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Vaccination Rates and Risk Factors Associated with Vaccine Compliance in Apartadó, Colombia

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Elon University
2016

Thesis Committee Chair: Dr. Juan S. Leon, Ph.D. MPH

An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
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Abstract

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Vaccinations are one of the most-cost effective and impactful public health interventions created; however, 1.6 million children die every year from vaccine-preventable diseases (VPDs). Low- and middle-income countries like Colombia have a higher-than-average burden of VPDs because of barriers to vaccine access, lack of trust in healthcare, and belief in alternative medicine remedies. The goal of this study was to evaluate the factors for vaccine adherence as it relates to children under 5 in Apartadó, Colombia by determining their vaccination status, compliance with recommended schedule, the duration of delay in vaccination, and risk factors for vaccine compliance. By conducting a secondary data analysis, this study evaluated vaccination status and compliance for 10 of the 12 vaccines recommended by the World Health Organization and the Colombian Ministry of Health. Multivariate logistic regression models were used to evaluate the socio-demographic risk factors that may be associated with vaccine compliance for each individual vaccine and overall vaccine compliance, where age-appropriate children were compliant if they received all 10 vaccines on-time. The vaccines that had the highest percentage who had received all of their age-appropriate doses were Bacillus Calmette-Guérin (BCG) (99%), hepatitis B (97%), and rotavirus (97%). Similarly, the vaccines that had the highest percentage of all age-appropriate doses received on-time were hepatitis B (96%), BCG (94%), and pneumococcal (92%). When determining the vaccines with the shortest duration for delay in vaccination, the first doses for the pentavalent and polio vaccines had the shortest time delay at 0.19 months each. None of the socio-economic demographics for caregivers had a strong association with overall vaccine compliance. Apartadó, Colombia has strong rates for vaccination status and vaccine compliance; however, public health researchers need to increase the number of children who receive all of their age-appropriate vaccines on-time.

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Chapter 1: Literature Review

Global burden of Vaccine-Preventable Diseases

Infectious diseases have historically been the cause of death and devastation worldwide, especially in countries and regions that have lower access to resources and prevention measures. According to the Children's Hospital of Philadelphia, "more than 1.5 million people worldwide die from vaccine-preventable diseases every year" (2020). One of the most significant public health interventions has been vaccines, which prevent morbidity and mortality from diseases such as measles, tetanus, varicella, and others in susceptible populations. Only clean drinking water is a more impactful public health intervention than vaccines (Andre et al., 2008). Vaccines are an incredibly impactful tool because not every person needs to be vaccinated to receive the effects of herd immunity, which is when a certain threshold of the percentage of vaccinated individuals within an area. When more individuals are vaccinated, fewer individuals get sick and less transmission within communities occurs. While vaccines possess a fantastic opportunity to save lives, they are ineffective without being administered into the body. Without this life-saving technology, we lose 2 million to 3 million people per year (CHOP, 2020); most of whom are children under 5 (UNICEF, 2005).

Vaccine-Preventable Disease and Children Under 5

While the number of children who succumb to vaccine-preventable diseases (VPD) has decreased substantially over the past three decades, there are still far too many children across the globe that have not received all of the vaccines required for their age (Vanderslott, 2018). We must find a way to increase vaccine coverage globally for all the necessary immunizations, especially for the most vulnerable children under five. Most of the vaccines recommended by the World Health Organization (WHO) are targeted toward children under five. The WHO recommends nine antigens for all children under the age of five: Bacillus Calmette-Guérin (BCG) against tuberculosis; hepatitis B, Polio, Diphtheria Tetanus, and Pertussis-containing (DTP) vaccine; Haemophilus influenzae type b (HiB); Pneumococcal; Rotavirus; Measles; and Rubella (World Health Organization, 2020a). Varicella, Mumps, and hepatitis A are recommended for children in certain regions and high-risk populations. By receiving all of the vaccinations at a young age, children under five are protected from infectious diseases that are damaging to their weak immune systems with potential life-threatening outcomes (CDC, 2019). While children under 5 are the primary populations targeted by vaccines, 1.6 million children still die every year from VPDs (CHOP, 2020).

Vaccine Adherence

Vaccine adherence in communities depends on many factors such as access to vaccines, vaccine hesitance, and trust in the safety and effectiveness of vaccines (De Figueiredo et al., 2020). Ten countries represent 62% of unvaccinated and unprotected children globally: Nigeria, India, Democratic Republic of Congo, Pakistan, Ethiopia, Brazil, Philipines, Indonesia, Angola, and Mexico (WHO & UNICEF, 2020). According to WHO and UNICEF data, the vaccines with the highest vaccine coverage are DTP, Measles first dose, and Rubella. A cross-cultural longitudinal study examined how perceptions of vaccine safety, importance, and effectiveness have changed globally from November 2015 to November 2018. Beliefs about vaccines being safe and effective increased slightly but remained relatively low (30-50%) in Europe throughout those three years (De Figueiredo et al., 2020). Researchers can make a similar observation within South America, where many countries decreased in their belief that vaccines are safe and effective over the past few years. Countries to note following this trend include Colombia and Brazil (De Figueiredo et al., 2020). In other countries like Japan and Indonesia, vaccination rate decreases stem from vaccine policy changes. Japan suspended Human Papillomavirus vaccinations after questions of vaccine and safety (Larson et al., 2014). Muslim religious leaders in Indonesia questioned the safety and ingredients in Measles, Mumps, and Rubella (MMR) vaccine (Rochmyaningsih, 2018). In Indonesia, these instances led to a decrease in vaccine adherence while increasing the number of people seeking natural alternatives to vaccinations or relying on natural immunity (Syiroj et al., 2019). While most global populations have high vaccine adherence, public health experts worldwide need to find a way to decrease vaccine hesitancy in communities.

Because most vaccines are targeted toward children under the age of five, parents are the drivers of vaccine compliance in children. Parents across the globe want what is best for their child; however, when they choose not to vaccinate, they leave their children and those in their community at risk for deadly infectious diseases (Phadke et al., 2016). In 2019, the WHO declared vaccine hesitance as a top 10 threat to global health (World Health Organization, 2019). Often, there is a misunderstanding about vaccines like the idea that the influenza vaccine may make the recipient sick with the influenza illness. This widespread belief cannot be true because the influenza vaccine is an inactivated virus, meaning there is no chance of sickness after influenza vaccination (Gallagher, 2019). While vaccine hesitancy is a common notion across the globe, “different factors influence vaccine hesitancy and these are context-specific, varying across time and place and with different vaccines” (Dubé et al., 2014a). The Strategic Advisory Group of Experts on Immunization (SAGE) Working Group Vaccine Hesitancy Model includes contextual influences (religion/culture/gender), individual and group influences (perceived risk/benefit), and vaccine and vaccination specific issues (introduction of a new vaccine) as the primary influences for vaccine hesitancy. Other than vaccine hesitancy, the effects of lower vaccine rates may be due to complacency, limited access to vaccines, language barriers, and lack of knowledge of significant health consequences when children aren’t vaccinated (Alvira, 2019).

Risk Factors and Vaccine Adherence

Several studies have identified specific demographics of people with characteristics that are more likely to be in vaccine compliance worldwide. In a United States study, Baumgaertner et al. found that “the risk of mortality invokes a larger proportion willing to vaccinate than mere morbidity, that older populations are more willing than younger, that the highest income bracket (>$90,000) is more willing than all others, that men are more willing than women, and that the proportion willing to vaccinate can depend on both ideology and level of risk” (2020). A Polish study had similar findings that positive ideas about vaccination were attributed to older age, higher education level, and whether they received information from their medical provider about vaccinations (Czajka et al., 2020). Studies conducted in Brazil and Venezuela found that working mothers, parents with higher education, and parents associated with the health care system are more likely to vaccinate their children (Guzman-Holst et al., 2020; Couto & Barbieri, 2015; Burghouts et al., 2017).

On the other hand, a survey in Italy of parents' opinions of vaccinations found an opposite trend; parents who were younger with less education were more likely to vaccinate their children (Facciola et al., 2019). Researchers in this study found parents to be most compliant with the MMR vaccine while HiB had one of the lower vaccination rates. Facciola et al. suspect that MMR, Polio, and HBV are more likely to have higher vaccine compliance because the diseases are more familiar to this community (2019). Additionally, in French Guinea, individuals that had at least a high school education were more likely to be vaccinated against Yellow Fever than those who did not (Guzman-Holst et al., 2020; Koivogul et al., 2017). Studies have not reached a consensus about global trends and risk factors for vaccine compliance, but similar characteristics like age and education level may be important when targeting certain demographics.

People worldwide may have some hesitancy or outright refusal of vaccines because of fear or concern about adverse reactions after the vaccines' reception (Etzioni-Friedman & Etzioni, 2020). Because vaccinations have been a part of public health prevention measures for over several centuries, researchers have had time to implement the Vaccine Adverse Effects Reporting System (VAERS), which allows individuals to report their side effects after receiving different vaccinations. This measure gives some control to the general public to monitor their systems and report them to the corresponding agency.

Vaccine Compliance and COVID-19

As scientists worked to combat vaccine hesitancy and increase vaccination rates globally, the COVID-19 pandemic limited and perhaps inhibited the progress. A risk assessment from the Pan-American Health Organization found that "health systems [in the Americas including South America] were being challenged and routine immunization activities are being postponed in most countries" (PAHOa, 2020). While the WHO recommended routine immunizations to continue throughout the pandemic, experts stated that mass vaccination campaigns should be suspended because of the high risk of transmission during the COVID-19 pandemic (GAVI, 2020). Many countries followed these recommendations as Colombia and other nearby countries suspended two vaccination campaigns: measles and yellow fever (WHOb, 2020; PAHOb, 2020). Restrictions on movement and community gatherings have prevented vaccination efforts in many of these countries. Communities that have access to healthcare may continue to receive on-time vaccinations. Meanwhile, "indigenous populations living along the borders of Venezuela, Brazil, and Colombia, in particular,...are also particularly at-risk due to the difficulty in reaching these populations and due to the limited access to essential health services and immunizations" (PAHOa, 2020). The COVID-19 pandemic and its restrictions may have limited routine immunizations of children under five as concerns about COVID-19 morbidity and mortality surfaced; however, many people who received mass vaccination campaigns fell behind on their vaccinations. As countries from across the globe report outbreaks to the WHO during the COVID-19 pandemic, lower vaccination coverage may continue to lead to a resurgence of VPDs in the coming years as herd immunity in communities decreases (Khatiwada et al., 2021).

Colombia Vaccination Rates

Many different factors contribute to stagnant and decreasing vaccine rates across the globe, but Colombia has seen an increase in vaccination rates in the past several years. In 2016, Dr. Carissa Etienne, director of the Pan American Health Organization (PAHO), remarked that Colombia had one of the most “complete and solid vaccination schemes in the region” (Colombia Ministry of Health, 2016a). While that is a fantastic feat, Colombia is still below the herd immunity threshold for many childhood vaccinations. The WHO reports that vaccine coverage ranged from 67-96% for VPDs during 2019 (2020). The vaccines with the lowest vaccine coverage were tetanus toxoid (TT2+) at 67% and hepatitis B birth dose (HepB BD) at 81%. Unfortunately, inadequate vaccine coverage directly corresponds with higher incidence of VPDs, meaning that missed vaccination opportunities lead to death and injuries among children. Out of 78,449 vaccine-preventable cases in countries in the Americas for 2017, Colombia had 23.2% of them (PAHO, 2019). According to PAHO, there were 18,214 vaccine-preventable cases in Colombia during 2017. Vaccination efforts are vital in Colombia, but country-specific barriers to compliance may hinder those efforts. García et al. found that while most people (98%) utilized the vaccine card system, some beliefs and attitudes about vaccines were not in favor of vaccination (2014). The six main vaccination barriers for children with at least 70% of their vaccine schedule incomplete in Colombia are “factors related to caregivers (24.4%), vaccinators (19.7%), health centers (18.0%), the health system (13.4%), concerns about adverse health effects (13.1%), and cultural and religious beliefs (11.4%)" (García et al., 2014). Colombia has relatively high vaccine compliance, but scientists and public health officials still need to address vaccine concerns and meet WHO regulations for herd immunity.

Apartadó, Colombia Characteristics

Colombia has seen considerable growth in its population over several decades. In 1990, the population was 32.6 million people and increased to 50.6 million people in 2017 (IMHE, 2021). Current trends indicate that life expectancy is rising while fertility rates decrease (IMHE, 2021). Child mortality has decreased throughout the entire country of Colombia from 2000 to 2017. The areas with the highest concentrations of child mortality are in the country's northern-most and southern regions, and the municipality of Apartadó in Uraba is located within that northern-most region (Burstein et al., 2019). In 2020, Apartadó had a population of 127,744 inhabitants, which is an increase of about 15,000 from 2010 (City Population, 2020). A majority of the population is under the age of 30 with about equal distributions of people between the ages of 0-9, 10-19, and 20-29. (City Population, 2020). While Apartadó is an area of Uraba that continues to grow over the years, not much information is known about the community's health, specifically vaccination rates, vaccination compliance, and risk factors for vaccination compliance.

Conclusion & Significance

While studies have explored the barriers to vaccine compliance in Colombia, vaccination rates are still below the WHO's standards. Additionally, the risk factors for children under 5 in Apartadó, Colombia have not been explored before. This study aimed to evaluate the factors for vaccine adherence for children under 5 in Apartadó, Colombia. We segmented this goal into four more minor aims: Aim 1: To determine the percentage of children under five who received all of the vaccines recommended by the Colombia Ministry of Health. Aim 2: To determine the percentage of children under five who received their vaccinations on schedule according to the Colombia Ministry of Health. Aim 3: To calculate the duration of time between on-time vaccinations and the actual vaccinations from the data. Aim 4: To understand the risk factors associated with children who deviate from the vaccination schedule.

Through the goal and the four aims of this project, vaccine adherence and up-to-date vaccine rates of country-mandated vaccines in Apartadó, Colombia, within the context of this study can be recorded. There is currently not any updated vaccine adherence data available for children under 5 in Apartadó for children who have received the vaccines recommended for their age, so calculating vaccination rates will allow public health scientists to understand which vaccines may need additional communication campaigns. Along with general vaccination rates, the percentage of children who received each vaccine on time will give researchers insight into which vaccines are being delayed or not received at all. This information will be critical when evaluating the discrepancies and strategies to increase the rates of vaccines that are more likely to be delayed. Moreover, calculating the duration of each vaccine dose delay will give public health officials more context about vaccine compliance. Finally, any risk factors associated with compliance for children under 5 can be documented and studied in future studies. This information can also be used to target the demographics of parents or caregivers who fall outside of the associated risk factors to ensure that vaccination rates in Apartadó, Colombia continue to increase in the future.

Chapter 2: Methods

Introduction

The goal of this project was to evaluate the factors for vaccine adherence for children under 5 in Apartadó, Antioquia, Colombia. There were several aims that were explored throughout the course of this research thesis. Aim 1: To determine the percentage of children under 5 who received all of the vaccines recommended by the Colombia Ministry of Health. Aim 2: To determine the percentage of children under 5 who received their vaccinations on schedule according to the Colombia Ministry of Health. Aim 3: To calculate the duration of time between on-time vaccinations and the actual vaccinations from the data. Aim 4: To understand the risk factors associated with children who deviate from the vaccination schedule.

Study Approval and Location

This study was approved by the Emory Institutional Review Board (CR001-IRB00088473) and the Colombian Institutional Review Board. Morgan Fleming has been added to the IRB protocol (MOD002-IRB00088473). This study took place in Apartadó, Colombia.

Population and Sample

The data utilized in this study was a subset of data collected in a larger study of mother-infant pairs in Apartadó, Colombia. Mothers with infants were recruited in the waiting rooms of postnatal well visits for the child. The inclusion criteria for the study were that mothers were at least 15 years of age, children were between the ages of 6 and 60 months of age, and the child and mother were in good health. Additionally, the mother was required to complete post-natal medical visits, must have desired to continue with medical care, and had to speak Spanish. This population of mothers and infants in Apartadó, Colombia was chosen in particular because they are a vulnerable and understudied population that have a high incidence and prevalence of malnutrition, enteric disease, and other ailments.

For this thesis, the data used was limited to demographic information and vaccine dose dates for the infants.

Data Collection Procedures

During the data collection process by Dr. Leon's team, the study team obtained informed consent from caregivers and collected the information for the study while in the waiting room of postnatal well visits. When asking questions on the questionnaire, a follow-up interview was scheduled within one week if all of the questions could not be answered during the initial encounter. The questionnaire was intended to last around 1.5 hours. A validated health assessment survey was used to ask questions about the child such as demographics, breastfeeding frequency, and other habits. Blood, stool/saliva, and anthropometry were collected for each mother/infant pair. One of the questions asked participants to state their socio-economic level using a social stratification system that ranges from 1-6 with 1 being the poorest and 6 being the richest (Jessel, 2017). Levels 1-3 are generally classified as being in the lower strata and levels 5-6 are recognized as the higher strata (Jessel, 2017).

To collect vaccination data, the researchers primarily took photographs of the vaccination card for each infant; vaccine doses and dates that were illegible were omitted from the database. The vaccination data was then entered into the database several months later. For the rotavirus vaccine only, due to specific interest of the study PI, the doses and dates for each child were recorded at time of data collection. If vaccination cards were not available, then researchers referenced records from the health clinic to collect the data.

Secondary data analysis was conducted based on the vaccine data and the demographic information collected from the questionnaire.

Data Entry Procedures

Several months, after researchers collected the vaccination data, they utilized the double-entry procedure and entered the into two separate databases. Using these first two databases, a third database was created to validate the data and ensure that the information reflected was correct. Then, the third database was confirmed once more with the original photographs one more time.

Data Analysis: Methodology

This research study was a secondary data analysis of a dataset containing information about infant immunization dates for each vaccine, which was collected in 2016 by an Emory student team. Additionally, other characteristics collected such as breastfeeding practices, disease susceptibility, socio-economic status, and household conditions were examined as potential risk factors. In order to determine the percentage of children who received all of their age-appropriate vaccines, the vaccine coverage data, collected from the dataset and displayed in Excel format, was imported into Statistical Analysis Software (SAS) and compared to the vaccine schedule recommended by the Colombia Ministry of Health (Colombia Ministry of Health, 2016b), which is considered the most current source for information. Children under 5 are required to receive to 12 different vaccines, and the data collection procedures obtained information on 11 of those vaccines [Table 1]. The one vaccine that we did not have data for was varicella, which is received at 12 months.

Table 1: Colombia Vaccination Schedule

	Birth	**2 months**	**4 months**	**6 months**	**7 months**	**12 months**	**18 months**	**5 years**
BCG	BCG							
Hepatitis B	Hep B							
Pentavalent		Hep B DPT HiB	Hep B DPT HiB	Hep B DPT HiB			DPT Booster	DPT Booster
Polio		Polio	Polio	Polio			Polio Booster	Polio Booster
Rotavirus		Rotavirus	Rotavirus					
Pneumococcus		Pneumo	Pneumo			Pneumo Booster		
Seasonal Influenza		Seasonal Influenza	Seasonal Influenza					
MMR						MMR		MMR Booster
Varicella						Varicella		
Hepatitis A						Hep A		
Yellow Fever						YF		

Within the database, 194 number of vaccine cards were reviewed and 37 number of observations were removed because they didn't have any vaccine data, which was critical for analysis. Because the rotavirus vaccine data was collected differently than the other vaccines, there were some children who only had information for the rotavirus vaccine. Those participants were included in the 37 observations that were removed. New binary variables (yes/no) for each vaccine dose were created in SAS that indicated the number and percentage of children who received each vaccine regardless of whether they were within the timeframe recommended. Additionally, the number and percentage of children who were fully vaccinated, or received all of the recommended doses for their age, were calculated for each vaccine. This fully vaccinated variable does not include the booster shots for the Polio, Pneumococcus, and Measles, Mumps, and Rubella (MMR) vaccines. Children were considered under-vaccinated if they did not receive at least one of the recommended doses for each vaccine that they were eligible to receive. This percentage was calculated by subtracting the fully vaccinated percentage from 100%.

When calculating compliance or the percentage of children under 5 who have received their immunizations on time for each vaccine, a similar procedure as above was followed. First, a new column in Excel was created in order to determine the age of the child when receiving the vaccine by subtracting the date the child received vaccination from the age of the child at data collection. Children were determined to be compliant if they received their vaccine within the time-frame indicated by the Colombian Ministry of Health with a one-month grace time period often allotted by the World Health Organization. New binary variables (yes/no) for each vaccine dose were created in SAS and indicate whether each vaccine dose was received on time. After the number and percentage of compliance for each vaccine dose were calculated, the number and percentage of fully vaccinated and under-vaccinated children for each vaccine as defined above were calculated. The mean duration and standard deviation between an on-time vaccination and the actual vaccinations were calculated using descriptive statistics in SAS. As a convenience to the reader, certain non-normal statistics are presented as means and standard deviations. Statistical significance was defined as alpha=0.05.

Data Analysis: Logistic Regression Models

To complete data analysis, two models were created using logistic regression in SAS to determine statistically significant risk factors for deviating from vaccine compliance. The risk factors were chosen from the dataset were caregiver's age, caregiver marital status, socioeconomic status, housing circumstances, caregiver's education level, and caregiver's race. The first model was a multivariate logistic regression analysis of the risk factors for vaccine compliance within each vaccine for the children who were eligible to receive it. The second model was also a multivariate logistic regression analysis, but it was used to examine overall vaccine compliance, which is defined as whether a child was compliant with every vaccine they were eligible to receive. In the model, overall vaccine compliance and its potential risk factors were studied. So, for the latter, the only children that would have been included were children who were compliant for each age-appropriate vaccine. The output for both of these models were odds ratios for each risk factor with their corresponding 95%

confidence intervals. The model created was an all-inclusive model with every risk factor included; this model was chosen because we wanted to analyze each of the demographics for any statistical significance.

Chapter 3: Results

Characteristics of Children and Caregivers

We sought to examine which caregiver demographics were risk factors of vaccine adherence for children under 5 in Apartadó. When determining vaccine compliance amongst the children in the study, it was important to describe the study population including child's age (in months), caregiver's age (in years), caregiver's race, caregiver's socio-economic status, caregiver's marital status, and caregiver's education level [Table 2]. These data were collected at the beginning of the survey conducted in the waiting area of the clinics by surveying caregivers of children. A total of 157 children, aged 6 months to 60 months, were included in the data collected for vaccination and compliance. The dominant characteristics for caregivers were between the ages of 21 and 30 (48%), mixed race (46%), lowest economic status bracket (74%), unmarried living with their partner (53%), and an education level that stopped before completing secondary school (40%). Overall, participants were relatively young, unmarried, and uneducated in the lowest economic strata.

Table 2: Characteristics of Children and Caregivers in Apartadó, Colombia

Variable	N (%)
Child age	
Continuous	22 (16) Mean (SD)
6 months	22 (14)
7-12 months	50 (32)
13-36 months	54 (34)
37-60 months	31 (20)
Caregiver age (years)	
Continuous	26 (11) Mean (SD)
15-20	49 (31)
21-30	75 (48)
31-40	25 (16)
41+	5 (4)
Not sure/No response	2 (1%)
Caregiver's Race	
Afro-descendant	53 (34)
Mixed race	73 (46)
White	12 (8)
Indigenous	3 (2)
Not sure/No response	16 (10)
Caregiver's Socio-economic Status	
1 Lowest Economic Status	116 (74)
2	26 (17)
3	2 (1)
4	0 (0)
5	0 (0)
6 Highest Economic Status	0 (0)
Caregiver doesn't know	13 (8)
Caregiver's Marital Status	
Married and lives with partner	18 (11)
Not married and lives with partner	83 (53)
Separated, divorced, or lives alone	55 (35)
Not sure/No response	1 (1)
Caregiver's Education Level	
Without education	0 (0)
Incomplete primary school	7 (4)
Complete primary school	11 (7)
Incomplete secondary school	62 (40)
Complete secondary school	56 (36)
Beyond secondary school	21 (13)

Vaccination Status of Children

To determine the percentage of children who received each dose of each vaccine, information collected from each child's vaccine card, or from the health clinic itself, was used to sum the number of children eligible based on age for each vaccine dose [Table 3]. For some vaccines, there was no information available because the vaccine did not have more than one dose or booster doses; this is indicated by a dash in the table. The term fully vaccinated was used to describe the children who had received all of their age-appropriate vaccine doses while the term under-vaccinated described children who were missing one or more doses of the vaccine that they should have received for their age. Booster doses for Polio, Pneumococcus, and MMR were not included in the fully vaccinated terminology as indicated in the footnote of this table. The vaccines that had the most children that were fully vaccinated were BCG (99%), hepatitis B (97%), and Rotavirus (97%) while the vaccines that had the least number of children that were fully vaccinated were Yellow Fever (60%) and Seasonal influenza (68%). All vaccines had at least 60% of children that were fully vaccinated according to their age, but some vaccines had higher vaccination rates than others.

Table 3: Vaccination Status According to Doses and Vaccines

Variable*	BCG		Penta valent		Hepatitis B		Polio		Rota virus		Pneumo coccus		Seasonal influenza		MMR		Hepatitis A		Yellow Fever	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Received the 1st dose	155	99	156	100	151	97	156	100	154	99	157	100	115	74	87	88	77	81	59	60
Received the 2nd dose	-	-	154	98	-	-	154	99	152	97	153	98	91	68	-	-	-	-	-	-
Received the 3rd dose	-	-	134	86	-	-	136	88	-	-	-	-	-	-	-	-	-	-	-	-
Received the 1st booster**	-	-	-	-	-	-	57	85	-	-	84	85	-	-	+	+	-	-	-	-
Received the 2nd booster**	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-
Under vaccinated***	1	1	24	15	5	3	19	12	4	3	4	3	42	32	12	12	18	19	40	40
Fully vaccinated****	155	99	133	85	151	97	136	88	152	97	153	97	91	68	87	88	77	81	59	60

* The symbol "-" indicates that there is no data available for that entry
** The symbol "+" indicates that no children eligible for that vaccine received it
*** Under vaccinated is defined as the children who did not receive all of the doses of the vaccine scheduled for their age group excluding the booster shots for Polio, Pneumococcus, and MMR vaccines
**** Fully vaccinated is defined as the children received each dose of the vaccine that they were eligible age-wise. This does not include the booster shots for the Polio, Pneumococcus, and MMR vaccines

Compliance with Recommended Schedules

After looking at vaccination rates for each vaccine dose, we wanted to determine the compliance, which is defined as receiving the vaccine dose within the timeframe recommended by the Colombian Ministry of Health [Table 4]. We allowed for a one-month grace period of each vaccine dose, where the child would still be considered compliant. For compliance, the numerator is the number of children who received the vaccine dose on time while the denominator represents every child who received the dose at all. To determine the percentage of children who were compliant with each vaccine dose, we identified the age of each child when receiving each vaccine dose and indicated whether it met our definition of compliance. The term compliant with schedule was used to categorize children who received all of their vaccine doses for each vaccine on-time or within the one-month grace period. The term delayed one or more doses was used for children who received one or more doses of their vaccine outside of the timeframe and grace period. The vaccines that had the most overall compliance, including all applicable doses, among the sample were hepatitis B (96%), BCG (94%), and MMR (94%). On the other hand, seasonal influenza (45%) and yellow fever (72%) were the vaccines that had the least compliance. Every vaccine except for seasonal influenza (45%) had a compliance of at least 72%.

Table 4: Compliance with Recommended Schedules by Dose

Variable*	BCG		Penta valent		Hepatitis B		Polio		Rotavirus		Pneumo coccus		Seasonal Influenza		MMR		Hepatitis A		Yellow Fever	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Compliant with the 1st dose***	135	94	145	97	134	96	140	97	142	95	148	97	57	53	76	93	68	91	38	72
Compliant with the 2nd dose	-	-	138	93	-	-	131	91	136	93	133	92	42	47	-	-	-	-	-	-
Compliant with the 3rd dose	-	-	116	91	-	-	114	88	-	-	-	-	-	-	-	-	-	-	-	-
Compliant with the 1st booster**	-	-	-	-	-	-	38	69	-	-	72	94	-	-	+	+	-	-	-	-
Compliant with the 2nd booster**	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-
Delayed one or more dose****	9	6	14	11	6	4	17	13	14	10	12	8	46	55	5	6	7	9	15	28
Compliant with schedule*****	135	94	110	89	134	96	109	87	132	90	133	92	38	45	76	94	68	91	38	72

*The symbol “-” indicates that there is no data available for that entry
** The symbol “+” indicates that no children eligible for that vaccine received it
*** Compliant here is defined as receiving the required dose within 2 months of schedule
**** Delayed one or more dose is defined as a child who received a dose more than two weeks late
*****Compliant with schedule is defined as a child who received all of their age-appropriate required doses within 2 months of schedule

Risk Factors Associated with Individual Vaccine Compliance

To determine whether there is a significant relationship between compliance of individual vaccines and caregiver demographics, a multivariate logistic model was created for each vaccine in this study [Table 5]. The characteristics studied were caregiver’s age, caregiver’s race, caregiver’s socio-economic status, caregiver’s marital status, and caregiver's education level. No significant differences were found between any characteristic groups for any vaccine. We can conclude that within the context of this study that the characteristics of the caregivers were not correlated with whether an infant was likely to be vaccinated with any vaccine.

Table 5: Risk Factors Associated with Compliance for Each Vaccine

	BCG			Pentavalent			Hepatitis B			Polio			Rotavirus			Pneumococcus			Seasonal Influenza			MMR			Hepatitis A			Yellow Fever		
	OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI	
Caregiver's Age	1.0	0.9	1.0	1.0	1.0	1.0	1.0	0.9	1.1	1.0	1.0	1.0	1.0	0.9	1.0	1.0	1.0	1.1	1.0	1.0	1.0	1.0	0.9	1.1	1.0	0.9	1.1	1.1	1.0	1.1
Caregiver's Race																														
Afro-descendant (reference)																														
Mixed race vs. Reference	2.1	0.4	9.6	0.6	0.3	1.2	0.2	0.2	10.7	0.3	0.1	1.2	1.0	0.3	3.8	0.8	0.2	3.0	1.1	0.4	2.9	0.4	0.0	4.4	0.2	0.0	2.0	0.4	0.1	1.7
White vs. Reference	0.9	0.1	9.3	1.0	0.3	3.1	0.5	0.0	5.5	0.7	0.1	7.3	0.5	0.1	3.0	0.9	0.1	9.3	0.4	0.1	2.6	999	0.0	999	999	0.0	999	1.4	0.1	16.2
Indigenous vs. Reference	999	0.0	999	2.0	0.2	19.8	999	0.0	999	999	0.0	999	999	0.0	999	999	0.0	999	1.1	0.1	19.0	999	0.0	999	999	0.0	999	999	0.0	999
Not sure/No response vs. Reference	1.4	0.1	13.5	1.2	0.5	3.3	0.6	0.1	7.6	0.5	0.1	3.3	0.7	0.1	4.0	999	0.0	999	0.5	0.1	2.2	0.5	0.0	8.0	0.4	0.0	7.3	999	0.0	999
Caregiver's Socio-economic Status																														
Lowest Economic Status (Reference)																														
2 vs Reference	999	0.0	999	2.9	0.4	23.9	999	0.0	999	3.4	0.4	27.2	1.6	0.3	7.4	999	0.0	999	0.7	0.2	2.4	999	0.0	999	1.4	0.2	12.9	0.4	0.1	1.6
3 vs Reference	999	0.0	999	999	0.0	999	999	0.0	999	999	0.0	999	999	0.0	999	999	0.0	999	999	0.0	999	999	0.0	999	999	0.0	999	-	-	-
Mother does not know vs Reference	999	0.0	999	1.7	0.2	14.3	999	0.0	999	0.8	0.2	4.1	999	0.0	999	1.4	0.2	11.9	2.6	0.4	15.2	999	0.0	999	999	0.0	999	999	0.0	999
Caregiver's Marital Status																														
Marries and lives with partner (Reference)																														

Not married and lives with partner vs. Reference	1.0	0.1	8.7	2.6	0.6	10.2	1.6	0.2	16.2	2.5	0.6	9.6	0.0	0.0	999	1.0	0.2	5.3	2.6	0.6	11.0	1.5	0.1	16.3	0.8	0.1	0.7	0.1	4.4	0.7
Separated, divorced, or lives alone and vs. Reference	1.1	0.1	11.0	4.8	0.9	24.3	1.6	0.1	18.5	3.1	0.7	13.6	0.0	0.0	999	3.1	0.4	24.0	3.2	0.7	14.1	2.9	0.2	51.1	3.4	0.2	2.0	0.3	15.6	2.0
Not Sure/No Response vs. Reference	999	0.0	999	999	0.0	999	999	0.0	999	999	0.0	999	1.0	0.0	999	999	0.0	999	-	-	-	-	-	-	-	-	-	999	0.0	999
Caregiver's Education Level																														
Incomplete primary school (reference)																														
Complete primary school vs. Reference	1.8	0.1	35.4	0.4	0.1	2.3	1.0	0.0	999	0.1	0.0	1.6	1.2	0.1	22.9	0.3	0.0	3.0	0.4	0.0	9.4	0.0	0.0	999	0.0	0.0	999	0.0	0.0	999
Incomplete secondary school vs. Reference	11.2	0.6	207.4	1.0	0.3	3.5	0.0	0.0	999	1.2	0.1	11.7	1.2	0.1	11.9	3.1	0.3	34.2	3.6	0.3	39.0	0.0	0.0	999	0.0	0.0	999	0.0	0.0	999
Complete secondary school vs. Reference	2.0	0.2	20.3	1.3	0.4	4.6	0.0	0.0	999	1.3	0.1	13.1	2.0	0.2	21.0	2.0	0.2	21.0	2.8	0.3	30.2	0.0	0.0	999	0.0	0.0	999	0.0	0.0	999
Beyond secondary school vs. Reference	3.2	0.2	61.0	1.3	3.2	5.6	1.0	0.0	999	999	0.0	999	3.2	0.2	58.7	999	0.0	999	2.1	0.2	27.1	0.0	0.0	999	0.0	0.0	999	0.0	0.0	999

Risk Factors Associated with Overall Vaccine Compliance

After examining potential risk factors for each individual vaccine, we ran another multivariate logistic model that used overall compliance, which only included children who were compliant for all vaccines. This model examined if there were any commonalities between children compliant for all vaccines and the caregiver's age, socioeconomic status, marital status, education level, and race [Table 6]. The children that were included in this model were 12 months of age or older and had data (yes/no) for all of their recommended vaccines. The three booster shots were not included because they are given at 5 years of age, which is the upper extremity of our sample. Of the 53 children that met the inclusion criteria, only 7 (14%) were compliant with all of their vaccines. No potential risk factors were found to be significant in the model; however, the model was significant at the alpha=0.05 level.

Table 6: Risk Factors Associated with Compliance Across All Vaccines

	OR	95% CI	
Care Giver's age	0.925	0.813	1.052
Care Giver's Marital Status	1.835	0.424	7.942
Care Giver's Social economic status	0.827	0.076	9.061
Child Care Giver's race	0.722	0.206	2.532
Care Giver's education level	1.184	0.468	2.996

Duration of Delay in Vaccinations

In order to better understand the delays in vaccinations for children, we looked at the mean and the standard deviation for the age the child received each vaccination in months and subtracted the recommended vaccination age from it to find the difference [Table 7]. This number represented the average delay of vaccination in months. We found that the vaccine doses with the shortest average delay were the first doses for Pentavalent (0.19 months), Polio (0.19 months), MMR (0.21 months), and Pneumococcus (0.21 months) vaccines while the vaccine doses that had the longest average delay were booster shot 1 of Polio (3.58 months), dose 2 of Seasonal Influenza (3.26 months), and dose 1 of Seasonal Influenza (2.69 months). The average delay for a vaccine dose varied by 3.39 months for each eligible vaccine.

Table 7: Average Duration between On-Time and Actual Vaccinations*

Vaccine**	On-Time	Mean Actual Time	Standard Deviation	Difference
BCG	0 months	0.36	1.67	0.36
Hepatitis B	0 months	0.30	1.63	0.30
Pentavalent				
Dose 1	2 months	2.19	0.98	0.19
Dose 2	4 months	4.56	3.18	0.56
Dose 3	6 months	6.44	1.77	0.44
Polio				
Dose 1	2 months	2.19	1.02	0.19
Dose 2	4 months	4.61	3.2	0.61
Dose 3	6 months	6.53	1.87	0.53
Booster 1	18 months	21.58	16.46	3.58
Booster 2	60 months	-	-	-
Rotavirus	2 months			
Dose 1	4 months	2.36	1.88	0.36
Dose 2		4.50	2.44	0.50
Pneumoccocus				
Dose 1	2 months	2.21	1.02	0.21
Dose 2	4 months	4.65	2.26	0.65
Booster	12 months	12.24	1.09	0.24
Seasonal Influenza				
Dose 1	6 months	8.69	4.72	2.69
Dose 2	7 months	10.26	3.86	3.26
MMR				
Dose 1	12 months	12.21	1.06	0.21
Booster	60 months	-	-	-
Hepatitis A	12 months	13.17	6.18	1.17
Yellow Fever	12 months	13.94	3.28	1.94

*While the data is non-normal, normal statistics are used for this table as a convenience to the reader
**The symbol - indicates that there is no data available for that entry

Chapter 4: Discussion

Introduction and Findings

Throughout the course of this research investigation, the goal was to determine vaccine status (received yes/no) and compliance rates (on-time with one month grace period yes/no) for the study population of children under 5 in Apartadó, Colombia. In this study, compliance and adherence are used interchangeably to mean children who received the vaccine on-time including a one-month grace period. There were four main findings from the investigation. First, the vaccines that had the highest number of children that were fully vaccinated (they received the vaccine at all, including those who received their vaccine late) were BCG (99%) and hepatitis B (97%) while the vaccines that had the lowest number of children that were fully vaccinated were yellow fever (60%) and seasonal influenza (68%). Second, the vaccines that had the most compliance among the children were hepatitis B (96%), MMR (94%), and BCG (94%). Seasonal influenza (45%) and yellow fever (72%) were the vaccines that had the lowest compliance. Third, the doses with the shortest average duration in delay of vaccination were the first doses for pentavalent (0.19 months) and polio (0.19 months) while the vaccines with the longest average delays were the booster shot of polio (3.38 months), dose 2 of seasonal influenza (3.26 months), and dose 1 of seasonal influenza (2.69 months). None of the risk factors (caregiver's age, caregiver's race, caregiver's marital status, caregiver's economic status, and care giver's education level) were found to have a significant relationship with either individual or overall vaccine compliance. Hypotheses suggesting explanations for these results will be explored throughout this section.

Vaccination Status

The vaccines that had the highest number of children that were fully vaccinated were BCG (99%) and hepatitis B (97%). The vaccination status for both vaccinations were higher than WHO/UNICEF estimates at 89% and 77%, respectively (WHO, 2020c). The three vaccines mentioned here are all recommended to be received within 4 months of the child's birth. It is no surprise that the BCG and hepatitis B vaccine had near 100% vaccination status because they are scheduled to be given within one month of birth if not shortly after birth (Colombia Ministry of Health, 2016b). A global study found that higher rates of hepatitis B vaccination at birth was associated with deliveries at institutions that had medical personnel in attendance (Allison et al., 2017) In another study, Hu et al. postulate that children born in maternity hospitals would have been more likely to receive the BCG and hepatitis B doses because they would be given shortly after birth (2018). Because BCG and hepatitis B are scheduled to be given at birth, they are more likely to have higher rates of vaccination.

The vaccines that had the lowest number of children that were fully vaccinated were yellow fever (60%) and seasonal influenza (68%). While seasonal influenza rates were not available, WHO and UNICEF report that yellow fever vaccine coverage was at 87% in Colombia in 2019, which was substantially less than the rate in this study (WHO, 2020b). However, among children 0 to 4 years old, the participants in this study had higher vaccination rates for yellow fever than others reported for this group (Shearer et al., 2017). Of all countries in South America for which data is available, Colombia has the lowest vaccine coverage for yellow fever (Shearer et al., 2017). In 2019, there was only 1 case of yellow fever reported in Colombia, and in the past two decades, there have not been more the 6 cases reported in one year (WHO, 2020b). As perceived risk of disease decreases, willingness to vaccinate may decrease as well since people are not as concerned about getting sick (Baumgaertner et al.,2020). The low vaccination rate of seasonal influenza is concerning because children less than 5 are at an increased risk of contracting influenza or influenza-related diseases from visits to hospitals or other outpatient facilities (Grohskopf et al., 2020). Several studies show knowledge and willingness of parents to vaccinate their children against influenza while influenza vaccination rates remain low in China and Singapore (He et al., 2015; Low et al., 2017). Doctors and providers must ensure that parents understand the importance of seasonal influenza vaccination and the risk of disease without the vaccine (Cooper Robbins et al., 2011).

Compliance with Vaccination Schedule

The vaccines that had the most compliance among the sample were hepatitis B (96%), BCG (94%), and MMR (94%). Compliance is defined as receiving the vaccine within one month of the recommended schedule by the Colombian Ministry of Health. Similar to vaccination status, the vaccines with the highest compliance were the ones recommended to be given at birth: hepatitis B and BCG. However, the MMR vaccine, which is given at 12 months, has high compliance in this study as well. When discussing vaccine compliance, we must distinguish between parents who refuse vaccines for their children and those that are hesitant about vaccines because they have different motivations and influences. The latter is where a lot of parents fall as they have questions about safety and/or want to delay certain vaccine doses (Dube et al., 2014b). While children who have no received all of their vaccines are at higher risk of contracting a VPD, providers and healthcare providers should be wary of the way that they frame their messaging. Research shows that all parents who fully vaccinated, partially vaccinated, or did not vaccinate their children believed that they were taking the necessary steps to protect their children (Couto & Barbieri, 2015).

Duration in Delay of Vaccination

When determining the average delay in vaccination, the doses with the shortest average delay were the first doses for Pentavalent (0.19 months) and Polio (0.19 months). The vaccines with the longest average delays were the booster shot of Polio (3.38 months), dose 2 of Seasonal Influenza (3.26 months), and dose 1 of Seasonal Influenza (2.69 months). Some parents intentionally delay vaccines for their infants or use an alternative schedule as they have concerns about safety or the number of vaccines required for their infant (Dempsey et al., 2011; Brown et al., 2010). This is concerning because children whose parents choose an alternate schedule or delay vaccinations were more likely to stay under vaccinated and risk infection for VPDs (Smith et al., 2016). In some LMIC, having adequate vaccine supply is an issue that prevents some children from being vaccinated on time (Akmatov & Mikolajczyk, 2012). It is imperative that public health scientists address the causes of delay in vaccination to ensure that vaccine coverage increases among this population.

Strengths and Limitations

While conducting this epidemiologic study, we identified various strengths and limitations that are important to consider. First, we clearly defined and analyzed vaccine status and vaccine compliance as separate terms. In part, because of that clarity, we were able to achieve the goals and aims set out at the beginning of this project. Additionally, relationships between each vaccine and socio-economic demographics were considered, which provided an in-depth analysis about risk factors, which may have been different for each vaccine.

Some limitations to this epidemiological study include missing data due to illegible vaccination cards during data collection. This means that data was excluded from data analysis, which would have increased the sample size for each vaccine; incorporation of this missing data would increase the reliability of the data for many of the tables. Another limitation was that the booster doses for Polio, Pneumococcal, SRP, and Pentavalent were excluded were because the sample size for children eligible to receive that vaccine was too small to make any meaningful analyses.

Implications

These results suggest several important implications: vaccinations received within 6 months had high vaccination rates, vaccines with low coverage need new and innovative strategies to increase uptake, and larger studies in Colombia should explore the relationship between socio-economic factors and vaccine compliance. Because vaccine rates decrease as the children get older, there need to be some programs or mechanisms in place or evaluation of current programs in place to make sure children stay up-to-date with vaccines as they get older such as reminders systems, strong recommendations from providers, and home visits to children who have missed some of their vaccines (Stinchfield, 2008; Oyo-Ita, 2016). At that point, the caregivers who forget about their children's vaccinations but would otherwise vaccinate them on time can be separated from caregivers who are vaccine-hesitant. Additional strategies can then be deployed in order to target that demographic of caregivers. Future studies in Apartadó should recruit a larger vaccine study so that more infants can be included in multivariate analysis. Other information should be collected to confirm or refute findings of other studies such as the association between hospital births and high birth dose rates.

Conclusion

In summary, both vaccine completion and vaccine compliance rates were higher when the vaccine is administered within 6 months of age, especially those that were scheduled to be birth doses (hepatitis B and BCG). Though this multivariate model was found to be significant at the alpha-0.05 level, this study did not find any significant associations between any factors and overall vaccine compliance. Additionally, the delays in vaccination were shorter when the vaccines are administered closer to birth. Interventions at the federal, state, and local level should be targeted to increasing vaccine status and vaccine compliance. The Ministry of Health and healthcare providers should find a way to follow-up with children and their caregivers to encourage them to stay up-to-date on all vaccinations, especially those after the 6-month mark.

Chapter 5: Public Health Implications

- This study found that the vaccinations given at birth (BCG and hepatitis B) were more likely to have higher rates of children who were fully vaccinated. Mothers who gave birth at hospitals around qualified personnel typically have higher rates of vaccination for hepatitis B (Hu et al., 2018).
- BCG and hepatitis B are the same vaccines that have the highest rate of compliance or vaccines received within one month of the recommended schedule.
- While all of the vaccinations had at least 60% of children who were fully vaccinated, yellow fever and seasonal influenza rates are low when compared to recent vaccine coverage data from Colombia (WHO, 2020b).
- Seasonal influenza and yellow fever also had the lowest rates of compliance. Providers should make sure to emphasize the importance of receiving all childhood vaccinations.
- Excluding the single-dose yellow fever immunization, vaccines with single doses had higher compliance than those with multiple doses like polio and the pentavalent vaccine
- Vaccine delays were most common among both influenza doses and the booster shot of Polio.
- Children under 5 have a higher chance of contracting influenza or influenza-related diseases from visits to hospitals or other outpatient facilities, so it is crucial to find a way to increase vaccination uptake for influenza (Grohskopf et al., 2020).

- It is important to consider that all parents regardless of their child's vaccination status (fully/partially/not vaccinated) believe they are doing what is necessary to protect their children (Couto & Barbieri, 2015). Messaging to increase immunization coverage should incorporate perceptions caregiver protection into their messaging.
- Providers must find a way to increase vaccine coverage for their patients through interventions such as reminder systems and home visits to patients missing doses of vaccines (Stinchfield, 2008; Oyo-Ita, 2016).
- While no significant associations were found between the socio-economic demographics collected from caregivers, larger studies should explore these relationships in further detail.

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Appendix A: IRB CONTINUING REVIEW APPROVAL

August 20, 2020
Juan Leon, MD
jleon3@emory.e
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Title:	Immunity to viral pathogens that cause acute diarrhea: transmission of immunity status among the motherinfant population in Urab., Colombia: Pilot Study
Principal Investigator:	Juan Leon
IRB ID:	CR001-IRB00088473
Funding:	None
IND, IDE or HDE:	None
Documents Reviewed:	• Changes to Scientific Protocol (Amendment)_January_23_2017, Category: IRB Protocol; • Colombia's IRB Consent to Expand Study Age to 6-60months , Category: Consent Form; • Original_Spanish_Informed_Consent_4-16-16, Category: Consent Form; • Translated_English_Informed_Consent_6-5-16, Category: Consent Form;

Dear Juan Leon:

Thank you for submitting a renewal application for this protocol. The Emory IRB approved it by the expedited process on 8/18/2020, per 45 CFR 46.110, the Federal Register expeditable categories [F2a, F2b, F3, F4, F7], and/or 21 CFR 56.110.

This reapproval is effective from 8/18/2020 through 8/17/2021. Thereafter, continuation of human subjects research activities requires the submission of another renewal application, which must be reviewed and approved by the IRB prior to the expiration date noted above.

Please note carefully the following items with respect to this approval:

- Changes to Scientific Protocol (Amendment)_January_23_2017

In conducting this protocol, you are required to follow the requirements listed in the Emory Policies and Procedures, which can be found at our IRB website.

Sincerely,

Kalifa Alexander
IRB Analyst Assistant

Your stamped consent form is available under the "Documents" tab.

Now that your submission has been approved, please take a few moments to complete the Emory IRB Satisfaction Survey. We will use your responses to improve our service to the Emory research community. We appreciate your feedback!

Appendix B: ACKNOWLEDGEMENT OF PERSONNEL UPDATE

August 21, 2020
Juan Leon
jleon3@emory.edu

Title:	Immunity to viral pathogens that cause acute diarrhea: transmission of immunity status among the mother-infant population in Urab., Colombia: Pilot Study
Principal Investigator:	Juan Leon
IRB ID:	MOD002-IRB00088473
Funding:	None

Dear Juan Leon:

The IRB acknowledges your updated list of study personnel, effective as of 8/21/2020, for the above-referenced protocol. Please see the electronic modification record to view the individual(s) added and/or removed. The updated personnel list should now be reflected in the main study workspace.

Sincerely,

Jessica Kang
Student Analyst for Staff Changes
Institutional Review Board
jjkang9@emory.edu

Now that your submission has been approved, please take a few moments to complete the Emory IRB Satisfaction Survey. We will use your responses to improve our service to the Emory research community. We appreciate your feedback!