccines during pregnancy and childhood. Women rely on unsubstantiated information obtained through word of mouth, friends, the internet, and family members. Public health interventions should be geared to improving access to information about recommended vaccines, collaborating with all stakeholders involved in vaccination to increase not only influenza and pertussis vaccine uptake but other vaccines for vaccine preventable diseases.

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Chapter 1
Introduction and Rationale

Influenza and pertussis affect a disproportionate number of people each year in the United States.[1] In the 2017-18 influenza season (October 1, 2017 through March 30, 2018), there were 28,543 clinical confirmed influenza cases with 142 pediatric deaths.[2,3] In 2016, there were 17,972 confirmed pertussis cases compared to 20,762 cases with 9,340 pediatric (age 0 – 10 years) cases reported in 2015.[4,5] Recent studies show that pregnant women and children are more vulnerable to these diseases with severe health comes that lead to hospitalization and death.[1]

Immunization during pregnancy has been shown as the most effective strategy to protect pregnant women and children against these diseases.[6] Childhood vaccination coverage against these diseases is higher than coverage among adults. As of November 2016, the national maternal influenza vaccine coverage stood at 46.6% and pertussis coverage ranged between 45-55%.[7] All 50 states in the United States, including the district of Columbia, Puerto Rico, Guam, and the U.S. Virgin Islands, have been affected by these diseases.

Influenza and pertussis patients experience physical and psychological distress, resulting in an increased burden on the household through increased care needs and strain on family resources. This disease burden not only impacts patients and their families but also the health care system, which has been overwhelmed by the increased number of emergency visits and the increased use of resources to manage these cases. Resources have been invested in the purchase and management of these vaccines are not optimally used.

With less national vaccination coverage for these diseases, an increasing number of people serve as reservoirs and continue the spread or transmission of these diseases. This not only strains

the healthcare system but increases tax payer cost to manage infected cases. Public health agencies also continue to face tremendous challenges in the control and management of outbreaks.

The federal government and other professional organizations have developed vaccination policies and recommendations geared at increasing the level of vaccine uptake among these groups to reverse the national morbidity trends of these diseases.[8] There are also private partners and other agencies at the state and county levels that support this effort.

Immunization during pregnancy protects women and infants (through passive immunity) against these diseases.[6] Vaccinating adults who anticipate coming into contact with infants offers additional protection to the infant by reducing the level of exposures to these pathogens. Studies have shown that early and increased exposure to education materials and other sources of information promotes pregnant women's adherence to CDC's ACIP recommendations and increases vaccine uptake for both pregnant women and children.[9] Therefore, pregnancy provides immunization stakeholders the opportunity to target pregnant women with persuasive education messages on vaccines. Other stakeholders, like clinical practices that come into contact with pregnant women, need to be equipped with tools such as intercultural awareness competencies, communication strategies, and other important resources promoting increased vaccine uptake.[10]

Despite efforts made by federal, state, and local agencies, including the private sector, to increase national coverage of influenza and pertussis vaccination, there are complex cultural and multifactorial features that challenge these efforts. Efforts must be made through research to identify and propose solutions to reconcile the multifactorial barriers to vaccine uptake and stakeholders' efforts to achieve improved maternal and child health through increased acceptance and coverage of vaccines. In order to achieve this, a comprehensive study aimed at identifying and

addressing these complex barriers is needed to increase the adherence to CDC's ACIP recommendations and the acceptance of vaccines among the target population.

Problem Statement

The United States is far from reaching the Healthy People 2020 goal of 80% vaccination coverage. This goal, aimed at improving the health of the general population, is far from being realized. This is particularly true for influenza and pertussis vaccines, which have less than 56% national coverage in recent years. Despite substantial efforts by the national vaccines stakeholders to promote and improve vaccination coverage and good conditions in place to facilitate vaccination, the national immunization level is far from meeting this goal.

Numerous social epidemiologic studies have been conducted to investigate the causes of this low vaccination coverage. Significant associations have been established between low vaccination coverage and education level, race/ethnicity, exposure to unsubstantiated vaccines myths, and religious values, among others. Programmatic interventions based of these studies results have been implemented with some positive impact, although this was not consistent over time. The most striking unanswered question is to know whether there were factors unaccounted for that have not been identified by previous research. This research study was carried out to answer this question and provide programmatic insights to resolve the challenge.

More research is needed to explore and understand the complex socioeconomic and cultural factors that govern or determine why pregnant women and their spouses are reluctant to receive all the CDC's ACIP and the American College of Obstetricians and Gynecologists' (ACOG) vaccine recommendations despite the scientific evidence on the effectiveness and efficaciousness of these vaccines in disease control and prevention.

Further, the previous social epidemiologic studies have not explored the associations between vaccine uptake and faith and spirituality. This research was needed to provide more insight on these factors in order to provide context and guidelines on policies geared toward improving national vaccination coverage, not only for influenza and pertussis but also to other endemic vaccine preventable diseases in the US.

Significance Statement

There is a knowledge gap between the current national vaccine coverage and hesitancy factors that perpetuate low influenza and pertussis vaccine uptake among pregnant women and infants in the United States. This study aims to reduce this gap by providing more data that may help guide policies at federal, state, and county levels with the overall objective to meet the Healthy People 2020 goal of 80% national vaccination coverage for influenza and pertussis.

Definition of Terms

No	Acronyms	Definition
1	CDC	Center for Disease Control and Prevent
2	ACIP	Advisory Committee for Immunization Practices
3	ACOG	American College of Obstetricians and Gynecologists
4	Tdap	Tetanus, diphtheria, and pertussis
5	DTaP	Diphtheria, Tetanus, and Pertussis
6	HP2020	Healthy People 2020 Goal
7	ICU	Intensive Care Unit
8	OBRA	Omnibus Budget Reconciliation Act
9	MMWR	Morbidity Mortality Weekly Report
10	NNDSS	National Notifiable Disease Surveillance System
11	NREVSS	National Respiratory and Enteric Viruses Surveillance System
12	FDA	Food and Drug Administration
13	VFC	Vaccines for Children
14	NIH	National Institute of Health
15	P3	Providers, Practices, and Patients
16	WHO	World Health Organization
17	H2N3	Influenza A virus
18	H1N1	Influenza A virus
19	AAP	The American Academic of Pediatrics the Program for
20	PATH	Appropriate Technology for Health

Chapter 2
Literature Review
Introduction

Influenza and pertussis (whooping cough) are respiratory diseases caused by bacteria and viruses, respectively, transmitted through the inhalation of aerosolized nuclei particles or coming into contact with soiled objects from infected persons. These diseases are endemic in the United States and disproportionately affect women and children; pregnant women and infants have an increased risk of developing severe health outcomes.[11]

Since October 2015, influenza positive tests have been reported in all 50 U.S. states, the District of Columbia, Puerto Rico, Guam, and the Virgin Islands representing all the U.S. Departments of Health and Human Services.[12] In the 2017-18 influenza season (October 1, 2017 to March 31, 2018), a total of 28,543 laboratory confirmed cases were recorded with a hospitalization rate of 99.9% per 100,000 populations.[2] Children, the most vulnerable group to infectious diseases compared to the different populations' segments, had an infection rate of 66.4% per 100,000 populations. Children with medical conditions were severely affected compared to those without any health event; among the 253 admitted children with known medical information, 138 (55%) had at least one health condition. Furthermore, from CDC's weekly reports on influenza, pregnant women also had an increased risk for severe influenza-related complications. Among the 214 hospitalized women between15-44 years, 63 (29.4%) were pregnant women.[13]

According to the World Health Organization (WHO) and the National Respiratory and Enteric Viruses Surveillance System (NREVSS) for both public health and clinical laboratories throughout the U.S., both influenza A and B viruses have been reported in all 50 states, the District of Columbia, Puerto Rico and the U.S. Virgin Islands.[14] At the beginning of October 2017, a total number of 135,202 specimens had been tested at the clinical laboratories, with 5,070 positives for

influenza. Among these figures, 3,723 (73.4%) were influenza A viruses and 1,347 (26.6%) were influenza B viruses but influenza viruses were the dominant strain.[15]

Immunization has been shown as the most effective strategy to manage and control influenza.[16] Federal, state, and local agencies have made persistent and consistent efforts to increase national vaccination uptake for influenza. The national influenza coverage among pregnant women has fluctuated over the past seasons. According to the CDC's internet panel survey conducted in 2015 to estimate the 2014-2015 annual influenza vaccination uptake among pregnant women, national coverage was 50.3%, compared to 46.6% uptake as of November 2016.[17] According to this survey, 15.3% of respondents reported receiving the influenza vaccine before pregnancy and 35% during pregnancy. Among these participants, Non-Hispanic black women reported lower vaccination coverage (38.9%) compared to non-Hispanic white women (51.9%) Women who had a provider's recommendation and offer had higher vaccine uptake (67.9%) compared to women who received a provider's recommendation but no offer (33.5%); 8.5% of women reported no recommendation or offer by a provider.[18]

As of November 2016, the national influenza coverage rate was 46.6%, well below the 80% target of the Healthy People 2020 goal. As a result, many outbreaks of influenza were reported in all 50 states, including the District of Columbia, Puerto Rico, and the U.S. Virgin Islands, with adverse health outcomes for children less than one-year-old and pregnant women. Pregnant women have increased risk of developing serious health complications, such as preterm labor, preterm delivery, pregnancy loss, pneumonia, sinus and ear infections in infants.[11] Influenza morbidity and mortality rates have also increased; studies on influenza-related case fatalities estimated that from 1976 through 2006, influenza deaths ranged from 3,000 to 49,000.[19,20]

Just like influenza, pertussis or whooping cough is another severe contagious respiratory infection that can lead to hospitalization and death. According to the pertussis surveillance system, the U.S.'s national infection rates of pertussis have been steadily increasing during the past decades, although there were some seasonal variations in incidence rates among states.[21] During the 1920s in the United States, pertussis case counts or incidence was higher than 250,000 per annum, but there was a decline through the late 1930s[21]. These counts reduced tremendously to less than 10,000 cases after the introduction of pertussis vaccine in the 1940s. During the 1980s, the incidence started rising again.[5] Remarkable peaks of this disease occurred in 2004 (25,827 confirmed hospitalizations and 27 deaths), in 2010 (27,550 hospitalizations and 27 deaths), and in 2012 (more than 41,000 confirmed hospitalizations and 18 deaths).[22] Reported pertussis morbidity has declined in recent years due to continued efforts by national stakeholders. This was seen in 2016, where the national prevalence stood at 17,972 cases.[23]

Pertussis causes severe morbidity and mortality rates among women and children. Groups such as infants and pregnant women are more vulnerable to this disease, with increased potential for adverse health outcomes including death.[24] Although the source of infants' transmission of these diseases is not well known, in the past, mothers, siblings, and other household members have been the primary reservoir.[25] Children have been disproportionately affected by pertussis compared to other populations. In 2016, there were 17,972 confirmed hospitalizations, of which 1,407 (44.3%) were infants under six months and 634 (11%) were infants between 6 to 11 months old. Infants are more vulnerable to pertussis, as their immune system is underdeveloped and they are not in the recommended age range to receive the pertussis vaccine.[26]

Based on surveillance and other research, vaccination was determined to be one of the most effective and efficient ways to protect against Bordetella Pertussis infections. As recommended by

the CDC's ACIP, children should receive five doses of DTaP (Diphtheria, Tetanus, and Pertussis) at aged 2, 4, 6, 15, and 18 months of age. A booster dose is also recommended at 4 to 6 years of age.[27] National vaccine coverage for childhood pertussis vaccines has increased in the recent decades. National vaccination coverage for three doses of DTaP was sustained to higher than 90% during the last two decades, while that of adult ranges from 10.8% in 2006 to 68.7% in 2010.[27,28]

If nothing is done to reverse the trend of influenza and pertussis infections, the incidence and prevalence rates of these diseases will continue to rise with increasing numbers of case fatalities. The surge in case fatalities would not only burden affected families through the increased of care and treatment costs, but also the healthcare system and taxpayer cost to manage and control these diseases would also continuous to increase.

Influenza Epidemiology in Colorado

Colorado has a higher incidence rate of influenza compared to the state of Georgia. The trend of influenza incidence within the state was similar to that observed at the national level. In the 2014-15 influenza season, Colorado reported 369 hospitalizations with two deaths and 4,045 emergency visits for children and pregnant women, with a total hospital and emergency department charge of over $25 million (of $35 million for vaccine preventable diseases) for influenza alone.[29] This would continue to affect pregnant women and children disproportionately.

In the 2016-17 influenza season, there was a slight decrease in the number of reported hospitalized influenza cases to 3,340, with a rate of 61.4 per 100.000 population in all 55 counties compared to the 2014-15 influenza season.[30] Influenza A virus (H3N2) was the dominant circulating strain among inpatients and outpatients' specimens. The attack rate for infants was 145.6 per 100,000 population[30]. For the 2017-18 season (October 1, 2017 to March 24, 2018),

there were 172 outbreaks with 4,310 hospitalizations and one pediatric death.[31] Colorado regularly reports case fatalities as a result of influenza-related morbidities. In 2003-04, there were 12 reported pediatrics deaths, and since then, an average of 2.6% deaths have been reported each year with the exception of the 2009 influenza pandemic.[30]

Colorado had a higher influenza vaccination coverage (52.8%) compared to Georgia (29.9%) during the influenza season of 2009-10.[32] In the same year, the rate of pregnant women vaccine uptake in Colorado was 44.2%, while that in Georgia stood at 28.4%.[32] Efforts during this season were targeted to increase influenza vaccine uptake throughout the state. These efforts included collaborations with Obstetricians and Gynecologists among the local and state agencies.[32]

Pertussis Epidemiology in Colorado

Infants are more vulnerable and had the highest rates of infections compared to other populations. Children start receiving pertussis vaccine at the age of two months based on CDC's ACIP recommendation.[33] State and local health departments, with the support from the federal government, have made concerted efforts to decrease transmission of pertussis with some good results. In early August 2012, Colorado reported 735 hospitalized patients suffering from pertussis compared to the 160 patients admitted for pertussis infections in 2011.[34] However, data from the Colorado Department of Public Health and Environment shows a consistent drop in the incidence of pertussis infection from 2012 through 2017. In 2012, 1,432 (28.0%) cases were registered, the same numbers were observed in 2013 (28.0%), while in 2014 the reported cases dropped down to 1,258 (24.6%). In 2015, the incidence declined to 914 (17.1%) cases. In 2016, the number of cases dropped significantly to 591 (11.0%) and increased slightly to 680 (12.3) in 2017.[35]

It was observed from the data that infants and children were the most affected segment of the general population. Also, counties within the state were disproportionally burdened with this disease through the increased incidence and hospitalization. Boulder, Adams, Broomfield, Jefferson, and Denver had attack rates of 50.9, 45.6, 61.1, 49.4, and 33.7 respectively.[35]

In Colorado, although Tdap (Tetanus, diphtheria, and pertussis) vaccine uptake for pregnant women is low compared to the Healthy People 2020 goal of 80%, it has been increasing in the recent past. Coverage increased from 40.6% in 2012 to 53.6% in 2013.[36] Childhood vaccine uptake within the state was higher than that of adults in the recent past in Colorado. State school policies required that children meet up their vaccination requirements as a prerequisite for enrollment. According to school and childcare immunization data from 2016-2017, DTaP coverage was 94.8%, surpassing the Healthy People 2020 goal of 80%.[37]

Significant socioeconomic and racial/ethnic disparities were observed for both infants' and maternal pertussis vaccination uptake. One study on Tdap vaccine attitudes and utilization among pregnant women among high-risk populations revealed that non-Hispanic Black women were less likely to receive the Tdap vaccine compared to Hispanic and Non-Hispanic white women.[38]

Influenza Epidemiology in Georgia

In Georgia, the incidence rate of influenza has steadily increased since the 2009 H1N1 influenza pandemic. According to CDC's pregnancy influenza surveillance system, there were 181 Intensive Care Unit (ICU) survivals and 37 confirmed deaths in 2009.[39] In the 2010-11 influenza season, the system recorded 69 ICU's survivals (all pregnant women) and ten deaths.[39] The incidence and case fatalities have increased in recent years. According to the Georgia Department of Public Health's weekly influenza activity report, there were 1,460 hospitalizations and 28

confirmed deaths in the 2014-15 influenza season.[40] In the 2016-17 influenza season, it was reported that the number of hospitalized cases increased from the previous season to 1,448 patients with nine fatalities. As of March 14, 2017, there were 24 reported outbreaks reported to the Georgia Department of Health. Most of these outbreaks were associated with the H2N3 strain and occurred in schools and long-term care facilities. This strain severely affects children under five years of age.[40] The recent reduction in the number of cases was due to increased surveillance, management, and control of the disease; however, most of the observed fatalities and hospitalizations were pregnant women and children under the age of six months.[41]

Although influenza vaccine recommendations were made during the 60s, influenza vaccination uptake among pregnant women in Georgia remained low compared to other groups. General vaccination coverage is steadily increasing. According to the CDC's MMWR (February 2012), Georgia had 29.9% influenza vaccination uptake. CDC's 2012-13 influenza season report on vaccination uptake in Georgia showed 50.5%. There was an increase to 52% in the 2013-14.[42]

Racial/ethnic disparities in influenza vaccination have been observed. Research on persuasive messaging on influenza decision-making processes among ethnic disparities showed that 40% of non-Hispanic black women received influenza vaccine during pregnancy compared to 49% pregnant Hispanic women and 48% pregnant non-Hispanic White women.[24] Some reasons for low vaccine uptake were linked to adverse vaccine attitudes, bad experiences with vaccine providers, concerns on vaccine effectiveness, safety, and lack of trust of public health agencies.[43]

Pertussis Epidemiology in Georgia

Pertussis coverage in Georgia was similar to that of the national level. In 2005, Georgia had the lowest number of reported pertussis cases among the ten most populous states, and the

trend of the disease increased after 2005. In 2009, the attack rate of pertussis was 2.3% (230 cases per 100.000 population) compared to 0.5% (79 cases) in 2005. According to the CDC National Notifiable Disease Surveillance System (NNDSS), 32,971 cases of pertussis were clinically confirmed in 2014; cases declined in 2015 and 2016 (20,762, and 17,972 cases respectively).[4]

To reduce infants' exposure to Bordetella Pertussis, parents must receive a Tdap vaccination during pregnancy or postpartum. Research has shown that Tdap received during the third trimester of pregnancy confers stronger immunity than postpartum vaccination. All siblings and household members who anticipate coming into contact with infants should also be vaccinated, as transmission factors such as household density and siblings contribute to infants' morbidity and mortality.[44] Children from unvaccinated parents are at higher risk for contracting and developing severe pertussis complications that lead to hospitalization and death compared to children born from vaccinated mothers.[45] Some studies have demonstrated that herd protection does not work effectively for pertussis and the reasons for this is still unknown.[45]

In Georgia, before ACIP extended its recommendation to include pregnant women in 2012, the overall vaccination rate of Tdap ranged between 2.6 to 10%.[46] According to the MMWR (May 22, 2015), Tdap vaccine uptake among pregnant women from September through December 2011 increased to 40.5%. The women took this vaccine at different periods: 9.2% received the vaccine before pregnancy, 6.8% during pregnancy, and 24.6% after pregnancy.[47]

ACIP Recommendations on Vaccination

Influenza

CDC's ACIP and ACOG recommend that all adults receive influenza vaccine annually, and women who would be or are pregnant during the influenza season should receive the inactivated influenza vaccine during the second or third trimester of pregnancy, or at any time

during pregnancy.[19,48] Due to changes in the immune system, lungs, and heart during pregnancy, pregnant women are at increased risk of developing influenza complications such as pneumonia and other related complications that lead to hospitalization and death. Influenza is also harmful to the pregnant woman's developing fetus, including adverse health conditions such as fever and neural tube defects.[49] The influenza vaccine is a prerequisite for preconception, prenatal, and postpartum care, as having the influenza vaccine reduces the risk of illness by 40% to 60% during the influenza season.[49] Following this recommendation, the rate of influenza uptake among pregnant women has doubled since 2010, but significant improvements and efforts are still needed to achieve the Healthy People 2020 goal of 80% coverage.[50]

Pertussis

Research has shown pertussis vaccines (Tdap and DTaP) are the most effective strategy to protect people against pertussis and reduce the severity of the illness among those who have received the vaccine if they contract the disease. Faced with increased incidence of pertussis that has continued to strain the U.S.'s health care system, the ACIP and ACOG published recommendation guidelines for pertussis in 2006.[51] They recommend that all household members, friends and relatives who foresee coming into contact with an infant, should receive one dose of Tdap vaccine irrespective of the Tdap vaccination status two weeks before contact (cocooning).

Despite this preventive approach, recent data from national pertussis surveillance systems showed that the rates of morbidity, mortality, and hospitalization for this disease among infants and pregnant women were on the rise. This was as a result of low vaccination coverage of 46 - 55% compared to the Healthy People 2020 goal of 80%. Despite the proven benefit of protection provided by vaccination, the number of people who delay uptake of Tdap and DTaP vaccines was significant as was reflected in the national uptake rates. As a result of the continued pertussis

infections among infants and pregnant women, in 2011 the ACIP extended the recommendation of Tdap vaccination to include pregnant women in the second and third trimester of pregnancy. The vaccine could also be administered at any time during pregnancy. This was to provide passive immunity to the infants during the early phase of life until when they were eligible to receive DTaP vaccination or to reduce the severity of the disease if they contract it.[52]

Research on pertussis vaccines have shown that Tdap is safe for pregnant women. These women could take a Tdap vaccination at any time during pregnancy without any adverse effects for the child and the mother. The vaccine could also be considered at the postpartum period. However, some studies have proven that taking the vaccine during pregnancy provides better immune protection compared to postpartum immunization. Research findings show that vaccination during pregnancy has reduced annual infant pertussis incidence rates to 33% compared to 20% postpartum vaccination, reduced infant hospitalization by 38% versus 19%, and reduced mortality by 49% versus 16%,; further, the cost of annual life year saved for vaccination during pregnancy was lower compared to postpartum vaccination.[44]

Facilitators of Maternal Immunization

There are available structures to facilitate the immunization processes for pertussis and influenza. Although federal and state agencies do not mandate youth and adults to be vaccinated, there is national legislation such as the Omnibus Budget Reconciliation Act (OBRA), which created the Vaccines for Children (VFC) program to facilitate the production and administration of these vaccines. The ACIP is the federal government structure working in collaboration with the Secretary-General in the Department of Health and Human Services in developing national guideline recommendations on immunization. The Food and Drug Administration (FDA), a federal government structure, has the responsibility for approving and licensing vaccines. As vaccination

laws vary from one state to another, states have enacted ranging vaccines requirements for the entry into daycares, primary and secondary schools, high schools, colleges, the military and other professional institutions within the country. Also, there are recommended vaccines for pregnant women by the CDC's ACIP, among which are pertussis and influenza.[53]

Lobbying organizations and groups for and against immunization programs have been active in the past years. Associations such as ACOG have lobbied and advocated for better immunization policies and coverage as an effective public health intervention strategy to protect, promote, and assure health equity, especially for uninsured populations. Another vaccine advocacy group includes the 317 Coalition, which advocated for an increase of section 317 budget from Congress for the national infrastructural immunization needs. The American Academic of Pediatrics (AAP), the Program for Appropriate Technology for Health, and ACOG, among others continue to play a vital role in advocating for better health policies to promote public health through immunization practices to achieve the 80% coverage of the Health People 2020 goal.[54]

All states allow medical exemptions for vaccines, while 48 states also accept exemption for religious beliefs and 21 allow for personal belief exemptions. Research on vaccine preventable diseases has linked pertussis outbreaks to the states with high non-medical exemptions.[55] In addition, it was reported that there was an association between the administrative ease in obtaining non-medical vaccine exemptions and the rate of pertussis outbreaks.[56]

Since the 1990s, there have been a growing number of people with non-medical vaccine exemptions.[56] This increase coincided with the retracted article that linked the Mumps, Measles, and Rubella (MMR) vaccine to autism.[57] The high rates of non-medical exemption for vaccines have been associated with many vaccine preventable disease outbreaks. Many of these clusters of non-medical vaccine exemptions were linked to pertussis outbreaks in California.[58] In 2008, CDC

reported 131 cases during a measles outbreak, which doubled the yearly outbreak between the 2000 and 2007. CDC experts argued that this was not due to an increase in imported measles cases, but to an increase of transmission of imported cases among unvaccinated children whose parents did not want them to be vaccinated.[59] Advocates for vaccines argue that unvaccinated children posed a potential public health risk, as they can pass on infections to younger children and other vulnerable groups. Also, the vaccination rate for DTaP fell to almost 5% for children entering kindergarten between 2005 to 2010 as a result of non-medical expemtions.[60]

Despite scientific evidence that vaccination is the most effective strategy for disease prevention, there is a growing proportion of people who consider vaccines to be unsafe and unnecessary. Many studies have been conducted to investigate the complex socioeconomic and cultural factors associated with vaccine hesitancy. Some of the reported associated elements with vaccine hesitancy were linked to contextual factors (influences such as media, religion, social norms, policies), organizational factors (accessibility, and quality of services), and individual determinants (individual's knowledge and attitude, beliefs, and socio demographic factors).[61] Another study on behaviors and perceptions on seasonal H1N1 influenza vaccination during pregnancy reported more reasons for low vaccination coverage among pregnant women. The 813 postpartum women involved in the study, 25% of respondents mentioned lack of knowledge on the importance of the vaccine and 9% highlighted not knowing where to take the vaccine.[62]

Chapter 3
Materials and Methods

This research project was anchored on the lessons learned from the previous study of the P3 (patient-provider-practice) intervention, funded by the National Institutes of Health (NIH), and aimed to better understand the diverse and complex factors related to vaccine decision making among pregnant women in Georgia and Colorado. In-depth interviews were conducted to elicit more information from this population in order to refine the current P3 framework and develop a communication package for pregnant women to, ultimately, increase the uptake of recommended vaccines during pregnancy. The communication package that would be developed would be used by practices, various advocating groups for vaccines, and organizations.

Population and Sample

Study participants were pregnant women who met the following inclusion criteria: 1) be between 20-27 weeks of gestation for a subsequent pregnancy or at any gestation for a first pregnancy, 2) aged between 18 to 50 years, and 3) have not previously participated in the P3 study. Pregnant women were excluded from the study if they did not meet any of these criteria and were not from any of the selected practice sites within the two states. Data was collected from a convenience sample of a total of 45 participants from the two states who were classified in to three groups (vaccine accepters, vaccine hesitant, and vaccine refusals) on issues surrounding the perceptions, attitudes, and beliefs on maternal and childhood vaccination.

Research Design

The process began with the creation of the research protocol, in-depth interview guides, and other study materials. These materials were subsequently approved by the Emory University

Institutional Review Board (IRB). The sites were carefully selected to capture an array of racial, ethnic, and sociodemographic diversity among research participants as well as varying knowledge, attitudes, and beliefs on vaccines for pregnant women and children. Study recruitment was facilitated by the practices in both states; the research team had long-standing relationships with these practices from previous research. In-depth interviews were conducted by the research team with a convenience sample of pregnant women from the selected sites in partnering urban and suburban obstetric/gynecologic practices in Georgia and Colorado in 2015.

Study Instruments

The research materials included the screening form (inclusion/exclusion criteria checklist) and a semi-structured, in-depth interview guide developed based on the elaboration likelihood model basis (ELM) and previous research conducted on the subject.

Procedures

With approval from the practices, research staff approached pregnant women in the waiting areas. After gauging their interest in participating in a study on maternal and childhood immunization practices, study staff assessed potential participants for eligibility based on the predetermined inclusion criteria (age, previous participation and pregnancy status) on the screening form. Eligible participants were then grouped into one of the following based on their screening responses: 1) vaccine accepters, 2) vaccine hesitant, or 3) vaccine refusers. No personal health information or other identifying information was collected for the participant at this time. Participating healthcare providers at the partnering practices followed similar procedures.

Ethical Considerations

If the participant was interested and met the inclusion criteria, research staff had the potential participant review the informed consent (or it was read to them as needed) and ask any clarifying questions they may have about the study. Following this discussion, study staff obtained written informed consent. The participant was then engaged in an in-depth interview. Interviews with pregnant women were aimed toward generating discussions about attitudes, beliefs, and behaviors related to immunizations for pregnant women and children. Interviews with healthcare providers were geared towards generating discussions about patient perceptions about vaccines, knowledge on vaccine preventable diseases, vaccine safety, the impact of vaccines on practice workflow, time required to provide additional counseling on vaccination, and preferred messaging content and format to best communicate effectively and efficiently with pregnant women. A $25 gift card to either Target or Wal-Mart was offered to each participant for completing the interview.

Data Analysis

The interviews were transcribed, coded, and analyzed using NVivo 11.0 qualitative data analysis software (QSR International). The data was analyzed using the comparative approach within the grounded theory process model[63] that employs deductive and inductive approaches to identify major themes in the data.[64] All interview transcripts were coded following an established codebook, and these codes were further refined through a series of iterative cycles.

Random samples of transcripts (20%) were cross-coded in two rounds to establish the codebook structure and determine the extent of intercoder agreement on coding and subsequent definitional refinement. Intercoder reliability (ICR) was ultimately established by comparing the presence or absence of codes in a subsample of text from each interview. Disagreements in coding

resulted in team-based discussions and subsequent codebook refinement, followed by additional coding and adjudication when appropriate. In a third round, the team established overall agreement between coders at 84.3%, suggesting high overall ICR consistent with good qualitative research practice.[65] Finally, nodal correlation assessment for validation of coding and thematic convergence using Pearson's R across major codes was conducted.[66] Codes that met high correlation coefficient standards were included (e.g., $R \geq 0.80$) to validate the identified code relationships, and thematic findings were then summarized.[67]

Chapter 4
Results

Thirty-four research participants from Georgia and Colorado met the current study's criteria. The significant themes that aligned with the socioecological model (SEM) were identified from the data. A subset of varying themes was also identified from each topic including 1) beliefs and values, 2) central route processing, 3) sources of influence, and 4) trust of information sources.

Findings
Beliefs and Values:

There were consensus and discordance in the findings of some of the identified sub codes among participants from the states of Georgia and Colorado which are highlighted.

Choice: Participants from both states agreed that pregnant women should have the choice to receive or refuse the vaccines recommended by ACIP and ACOG during pregnancy. Participants argued that it is their constitutional right to accept or refuse vaccines and do whatever they want with their bodies. A pregnant woman from Georgia said:

> *I mean, this goes back to your constitutional rights and religious beliefs. I say that, yes, they should have the right, but at the same time, if you refuse vaccinations for your child, then you should not expect to, I want to say "assimilate" your child with other kids that have had, taken vaccinations. So - more or less, I guess what I'm trying to say - I've had my child vaccinated. If he's in a class with other kids who've been vaccinated, no, I do not wish to have your unvaccinated child in that classroom.*

Most participants in both states agreed that mothers should decide whether their children should be vaccinated or not. They claimed that mothers know what is best for their children and have the sole responsibility to decide for their children in a culturally appropriate manner. Some differences, however, were observed among Colorado participants. They pointed out that women should decide for themselves on vaccination issues, but the decision to vaccinate their children

should be influenced by the concept of community benefit (e.g., herd immunity). They believed that many women would make bad choices that would have a tremendous impact not only on their own children but also expose other children in the community who are not able to get vaccinated (e.g., under recommended age, immunocompromised). One Georgia woman reported:

> *I believe you have the choice to raise your children however you would like. However, if it affects the health of other people, then...I think it's a society decision. So, if you keep your unvaccinated child – to an extreme, this is, like, clearly extreme, I wouldn't recommend anyone doing this, but, if you don't want to vaccinate your kids, then you really need to isolate them. Because, what if they got measles and polio? And then, I have kids who are too young to be vaccinated for those things, and they get exposed. It's not their fault they were not vaccinated, they just weren't able to – you know, they're too young, or people who have, you know, immunodeficiencies or are undergoing chemo therpay, they can't really benefit from the vaccines that they've had, so you're exposing people, too. So, it's – yes, you can do whatever you want with your kids, but you need to think about how it affects other people in the world.*

Another pregnant woman from Colorado added:

> *That's a touchy subject, because I feel like, while it would be very smart to, it's also kind of like telling someone what to do with their own body and their own child's body, that's – I feel like you'd get a lot of controversy over that, you know, and it would be a very big deal, and I can see a lot of people fighting it…so that's kind of a tough one, and I don't know if I could be the one to decide that, you know?*

Alternative to parents for individual choice, some participants from Colorado believed that childhood vaccination should be mandatory and parents should have their children receive all the recommended vaccines. A woman from Colorado stated:

> *How do I put this? I mean you, you're in control of your own body, you know? You can do whatever to it, but when it comes to your child, you should be able to take care of that child. And, if they're recommending vaccines, like I said, obviously, it's for a reason, so you should let your child get the vaccine. But yourself? You know, that's your body, and that's your decision.*

It was apparent that misinformation and misperceptions on childhood vaccines were one of the reasons for vaccine hesitancy among pregnant women in both states. Some participants were of the opinion that the adverse health outcomes from receiving all recommended vaccines exceed

the negative health events that may occur from not receiving the vaccines at all. Some of these participants thought that giving many vaccines to a child at the same time can lead to autism. A Georgia woman stated:

> *I have heard this – you know, I don't know how true it is, or I haven't done any research on it – I've heard that if you give your child too many vaccines, it can cause autism.*

Another woman from Colorado added:

> *Probably because they want to know 100% sure what's going into their bodies, or that because the side effects in their minds are a lot more scary than what could happen if they didn't vaccinate, and I don't always necessarily agree with why people wouldn't want to get certain vaccinations, but I can, at the same time, understand why, because that could change your whole entire life, you know?*

More so, it was clear that some participants from Georgia believed that childhood vaccination is important but giving many vaccines to a child at once is not a good idea. These participants planned to split up these vaccines and have their children receive them at different times. A participant reported:

> *They don't like it that for the first 12 months I did exactly what the doctor told me for my infant but now, with this next one coming up, I'm not going to do that. I want to split the vaccines up, from just – I don't think my child had any problems, and thank God that she didn't, but I sometimes feel like they have too many vaccines to give to the children all at once, to the baby all at once…and fine, you know, if it works. But for me, I just want to kind of just split mine up a little more, just to space them out. Because a lot of times you'll go to a doctor's office and they'll say, 'Hey, this baby needs this vaccine, this vaccine, this vaccine,' and, if you haven't researched it, you'll just say 'Okay', but, the thing about it is, is that they can give it to you at one point when the child really doesn't need it until months later.*

Some participants from Georgia believed that mothers know and understand the needs of their children better than their doctors. They held the opinion that they do not always believe what doctors recommend for their children is right. They sometimes doubt some of the provider's recommendations and subsequently delayed vaccine uptake. One participant highlighted:

> *You know, a lot of people, they go by with what the doctor says. And, I mean, I'm not – who's to say that the doctors are right and I'm not, you know? But, my thing is, why pump them all full, with them being so little. Just space 'em out. Especially, like, hepatitis A, you're not supposed to have – you have your second dose at 2 years, but, like, what is it – 18 months? Something like that, don't quote me on this part, but I'm just talking in general, you know, like, 18 months they'll say, 'She's due for 3 shots.' Well when actually does she need this other shot? And then they'll say, 'Oh, she doesn't need it until she's 2'. Okay, well I can come back in 3 months, and get her the other shot, you know? And that's the only thing that, you know –I don't know why doctors are just like, 'give them all these shots'.*

Furthermore, some participants from Georgia believed that some vaccines, such as the influenza vaccine, are optional and not mandated or required. They thought that those "optional" vaccines should not be provided to children and pregnant women. One pregnant woman stated:

> *Some of them are, well, not required, but…I know that…I don't know how to say it. I just know that some of them are…they're not required. I know I have the right to refuse them, but they are strongly recommended at different stages of infancy. So I do consent to those. The ones that are, I don't want to say "optional" like the flu vaccine. Sometimes I wait on those, depending on whether or not my child has an increased exposure rate. But the general vaccinations that they receive at, what, one, three, at those milestones, I have not refused. I will allow them to get vaccinated.*

***Protection*:** There was a consensus among participants from Colorado and Georgia on vaccine protection. Participants believed that vaccines protect children and pregnant women from contracting diseases or reduce the severity of the illnesses and generally agreed that the potential benefit of vaccines outweighs the adverse effects. Some participants from the two states highlighted that children are more vulnerable and susceptible to infections, as their immune systems are not developed so protecting them through vaccination was primordial. More so, some participants highlighted that while many children are unvaccinated, vaccinating their children reduces the chances of contracting diseases in public places like schools. Participants generally accepted that children should receive recommended vaccines if they were truly necessary and recommended by the practitioners. A woman from Colorado stated:

> *I think that they're just as important. I mean, I grew up with asthma, so protecting my child against the flu, where he could end up getting lung problems, is important to me. And I think that, like I said before, the benefits definitely outweigh any potential risks.*

There were, however, some differences on how women from the two states perceived the importance of the vaccination of pregnant women in regard to the child's health. Participants from both states agreed that vaccines received during pregnancy prevent pregnant women from potential infections and prevent further transmission of the diseases to the fetus. Some participants from Colorado went further and stated the importance of maternal vaccination in protecting children from comorbidities or preventing severe complications if they were infected. They believed that vaccinating pregnant women not only protects them from diseases, but it also transfers immunity to their infants that protects them during the early weeks of life and also reduces the severity of the disease if contracted. One pregnant woman from Colorado mentioned:

> *This is actually the information that, from multiple sources I found myself, to know that baby and moms share antibodies during pregnancy as well as immediately after birth. So, I can pass on antibodies to my children, then they have that little bit of immunity. So, they're more likely to - if they do happen to come across the whooping cough, if they do get sick with it, they have a better chance of getting through it, without all the serious issues. You know, just like we do with the flu.*

Women from Colorado were also more aware of the morbidity and mortality caused by vaccine preventable diseases among children compared to participants from Georgia. These Colorado women highlighted the numerous childhood deaths caused by vaccine preventable diseases like influenza that would have been prevented by vaccination. One woman argued that parents that were more hesitant about childhood vaccinations should not be given the choices to decide on the health of their children, as they were more likely of making bad decisions:

> *Well, if you look at it, I mean there's kids that die around the world all the time from the flu, from something as simple as the flu, and, you know, we have a vaccine that can help protect them from it. So, especially for my child, being as young as he is, and being so*

> *susceptible to the negative effects of it, I think that being able to protect him from that is definitely a benefit. I don't think people see how serious an illness these actually are.*

Most women from both Georgia and Colorado indicated that their baby' safety, child and maternal health, the desire to have a healthy child, and the protection of their unborn baby were the most important factors they considered when making a health decision during pregnancy. Some women were hesitant to vaccinate during pregnancy, as they thought that it might have an adverse effect on their unborn baby in one way or another. On the other hand, some participants were more willing and open to vaccination to protect themselves and their unborn baby.

Science of Vaccines: There were mixed perceptions about the science of vaccines among women both across and within states. Many respondents from Colorado did not believe the vaccines were truly safe, indicating that they could not fully trust the information provided on vaccine safety for all available vaccines. These participants also added that they were more hesitant if the vaccines were newly developed, as there is little to no information available on the vaccine's safety. Additionally, many Colorado women worried more about the potential adverse effects of a vaccine than its benefit, believing that the potential adverse effects far outweigh the potential benefits. A pregnant woman from Colorado cited:

> *That's like, the main thing I worry about. What the side effects are, and long term effects, you know, that maybe they might not have the clearest idea about. I mean, I'm sure they've done a lot of research and everything, but it's just hard to tell, like I said, if you're gonna be one of those few that ends up it hurts more than it helps, you know. But I think the overall risks are a lot more worrisome about not getting it at all, for the most part. As far as, like, the more serious ones, you know? Like polio…so, I do worry about them, but not necessarily enough to where I wouldn't get them.*

Although some Georgia women believed in the science of vaccines, some were skeptical. These women felt that vaccines do not provide protection but rather cause the disease (e.g., the influenza vaccine causes influenza instead of protecting against it). One woman explained:

'Cause don't it give you the flu? Yeah, but they say it give you – it gets them sick, though.

Another pregnant woman highlighted the concern around using animals in testing for the efficaciousness of vaccines, that animals have a different system than that of humans. She stated:

> *The reason why I think certain flus are safe and not safe is because not all of them are tested as well, for the ones that are tested, they are testing it for other animals, and not mainly tested on humans, so that's different bloodwork for different animals and humans. And for the ones that are tested on humans, they have a positive or negative reaction to the blood in your system.*

Some woman thought that incorrect information on vaccine safety and benefits were provided through the media and other channels to attract good publicity for vaccine sales. They believed that companies involved in vaccine production were more concerned about making money than public health promotion. One participant highlighted this:

> *I mean, just because there's a lot of, you know, there's a lot of research that says they're safe and everything, but I don't, I don't necessarily trust the politics of everything. I don't know who's paying who, I don't know anything like that and so, you know, I don't know if they're lying to make more money, to sell more vaccines. So, just until it's more concrete, I guess, which it may never be. But, like I said, I guess, if I needed it, I'd get it.*

Furthermore, some pregnant women from Georgia were concerned about the link between vaccine and autism. They acknowledge that although science has not proven that vaccines were a cause of autism, it was still the main issue of concern for many people in their communities. One participant from Georgia State reported the following:

> *I mean, I do worry about the autism thing, is the big issue, and it's not been proven, but still, it's a threat that it could happen, so...I don't fully believe it, but there's, you know, there's a chance and I'd rather not take it until later, when she's developed a little bit more.*

Sources of Information and Influence

There were similarities and differences between Colorado and Georgia women on the most important sources of health information for mothers and infants during pregnancy or postpartum.

***Healthcare Providers*:** Many respondents from both states indicated that their primary source of health information during pregnancy was their healthcare providers. These participants generally fully trust these providers and the information and recommendations that they received from them. Some participants emphasized that other sources of information, as the Internet, were very unreliable, and contain a lot of faulty information. Highlighting the accuracy, they perceived of the providers. One woman from Georgia mentioned:

> *My doctor's a medical expert, and they're not going to recommend anything that isn't good for me, I think ethically, they wouldn't do that, and, frankly, legally they wouldn't do that, wouldn't put themselves at risk. So, I know that they're not going to encourage me to do anything that would hurt me or the baby. Because, too, I think, you know, generally the doctors who practice this also care about pregnant women and their babies.*

Another participant from Colorado added:

> *Most of what I've found out has been on the internet, but I know that's such an unreliable source, and so, like, just my doctor. She's really been, like, kind of my pregnancy bible. Yeah, I really have a lot of confidence in her.*

Some participants indicated that the information provided to them through consent forms, leaflets, brochures, medication labels, and pamphlets were the primary sources of their information. They added that providers do not give detailed information about vaccines and other services provided during pregnancy. One woman from Colorado explained:

> *That sheet of paper they always give you right before they give the vaccine. It tells you what they're preventing, and it tells you some of the side effects, and like, what's the risk.*

Some woman from Georgia, however, trusted neither their providers nor the vaccines. They argued that the providers did not know enough about the woman's background, body, and medical history from as far back as their own infancy. These pregnant women believed that providers give services only based on their experiences and education. One respondent said:

> *Two physicians could prescribe two different medication to treat the same ailment that could cause a drug reaction with a negative health outcome on the patient.*

Another pregnant woman reported:

> *The least would be my doctor, I choose my doctor the least. Because they don't know me, and they don't know my body, they wasn't with me through the whole time I was a baby, all the way up – because you go to a different doctor, they give you different opinions about what you should eat, what's more healthy for you. So that's why I'd choose that as the least.*

Another woman explained:

> *I don't trust the flu shot, I mean they just brought it – they just brought the flu shot out, like, five years ago. 'Cause when I was a kid, I don't remember the flu shot ever being out there much. Ah, that Tdap – especially for that whooping cough, no, indeed, that's a bad excuse. I don't need that. To me, personally, I don't need something that's going to stop me coughing, if that makes any sense, 'cause I feel like when you cough you're trying to access whatever's in your throat or whatever, and you're trying to remove whatever's inside.*

***Online Sources*:** The second reported source of trusted information reported was the Internet. Some pregnant women from both states indicated that they research on the Internet for valuable information during pregnancy. However, there were differences regarding the types of sites used. Respondents from Colorado reported using only Google and apps for vaccine related information. One woman reported:

> *I do, on my phone. I go to Google and ask Google every single week, like, what I'm supposed to be looking at, looking for. I have that app on my phone. It calculates your whole pregnancy, tells you what you should do.*

Some women from Georgia, on the other hand, reported relying on "mommy blogs" and other pregnancy sites (e.g., The Bump) for all the information they need. Others indicated they may use media channels, books, government websites (e.g., CDC, the National Institutes of Health (NIH)), WebMD, and the Mayo Clinic site.

> *It was more of the Moms saying, "if you don't want to get it, you have the option of telling the doctor 'no'. It's your choice". Basically, that was mostly what the mommy blogs were saying.*

> *Research would be, mainly, just really sitting down with the pediatrician, and talking out the risk benefits of the vaccine. I also go to National Institute of Health, so NIH.gov, and CDC I'll look at. The websites. I trust those websites.*

***Social Networks*:** The third most reported source of influence for pregnant women was close family members and friends, especially spouses and parents. Respondents from both states knew people who had either been positively and negatively impacted by vaccines. Parents and spouses exerted the greatest impact. A woman from Colorado mentioned:

> *It was, for my daughter, her dad didn't want her to get vaccinated. Because of the whole thing with vaccinations causing children to be autistic.*

Another responded added:

> *My mom was more…she didn't tell me why, she'd just always tell me "You have to get them before you go to school, you have to do this, you have to do that." So, that was just - that's how I took it. It's something that I have to do.*

Known History of Vaccine Reaction: The fourth most reported influence for pregnant women from both Georgia and Colorado on vaccine uptake for pregnant women was a history of an adverse vaccine reaction for a family member, a relative, a friend, or someone they heard about in the community. Some respondents reported that their family members or someone they knew had an adverse health event after vaccination. A woman from Colorado said:

> *My dad has gotten a flu vaccine that he thought gave him the flu. I wasn't necessarily convinced that he had the flu, but...*

Another pregnant woman from Georgia added:

> *I mean, people always say about 'my neighbor, who's son's soul left their eyes when they got the MMR vaccine, and they were diagnosed with autism,'…I don't think so.*

Peer Influence: Women from both states agreed that peer influence plays little to no role in their decision-making process on vaccines. Although they were willing to hear what others think, they reiterated that they make the final decision for their own child. One woman from Georgia stated:

> *If my friends are talking about it, that's not a reason to get a vaccine.*

Another pregnant woman from Colorado added:

> *I don't really think it impacts me that much, because like I said I'm not worried about what they're doing with their children, I'm worried about my child, and what I can do to protect him. And, you know, if I can help someone to make a decision – an informed decision about - with their child, then I think that's definitely a plus, but…*

Elaboration Likelihood Model (ELM)

Previous Knowledge and Opinion: Many participants from both states were not fully aware of the recommended vaccines for children. While there was consensus among respondents that children generally receive vaccines that protect them against infections (e.g., polio, hepatitis B, and measles), few women were aware of influenza and pertussis vaccines or vaccines recommended during pregnancy. A respondent from Colorado reported:

> *They get polio, chicken pox, diphtheria, and the hepatitis B, hepatitis A…*

Another woman from Georgia added:

> *I would guess a lot of them. Chicken pox – because if somebody has it, they can spread it, mumps, whooping cough, maybe? Isn't that pertussis, something?*

Some Colorado women believed that when women practice exclusive breastfeeding, the infant vaccinations were potentially unnecessary, as breastfeeding would protect child against infection. One pregnant woman explained:

> *I read that if you're breastfeeding, it's not 100% necessary to get it. And so, that's something, you know, that I was going to talk to the doctor about, and just see what she has to say.*

There was also consensus among both Georgia and Colorado women concerning recommended vaccines during pregnancy. Most of these women were not aware of the vaccines recommended during pregnancy. Although a few respondents from Georgia mentioned either the influenza or the pertussis vaccine, no one mentioned both vaccines. One-woman Colorado said:

> *As far as during pregnancy I hadn't heard anything, so I don't know anything about that.*

Other respondents from Georgia added:

> *In pregnancy, I don't really know about the benefits, other than the flu shot keeping you from getting the flu.*
>
> *I know you're supposed to get the the vaccine for pertussis, or whooping cough, I'm not sure if those are the same things or not, but I don't know if you get it when you're pregnant, or right after the baby's born, so that might be one.*

Central Route Processing: Many respondents from both Georgia and Colorado were unaware that getting the pertussis vaccine during pregnancy provides passive immunity to the infant during the early weeks of life. These women added that they were also unaware of the recommendation that anyone who may come in contact with the infant should also be vaccinated. Some pregnant women from Colorado stated:

> *I mean, it makes a lot of sense, because it's like, you could get the baby vaccinated all day, but if she comes into contact with someone that wasn't, and they had it, you know, she could still be greatly affected. And so, I understand, and I could even recommend it, but I don't think I'd be mad if, say, my mom didn't want to do it if for some reason she hadn't already. And I wouldn't tell her she couldn't come around the baby, but that would, I guess, make me cautious.*
>
> *Honestly, when you asked me 'Who else would you recommend for the whooping cough?', I didn't even think about other people that would come in contact with her. Like, that wasn't even a thought – an initial thought in my mind, so, that did kind of make me think.*

Some women, after reading the ACIP recommendation provided to them, were still not convinced and were hesitant to get the pertussis vaccine. On the other hand, some respondents from Georgia were more willing to get the pertussis vaccine after reading the recommendation. They indicated that the language of the recommendation was informational and persuasive. One woman from Georgia State explained:

> *It sounds like a good idea. It's nice that the vaccine passes to the baby and they have it immediately upon birth, and the fact that caregivers are supposed to get it, I think that's a good point, because if somebody is around the baby a lot, like, the dad, for example, it seems like a good idea that they should be vaccinated, too.*

Other respondents from Georgia, however, believed that the language of the recommendation for the pertussis vaccine was not persuasive enough. They indicated that the language could be improved to make it more appealing and convincing by adding information around potential adverse health events of not getting the vaccine during pregnancy for both the mother and infant. One woman stated:

> *I think it would be helpful to list or at least include one or two examples. Or adverse effects. Like, failure to vaccinate your child with whooping cough potentially exposes them to these side effects…So I think it would be more, I guess persuasive and convincing I guess, because I know a little bit more. I can relate, but for someone who's on the borderline I think it may help to further convince or validate the physician's point if it includes some of the - what's the word I'm looking for - some of the harmful effects if you fail to vaccinate.*

Trust of Information Sources: Generally, respondents from both states agreed that providers are the trusted sources of health information during pregnancy. They indicated that their providers are experts and professionals who have had training in the field. Some women noted:

> *I mean, you want someone who has gone to medical school and has medical training to evaluate something for you, and you come to them for their expertise. So, if they've gone through all this training, and been in practice, they probably know what's gong on, and what the current research shows is good to do. So, they're kind of experts. You're, essentially, getting an expert opinion.*

> *The one in the doctor's office, I just don't think they'd put up something they didn't endorse. Also, in the books, I read books I feel confident about, so I don't feel like those things would be in there if it wasn't okay, given that the books I read are generally written by medical doctors. So that's why I feel pretty confident about it, because it comes from reputable sources, or what I perceive to be reputable sources.*

Limitations

As in all qualitative studies, the findings of this study cannot be generalized to broader populations of pregnant women. However, the study provides an in-depth understanding of factors that promote and hinder maternal and child vaccination that could be used to develop interventions geared to increase vaccine uptake for both pregnant women and children. Recall bias is another limitation of the study, as respondents depended on recalling past experiences on vaccine uptake

and other issues surrounding vaccination. This means of data collection is susceptible to bias, as participants may not recall the exact experience or may not want to report the exact events or experiences.

Chapter 5
Discussion

The results of this study provide valuable information on the contextual, interpersonal, and operational factors that are aligned with the socioecological model and may be critical in improving maternal and childhood vaccine uptake. The results also provide unique information on the similarities and differences of influenza and pertussis vaccines uptake across and within Georgia and Colorado. Further, the overall findings offer insight on the barriers to vaccine uptake, which could be used to develop programs to promote childhood and maternal immunization by improving communication materials, reducing false information and beliefs about vaccines, improving provider and patient communication approaches, and using all available appropriate channels to disseminate vaccine information.

The study found that participants from both Georgia and Colorado agreed that women should have the right to decide whether to accept or refuse the vaccines recommended during pregnancy and early stage of their infant's life. However, some participants from Colorado disagreed, believing that some women were likely to make poor decisions around vaccination and should therefore not have the latitude in making vaccination choices for their children, as their choices affect not only their children lives but also those around them. The belief that some women would make poorly informed decisions stemmed from the belief that many women had received misinformation on vaccines from the Internet and other sources in their communities. This idea that women should have the right of choice to accept or refuse vaccines has been found in other similar studies. However, the belief that some women should not have the right to choose regarding their child's vaccination has not been previously discussed in the available literature. Women's education on the importance and functions of influenza and pertussis vaccines is essential to reduce

the level of vaccine hesitancy among those who choose to delay or refuse vaccines. Increasing access to educational materials on vaccines for pregnant women during their first antenatal visit would help to reduce this information gap.

It was clear that misperceptions on vaccines' functions were one of the primary reasons for vaccine hesitancy in both Georgia and Colorado. Many respondents believed that the potential adverse health outcomes from receiving a vaccine were greater than the health impact of not receiving it at all. Many of these women believed that the adverse side effects of these vaccines are greater than the benefits. In Georgia, some respondents thought that vaccines such as the influenza vaccine caused the disease it was to supposed to protect against. Counteracting these misperceptions with the right information in the vaccine's communication package and other vital tools (e.g., posters and flyers in public places and healthcare practices) would be valuable in increasing vaccine coverage among pregnant women.

Another misperception, particularly among women in Georgia, was that vaccines such as the influenza and pertussis vaccines are optional and not recommended. Some of these women failed to perceive the severity of these diseases, stating that vaccines for severe diseases like polio and measles were more critical and necessary. They were more likely to advocate for and have their children receive these vaccines for "severe" conditions rather than for influenza and pertussis. Interventions by vaccine stakeholders have to be carried out to bridge this information gap, increasing awareness not only about the benefits of influenza and pertussis vaccines but also on the severe potential adverse health outcomes of not receiving these vaccines.

Pregnant women from both states generally understood that vaccines protect against pathogenic microorganisms and reduce the severity of the disease if infected. However, there were knowledge gaps among respondents. Women from the Colorado were more aware of the

importance of maternal vaccination in protecting their child through passive immunity from pathogenic infections during the early weeks of life, whereas many Georgia women emphasized that vaccines protect the individual who receives them. Colorado women also were more aware that vaccines reduce the chances of developing comorbidities as well as reduce disease severity if infected. They were also more informed on morbidity and mortality caused by influenza viruses nationally and beyond the U.S. compared to Georgia women. Narrowing this gap in knowledge for pregnant women in Georgia through increasing awareness on the functions of vaccines would improve maternal knowledge on vaccines as well as increase vaccine acceptance among pregnant women, children and close family and friends.

Women from both states mentioned the child's safety, maternal and child health, and the desire to have a healthy child as some of the essential factors they considered when deciding whether to receive a vaccine. Respondents felt that the safety of their children should be considered before making a decision. Some indicated they would hesitate to accept a vaccine if they perceived the risk of receiving it was more significant than the potential benefits to the fetus.

Some pregnant women in Georgia believed that too many vaccines are given to infants at one time. Although they highlighted the usefulness of these vaccines in protecting children against pathogenic infections, they thought that giving all the vaccines at the same time was not necessary. As a solution to this, some women planned to split up these vaccines so they could be given at different visits. This group of respondents believed that administering several vaccines at one-time lead to vaccine reaction that may ultimately cause autism in the child. This trend of thoughts was also observed among some Colorado women. This finding was in line with results of other studies, showing that some women maintain and perpetuate misinformation on the association between vaccines and autism. As a consequence, these beliefs not only delay these women's decisions on

receipt of appropriate vaccines but also perpetuates the spread of misinformation within their communities and leads to increased levels of vaccine hesitancy, which has enormous public health implications. More pregnant women and children are made vulnerable through increased risks of exposure, which increases the public health challenges of controlling and managing these diseases.

Participants from both states expressed disbelief about and lack of trust in some of the available information on vaccine safety. They indicated that for newly developed vaccines, there were often scant or no available resources about the vaccine, which influenced their decision-making process for vaccine uptake. These respondents worried more about vaccine side effects, placing more value on potential adverse effects than potential benefits and often delaying or refusing vaccines for this reason. The beliefs around adverse effects of vaccines found in this study are consistent with findings of other related studies. However, the finding of little or no available information on new vaccines was not found in available literature. Future studies should therefore be conducted in this area to provide more information and insight.

Some respondents from Georgia believed that vaccines such as the influenza vaccine cause the disease that it is meant to protect against, which is consistent with previous studies. Some women stated that they did not know of anybody who contracted influenza after receiving the vaccine but mentioned of rumors as the primary sources of information about the topic. Education on vaccine function and importance should target this population to address this misinformation and misperception. Additionally, identifying influential members of the group to work as immunization champions could be essential in minimizing vaccines myths.

Some women in Georgia also did not believe in the efficacy and effectiveness of the influenza vaccine. It was cited that the science of the vaccine effectiveness through animal testing did not provide sufficient evidence on its efficaciousness. These women were more likely to refuse

the influenza vaccine. This finding was not identified in other literature, so more research could further examine the topic. Some Georgia women. also asserted that false information on vaccine effectiveness and efficiency was propagated through the media. They believed that companies and other stakeholders involved in the vaccine production propagate this data to make a profit rather than for the public health benefit. These women mistrusted vaccine information channeled through the mainstream media. Some published research findings documented this belief. This has public health implications – educational messages on vaccines that stimulate vaccine uptake behavior should be available in healthcare practices and other locations, as mainstream media may not be the most appropriate channels for these women.

This study also found consensus among pregnant women from both Georgia and Colorado that healthcare providers were often their primary source of health information. These participants generally trusted and relied on the provider's recommendation. It was also observed that women who received vaccine recommendations from a provider were more likely to get vaccinated compared to those who did not receive a provider's recommendation and offer. This finding is consistent with other published data. This study also identified that this group of women were aware of other sources of information, like the Internet, and they generally believed that these sources were not always unreliable. Some of these women highlighted the importance of some secondary sources like vaccine summary sheets, consent forms, brochures, flyers, and pamphlets as important sources of vaccine information. Government agency websites (e.g., CDC, NIH) and maternal health sites and apps were also cited as valuable sources of health information for some women. Immunization stakeholders should work in collaboration with these agencies to upload vaccine related information on these sites. After reading the ACIP recommendation, women from Georgia were more inclined to receive a pertussis vaccine compared to women from Colorado.

However, some pregnant women from Georgia felt that the recommendation was not persuasive enough and it could be improved by adding potential adverse health outcomes if the vaccine is not received. No articles reviewed discuss this finding; therefore, the ACIP vaccine recommendations should be reviewed during provider recommendation with pregnant women.

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Appendices

A Comprehensive Pre-Natal Intervention to Increase Vaccine Coverage

P3Plus – Pregnant Women Semi-Structure Interview Guide

Interviewer Script:

Hi, my name is _____ and I will be speaking with you. Thank you for being a part of this study.

The purpose of this study is to learn more about the pregnant women's attitudes and beliefs about vaccines and what motivates their decisions about it. We will be talking about seasonal flu and Tdap vaccines for pregnant women and also about the infant vaccines. This information will help us to improve how your health providers can better address your concerns about vaccines and provide further information to you.

Your participation is completely **voluntary**. You may choose **not to participate** or **not to answer** any specific question. You may **ask to skip** any question you do not wish to answer. There is no right or wrong answer. Please answer each question as honest as possible.

All answers will be kept strictly **confidential** and will **not** be linked to any personal or contact information. All of the information that you share with us will only be accessible to the members of our research team.

With your permission, I would like to **record** our conversation in order to make sure that later on we do not miss any important points in the analysis. Is that all right with you?

Do you have any questions before we begin?

- How many weeks (or months) have you been pregnant?
- Is this your first pregnancy?
- Do you know if it is a boy or girl?
- Have you experienced any challenges with your pregnancy?
- Have you received any immunizations since being pregnant?

PART 1: Elicitation of Information on Beliefs, Attitude and Immunization Behavior in the Context of Values and Motivational Factors

1. What are the most important factors you consider when you are making health decisions in pregnancy? **PROBE:** about mother, fetus and infant. Ask them to **rank** the reasons by priority.
2. What do you know about vaccinations in pregnancy and vaccines for infants? **PROBE:** about categories of information, such as intent of the vaccine, safety issues, importance of receiving, quality, etc. - Separate by those for the mother and those for the infant

3. Tell me about a time when you decided not to receive a vaccine that was recommended to you by your health care provider. Can you tell me what went into your decision to decline, including safety, quality, values, etc.?
    a. Have you ever refused a vaccine for another child/family member and what are the reasons behind the refusal?
4. Would you get a vaccine for your infant? Why? Why not? (Ask by category :quality, safety, recommended or not, peer influence, etc.)
5. Do you believe that vaccines are safe? **PROBE**: kinds of illnesses shots prevent, side effects, immunity development through shots, are there too many/too few shots, fear that shots might not be as effective in preventing disease etc.
    a. Follow up questions for each vaccine if required.
    b. Ask them to rank the reasons
6. Do you know anyone who had a bad reaction to vaccines?*
    a. Ask who that person was, what vaccine, when they received it, and if there was any follow up regarding the negative reaction.
7. Do you believe that your child should receive the full mandated vaccine schedule? (Describe full schedule to the respondents and then ask why and why not)
8. Do you believe some mothers should have the choice of NOT to vaccinate themselves and their children? **PROBE:** the reasons for Why? And Why not? Remind them of specific vaccines if necessary.
    a. So based on your prior responses, would you rank 3 main reasons for you to decide (or not) to get the vaccines? **PROBE:** about factors/concerns that motivate or demotivate her.

PART 2: Elicitation of information on readiness to make change within Stages of Change Framework

1. Have you thought about getting vaccinated? Getting your infant vaccinated?
2. When did you start talking about vaccines during your pregnancy and how was that conversation initiated? **PROBE:** who did you have these conversations with? (friends, mother, partner)
3. Would you consider being vaccinated? What concerns about your health in pregnancy do you want addressed before you consider it? What concerns for your baby do you want addressed before you consider it?
4. Have you taken any specific action on getting a vaccine for yourself and/or for your child? **PROB**E: have you been vaccinating in previous years? Talking to your doctor? Took an appointment? Read more literature?
5. Overall, how hesitant about vaccination in pregnancy would you consider yourself to be on a scale of 0 to 10, where 0 represents no concern and 10 represents definite concern?* **PROBE**: reasons in detail.

6. Overall, how hesitant about childhood vaccination would you consider yourself to be on a scale of 0 to 10, where 0 represents no concern and 10 represents definite concern?* **PROBE**: reasons in detail.

PART 3: Elicitation of information on vaccination messages within ELM Framework

1. What are the most valuable sources of health information for pregnant women about their own health during pregnancy? About their baby's health during pregnancy?
2. Have you heard of any specific vaccines that are recommended during pregnancy for mother? For babies? **PROBE:** which vaccines?
3. Tell me what you know about the flu shot? Tell me what you know about the Tdap vaccine (whooping cough vaccine for adults)?
4. Where or from whom did you hear about the whooping cough or Tdap vaccine?
5. How much do you trust these sources of information?
6. I'd like to read you some information about recommendations for Tdap, the adult whooping cough vaccine, from the CDC.

[READ DESCRIPTION OF VACCINE RECOMENDATIONS DURING PREGNANCY]

> Pregnant women can help protect their babies by getting a whooping cough (or Tdap) shot during the third trimester of each pregnancy. Vaccinated moms pass their immunity on to their babies, which helps protect them as soon as they are born until they are old enough to start getting their own whooping cough vaccine. Family members and caregivers should also be up-to-date with their whooping cough shot to create a circle of protection around the new baby.

a) If you come across this information, what thoughts come to mind? **PROBE:** using certain categories (safety, quality, recommendations, etc.)
    i. Would you flip through it or read the fine details? Is there anything you would do as a result of seeing this information? **PROBE:** regarding types of interpersonal influence.
b) What does this say to you?
c) Are there any questions regarding the language (appropriate/easy to understand for women like them)?
d) What are some of the benefits of this vaccine during pregnancy?
    i. Follow-up with whether or not they believe the benefits to be true and if they resonate with them.
e) What questions or concerns do you have about getting this vaccine during pregnancy? What would be your top concern and why? **PROBE:** for concern about the fetus/infant versus concern about self.
f) If your doctor recommends a vaccine for you, would you get it for yourself? Would you get it for your daughter or son? **PROBE:** Protection for self vs. baby

7. We are developing a tablet based app for patients that provides information to women about vaccines in pregnancy and vaccines for infants. Which of the following names would you choose as a top choice for this app? Please explain your reasons.

   a. ShotTalk
   b. VaxApp
   c. VaxClarity
   d. Immunization Truths
8. Do you have any ideas of your own for a name for such an app?

Thank you for participating in this interview! Your answers will help us create informative and motivational messages for pregnant women.

CDC RECOMMENDATIONS FOR TDAP, THE ADULT WHOOPING COUGH VACCINE

Pregnant women can help protect their babies by getting a whooping cough (or Tdap) shot during the third trimester of each pregnancy. Vaccinated moms pass their immunity on to their babies, which helps protect them as soon as they are born until they are old enough to start getting their own whooping cough vaccine. Family members and caregivers should also be up-to-date with their whooping cough shot to create a circle of protection around the new baby.