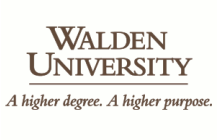

2017

Compliance of Caregivers with polio vaccine Dosages and Timelines in Lagos State Nigeria

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This is to certify that the doctoral dissertation by

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

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2017

Abstract

Compliance of Caregivers with Polio Vaccine Dosages and Timelines in Lagos State, Nigeria

by

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MA, Texas Woman's University, 2006

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Dissertation Submitted in Partial Fulfillment of

the Requirements for the Degree of

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Abstract

Caregivers' compliance with polio vaccine regimens and timely receipt of the recommended 4 doses of polio vaccine are pivotal to eliminating polio. This cross sectional study, conducted in Lagos State, Nigeria, examined polio vaccine compliance and demographic attributes of caregivers' for statistically significant associations. Using an adapted health belief model theoretical framework, 1,200 participants were recruited from well-baby clinics in 8 local government areas in Lagos State. Participants completed a brief demographic survey providing data on caregivers' age, gender, residence (rural or urban), and their level of education as well as records from their children's immunization cards. Data obtained were tested for associations between caregiver's demographic information and their children's receipt of polio doses within specified timelines using chi-square and logistic regression analysis. Fisher's exact analysis were conducted for variables with frequencies less than 5. The only significant association recorded was between the receipt of Polio Dose A and location of caregivers' residence: Rural dwelling caregivers were less likely to receive the first dose of polio. Results showed Polio Dose D to be the dose most likely received in an untimely manner as well as most likely missed of the 4 doses. Logistic regression analysis did not show any variable to be of greater odds in predicting completion of the 4 doses or compliance with timelines of their receipt. Study's results may inspire polio program planners to develop interventions that broaden the immunization coverage for rural dwellers to include nontraditional maternity locations. Positive social change will ensue by the improvement caregivers' compliance with full polio dose receipts with timelines, maximizing immunity.

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Dedication

Extraneous human factors I absolutely could not control turned this dissertation process into a grueling 7-year nightmare after completing doctoral classwork in 2011. Consequently, I dedicate this work to the Almighty God who gave me the grace to finish this without losing my mind. To Jesus Christ the faithful friend who stood like a trainer in my boxing ring corner and kept dusting me up to return and complete the fight. Thank You. I say thank you to the Holy Spirit, for always putting the right person in my way every time I was about to lose my mind or give up.

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To all those who contributed to this dissertation and my doctoral journey both positively and negatively, thank you. I was bent but not broken. I learnt that I can finish whatever I begin regardless of the knock downs and setbacks. Furthermore, the work of patience was perfected in my life. To my dissertation committee, Dr. Refaat, Dr. Danawi, and the URR Dr. James Rohrer, thank you. To Drs. Julius Ade, Helen Awatefe, and Chryss Okonofua who had gone before me and were always willing to answer all my questions, thank you. To Ellen who read and reread my drafts highlighting missed commas and periods, thank you. Dr. Grace Esimai, Dr. Bamidele Moyo, my indefatigable statistics mentors, thank you. To the very inspirational and helpful staff of Texas Woman's University Library and Computer Lab, especially the Dallas campus staff, thank you for your help and encouragement when the road seemed unending. Finally, I am deeply appreciative of the support of my long suffering husband and family. Sadly, my mother died before I could complete this dissertation. She waited in expectation for 6 years. I trust God she is smiling up there in Heaven seeing that though it was a vision that tarried, it finally came to pass.

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Chapter 1: Introduction to the Study

Introduction

There is little doubt about the deadly consequences of polio. More than 1.5 million children in the last two centuries have suffered disability or death from the disease (World Health Organization [WHO], 2014). The long history of polio among humans has been traced back to the early 1600s. Pearce (2005) reported evidence of paralyzed limbs in paintings in the tombs of Pharaohs dating back to that time. Other deadly contagious diseases such as smallpox have been eradicated successfully from the Earth using vaccines and mass immunizations Barquet & Domingo 1997, Behbehani, 1983; Hochman, 2009,). Eradicating polio through the use of vaccinations and mass immunizations has thus been a foremost target in global public health practice. Shazhad
& Kohler (2009). A polio eradication campaign with a goal to eradicate the disease by the year 2000 was launched by WHO and other cooperating bodies in 1988. De Quadroos ((1997). Dowdle, Featherstone, Birmingham, Hull & Aylward (1999). The worldwide campaign to eradicate polio from the globe met its year 2000 target except in India, Nigeria, Afghanistan and Pakistan. Smith, Leke, Adams and
Tangermann,(2004),,Yash,,(2007) With intense and concerted efforts by the Nigerian government and intergovernmental partner agencies like the WHO, UNICEF, USAID, Nigeria successfully broke the cycle of polio infection in 2014. The success of any childhood mass immunization campaign rests on the compliance of the children's caregivers with recommended vaccine dosages and timeline adherence for maximum effectiveness. Nagel, (1985), Halsey & Galaska, (1985), Yahaya, 2007., Yusufzai, 2011.

Currently, very little data exists on the adherence of Nigerian caregivers to WHO (1998) recommended polio vaccine regimen (four doses of oral polio) and stipulated timelines for their uptake.

Most often, polio vaccines are administered in addition to other vaccinations to protect children from contagious yet preventable childhood diseases such as mumps, rubella, and measles. Most of the research that has been carried out in Nigeria has studied childhood mass immunizations generally, but not polio vaccinations specifically. Ophori, Tala, Azih, Okojie & Ikpo (2014). Where research has been done on immunization status in Nigeria, very few studies have reported on the status of caregivers and their actions about polio. A research gap continues to exist in the determination of possible associations between caregivers' demographic attributes and their compliance with obtaining the recommended number of polio vaccine doses and their adherence to the specified timelines of uptake.

Hasley and Galaska (1985), Jenkinset al. (2008), O'Reilly et al. (2012), Modlin (2012), and Mahamud et al. (2014) attested to the effectiveness of the oral polio vaccine (OPV) and the attenuated or inactivated polio vaccines (IPV) in protecting children from poliovirus infection, disability, and death. Oostrovogel et al (1994), Kuwabara and Ching (2014) noted that outbreaks of preventable diseases remain persistent amongst populations that lack adequate herd immunity. The authors opined that lack of parental completion of vaccine dosages and nonadherence to timely vaccination schedules were factors that affect herd immunity. A lack of herd immunity is one of the factors that makes Nigeria's polio free status delicate. Yash, (2007b). Suboptimal uptake of polio

vaccinations and possible noncompliance with timely vaccination schedules affect the attainment of herd immunity. (Tickner, Leman and Woodcock (2006). It is therefore imperative that information is available to evaluate the status of the population in terms of polio vaccine acceptance and adherence to recommended timelines.

Unfortunately, very little primary data exist in Nigeria depicting caregiver completion of recommended polio vaccine doses. Neither are there scientific records of how adherent caregivers have been in complying with the most effective timelines of polio vaccine administration. In countries where mass immunizations have been deemed successful, administering the four doses of the polio vaccine effectively eliminated the incidence of polio. CDC, (2006a, 2007). In polio-free regions of the world, the Global Polio Eradication Initiative (GPEI, 2012) noted the reduction of polio incidence from millions of children annually in 1988, to about 330,000 cases in 125 countries by 1999. Several countries created the success of the expanded program on immunization (EPI) (Bonua, Rani & Razum (2004). and were collectively able to reduce fresh poliovirus incidences to only 358 cases in nine countries across the globe by the year 2014 (Aylward & Heymann, 2005; Andre et al., 2008), Crawford & Buttery (2010).

In spite of the consensus about the effectiveness of polio vaccines, several studies and publications have noted the troubling fact that most of the current incidences of poliomyelitis being recorded are vaccine derived. Vaccine-derived polio virus (vDPV) are infections occurring in children who have received one or more doses of the polio vaccine without completing the recommended regimen; such children thus lack full immunity against the disease. Hull and Aylward (2001), Leander et al, (2002), Kew et al.

(2002, 2005) De Vries et al (2011), and Liang et al. (2006), CDC (2006), Jenkins et al (2010) reported that most of the fresh incidence of polio being recorded in the polio endemic countries were either wild poliovirus or vaccine-derived. Khetsuriani et al. (2003), Kew et al., (2004), and Guo, Wagers, Srinivas, Holubar, and Maldonado (2015) also observed that vDPV was often due to gaps in vaccine uptake. Particularly, the GPEI (2014) published that Nigeria recorded a total of 35 incidences of polio in 2014. Of these, six cases were due to a wild poliovirus strain, and 29 cases were associated with type 2 vDPD.

Kew (2002), Wassilak (2010) and Modlin (2012), documented activities of various governments to achieve successful elimination of polio in polio endemic countries. However, the acceptance and completion of the recommended vaccine dosages within the timelines where they prove most effective are human decisions, which are beyond the control of governments. Children upon whom polio vaccines confer immunity are not their own decision makers. Caregivers are proxy decision makers on behalf of the children in their care. Very little if any data exists on caregiver compliance with the polio vaccine schedule and completion of the recommended four doses of polio vaccines in Nigeria.

Despite the critical role caregivers play in the success of any mass immunization campaign, very little research has examined possible associations between their demographic attributes and actions in terms of polio vaccine uptake and adherence to recommended timelines. Numerous studies, however, have reported on the status of poliovirus transmission and the strategies for the elimination of polio from Nigeria. The

National Demographic Health Survey (NDHS, 2013) in Nigeria reported that the uptake of vaccination against preventable childhood diseases in Nigeria continued to be below expectation. Among children age 12 to 23 months, only 25% of them have received all six types of childhood immunizations (NDHS, 2013). Furthermore, only 77% of children surveyed had received the first dose of the OPV (NDHS, 2013). Overall, only 54% of children in Nigeria had received three doses of polio vaccinations, and no data exist on how many have received the fourth dose of polio vaccine.

Similarly, very little data exist in Nigeria on the actual number of polio vaccine doses received across a cross section of children between 0 to 5 years of age on a state-by-state basis. It is uncertain how many caregivers in Nigeria have fully complied with the WHO May (1998) recommendation that each child receives four doses polio vaccine. The 2013 Polio Eradication Emergency Plan published by the Federal Ministry of Health National Primary Healthcare Agency in Nigeria noted an increase in the number of children above 59 months of age who became infected with vDPV. Lack of completion of the recommended four doses of polio vaccine has been queried as a possible cause of this spike in vDPV infections. Kew, Sutter, de Gourville, Dowdle & Pallansh (2005). The authors reiterated the absence of data on the number of children who have received the fourth (booster) dose of the polio vaccine. Consequently, a significant research need exists in the understanding of caregiver compliance with the statutory WHO-recommended dosage regimen for polio vaccine uptake and adherence to the specified timelines. It is important therefore to have information about caregivers on whom the

huge responsibility of compliance rests if the polio-free status in Nigeria will be a lasting one.

The WHO (1997, 1998) recommended that every child receives four doses of polio vaccine for optimal immunity. The Polio Eradication Program in Nigeria modified this to combat the endemic status in the country. Federal Ministry of Health Nigeria (2013). The doses and prescribed timelines are as shown in Table 1:

Table 1

WHO Recommended Polio Doses and Timeline

Polio Dose	WHO Recommended Timeline of Uptake	Recommended OPV uptake in Nigeria
Polio Dose A	Birth to 2 weeks of age	Birth to 2 Weeks
Polio Dose B	3 to 4 months of age	6 weeks
Polio Dose C	6 to 18 months of age	10 weeks
Polio Dose D	4 to 6 years of age.	14 weeks

Note. Adapted from "Polio Disease: Questions and Answers," n.d.-b, Centers for Disease Control and Prevention (CDC), Retrieved from http://www.cdc.gov/vaccines/vpd-vac/polio/dis-faqs.htm

Statement of the Problem

Global eradication of polio may never be achieved without eliminating it from endemic countries: Pakistan and Afghanistan. (WHO, 2002, CDC, 2005). Nigeria celebrated a short-lived break in transmission with no polio cases recorded in 2015. Nigeria is of particular importance in the global battle against polio because it has been the source of polio re-infections in all other African countries recording new incidence of

the disease in 2014 Burns et al (2013).Noted that all three strains of poliovirus continued to circulate in Nigeria even up until 2015. Fresh incidences of polio in previously polio-free countries such as Ethiopia, Cameron, Equatorial Guinea, and Somalia were traced to strains of wild poliovirus and vaccine-derived viruses that originated from Nigeria. CDC, (2006b)

However, four new cases of polio infections have been recorded in 2016. Caregivers remain pivotal in the attainment of the goal of polio eradication. Yet, very little primary data are obtainable about actual uptake of the four polio doses by children and the compliance with recommended timelines of their receipt of these doses in Nigeria. This research study addressed this gap in literature and data by collecting primary data from caregivers' about the receipt of the four doses of polio vaccine and the timelines for their uptake.

The lofty goal of polio eradication requires research-based information on the caregiver compliance with both the recommended number of polio vaccine doses as well as obtaining these within timelines. This dissertation documented the level of compliance of caregivers in terms of completing the recommended four doses of polio vaccine and their adherence to the stipulated timelines. The study also statistically measured if compliance with these was associated with caregivers' demographic attributes of age, gender, geographical location of residence (rural vs. urban), as well as level of educational attainment.

Purpose of the Study

Caregivers' behavioral attributes have been previously studied in Nigeria, although these were not polio specific. Babalola (2011) studied caregiver knowledge, attitude, and practice as they related to the caregivers' acceptance of childhood immunizations in general. The author observed how child characteristics, caregiver demographics, household profiles, and community characteristics predicted the likelihood of a child receiving all childhood immunization in Northern Nigeria. Even though Babalola examined childhood immunizations holistically, she only utilized the receipt of DPT3 (the third dose of polio vaccine) as the proxy indicator of the likelihood of full childhood immunization compliance. Even while considering only the receipt of polio dose C diphtheria, polio and pertussis (DPT3), the author reported an overall uptake of childhood immunizations at 16% or less. Although this study focused on the northern part of Nigeria, which was the area of high endemicity for polio in Nigeria at that time, no information about the caregivers were considered in the research focus. Yet, caregivers are the ultimate decision makers about vaccination uptake. Furthermore, this study did not examine the caregiver's compliance with vaccination schedules and timeline. Also, no information was included about the status of caregiver receipt of the fourth dose of polio vaccine.

Rahji and Ndikom (2013) also conducted caregiver-related studies in the southwestern part of Nigeria in 2013. These authors looked into factors influencing the compliance of mothers who had children aged between 0 to 12 months with holistic childhood immunization regimen in Oyo State, Nigeria. Again, polio immunizations were

not the particular focus of this study. The authors reported that distance of travel from caregivers' residence to the clinics, lack of synchronization of clinic hours with the mother's work schedules, and the "bad" attitude of health care providers in the clinics were factors that affected mothers' decisions about vaccine uptake. Rahji and Ndikom also recommended the need for further study to explore factors that motivated caregiver immunization decisions more deeply. Since polio was not the specific focus of these study's research questions, further exploration of the status of caregiver compliance with polio vaccine dosage and receipt timelines was an uncharted research territory that this study was designed to address.

The purpose of this study was to ascertain if an association exists between caregivers' demographic attributes and their actions regarding polio vaccine uptake and timeliness. The cross-sectional quantitative study also recorded the actual number of polio vaccines each child under the care of the study's participants received. A random convenience sample was obtained from volunteers among caregivers who attended clinics in the selected Local Government Areas (LGA)s of Lagos State, Nigeria. Sample size n = 1,200 as proportionally estimated through the calculation of the population mean in each of the LGAs with data available from the National Population Census Bureau. I conducted multiple logistic regression analysis to analyze caregiver demographic attributes; their receipt of each of the four recommended doses of polio vaccine; as well as the compliance with receiving the doses within WHO-recommended timelines.

Nature of the Study

This cross-sectional quantitative research was designed to ascertain how many polio vaccine doses each child in the study area received. Also, the study enquired if these doses were received within the recommended timelines of uptake for maximum effectiveness. The study also assessed possible associations of the demographic attributes of caregivers and the number of doses of the vaccine that was received, as well as the compliance of their vaccine uptake with the recommended timelines. The number of polio doses received, A, B, C and D, and the receipt of these within stipulated timelines were the dependent variables. The demographic attributes of the caregivers their gender, age, location of residence rural vs urban and the level of completed education were the independent variables. Data were obtained from caregivers attending public well-baby clinics in eight LGAs of Lagos State, Nigeria I asked caregivers to recall their uptake of polio vaccine doses from memory and also encouraged them to refer to their government-issued vaccination cards where available for validation of the information provided. The government-issued cards contained records for each dose of polio and other immunization administered by a certified health care worker. The cards also contained the dates the vaccine doses were administered, making them a good reference point to decipher compliance with the recommended timeline of uptake. I obtained the demographic information about the caregivers through the administration of a brief questionnaire, which caregiver participants either filled out directly, or the caregivers opted to answer the questions while I recorded the information. The dependent and independent variables were entered into the SPSS statistical analysis software and

analyzed. Possible associations between the independent and dependent variables were statistically derived using chi square tests and logistic and multiple logistic regression analysis.

Research Questions and Hypotheses

The research questions for the study were two pronged. The dependent variables were derived from data about the number of doses of polio vaccine the children received and compliance with the stipulated timelines. The independent variables were the demographic data obtained from questionnaires applied to caregivers.

Dependent Variables

DV 1 = How many of the recommended four doses of OPV were received by each child?

DV 2 = How timely are the caregivers' receipts of these doses of polio vaccines?

Independent Variables

IV 1 = Age of caregivers

IV 2 = Gender of caregiver.

IV 3 = Geographical location of caregivers' residence (rural vs urban).

IV 4 = Level of caregivers' educational attainment.

Dependent Variable Coding

DV 1: The number of the four doses of the polio vaccine received by each child whose immunization card is accessed. Were recommended four doses received? Yes (compliant) = 1. No (noncompliant) = 0.

DV 2: How compliant was the receipt of each dose of polio within the specified timeline of uptake? Were four doses received timely? Yes (timely) = 1. No (not timely) = 0.

Two broad research questions are answered by the data from this study. They are written out in two sets plotting each dependent variable against the four independent variables. According to this grouping, I then tested for an association between each dependent variable and the four independent variables.

Research Questions Set 1

RQ1: What is the association between caregivers' age and their receipt four doses of polio vaccine?

$H_0$1 There is no association caregivers' age and their receipt four doses of polio vaccine.

H_a1: There is an association between caregivers' age and their receipt four doses of polio vaccine.

RQ2: What is the association between caregivers' gender and their receipt four doses of polio vaccine?

$H_0$2: There is no association caregivers' gender and their receipt four doses of polio vaccine.

H_a2: There is an association between caregivers' gender and their receipt four doses of polio vaccine.

RQ3: What is the association between caregivers' geographical location of residence (rural vs urban) and their receipt four doses of polio vaccine?

$H_0$3: There is no association between caregivers' geographical location of residence (rural vs urban) and their receipt four doses of polio vaccine.

H_a3: There is an association between caregivers' geographical location of residence (rural vs urban) and their receipt four doses of polio vaccine.

RQ4: What is the association between caregivers' level of educational attainment and their receipt four doses of polio vaccine?

$H_0$4: There is no association between caregivers' level of educational attainment and their receipt four doses of polio vaccine.

H_a4: There is an association between caregivers' level of educational attainment and their receipt four doses of polio vaccine.

Research Questions Set 2

RQ1: What is the association between caregivers' age and their timely uptake of four doses of polio vaccine?

$H_0$1: There is no association between caregivers' age and their timely uptake four doses of polio vaccine.

H_a1: There is an association between caregivers' age and their timely uptake of four doses of polio vaccine.

RQ2: What is the association between caregivers' gender and their timely uptake of four doses of polio vaccine?

$H_0$2: There is no association between caregivers' gender and their timely uptake of four doses of polio vaccine?

H_a2: There is an association between caregivers' gender and their timely uptake of four doses of polio vaccine?

RQ3: What is the association between caregivers' geographical location of residence (rural vs urban) and their timely uptake of four doses of polio vaccine?

H_03: There is no association between caregivers' geographical location of residence (rural vs urban) and their timely uptake of four doses of polio vaccine?

H_a3: There is an association between caregivers' geographical location of residence (rural vs urban) and their timely uptake of four doses of polio vaccine?

RQ4: What is the association between caregivers' level of educational attainment and their timely uptake of four doses of polio vaccine?

H_04: There is no association caregivers' level of educational attainment and their timely uptake of four doses of polio vaccine?

H_a4: There is an association between caregivers' level of educational attainment and their timely uptake of four doses of polio vaccine?

Conceptual Framework

Anchoring research on existing knowledge, especially about human behavior, is strategically expedient. Health decision making and the factors that undergird these made the health belief model (HBM) proposed by Rosenstock (1966), an appropriate framework for this study. The HBM is dexterous in its application to examine and understand how participants in this study made decisions on receiving and complying with vaccination schedules. Donadiki et al. (2014) stated that the HBM is a useful tool to study attitudes and actions taken regarding vaccinations. The authors opined that the

model is especially useful in measuring compliance with recommended number of doses and timelines. In consonance with Zajac's (2011) submission that decision-making regarding health is a process, health choices result from various considerations given to several factors. Groopman and Hartzband (2011) also posited that every human has a "medical mind." This medical mind processes information and decisions about an individual's health and maybe that of others within his or her care in a series of complex steps. It is important to understand how medical and health decisions are made among parents or caregivers. This is particularly cogent as caregivers' health beliefs determine the immunization status of children.

Regarding polio vaccine acceptance and compliance, public health personnel are mobilized and geared towards extensive outreach. Program planners have dedicated days to ensure that each child is immunized; the ultimate number of polio doses children ultimately receive depends on the priority and willingness of their caregivers to comply with prescribed schedules. It is also the caregivers' decision if the total numbers of recommended doses of any vaccine are received or not. Caregivers determine not only what vaccinations their wards receive, but also they handle determining when and where this is done. Caregiver health decisions in this case about polio vaccine immunizations are connected to their personal beliefs, values, convictions, and convenience. Rasaria & Sachdev (2000). According to Brown et al. (2010), parents typically perceive the benefits of vaccination as lower than the risk of the actual disease, especially when children appear to be healthy. Rahji and Ndikom (2013) also reported that caregivers did not feel immunization regimens needed to be completed when children appeared to be healthy.

Understanding the demographic characteristics and context of populations are essential elements of the HBM. These provide a construct to measure and understand how people's beliefs guide the actions that affect their health, and that of others within their circle of influence or jurisdictional power. The HBM and its corresponding parameters provide a conceptual framework that served as a guide in the forming of research questions in this study. The framework also served as the lens through which I analyzed and interpreted findings.

Several authors, including Odusanya, Alufohai, Meurice, and Ahonkai (2008), Oladokun, Adewoyin, and Lawoyin (2010), and Babalola (2011) conducted studies anchored on the HBM and how parental beliefs shaped their attitudes toward childhood immunizations. These authors reported that parental religious beliefs and ideology positively influenced their uptake of childhood immunization. Furthermore, these researchers reported that knowledge about the benefit of childhood immunization affected mothers' decisions to vaccinate their children or refuse vaccination altogether. None of these examined the actual compliance with polio vaccinations. For this current study, I used the HBM focusing on the action stage of the process outlined Actual compliance needed to be scientifically documented amongst a subset of the population in Nigeria, and this was the focus of this research.

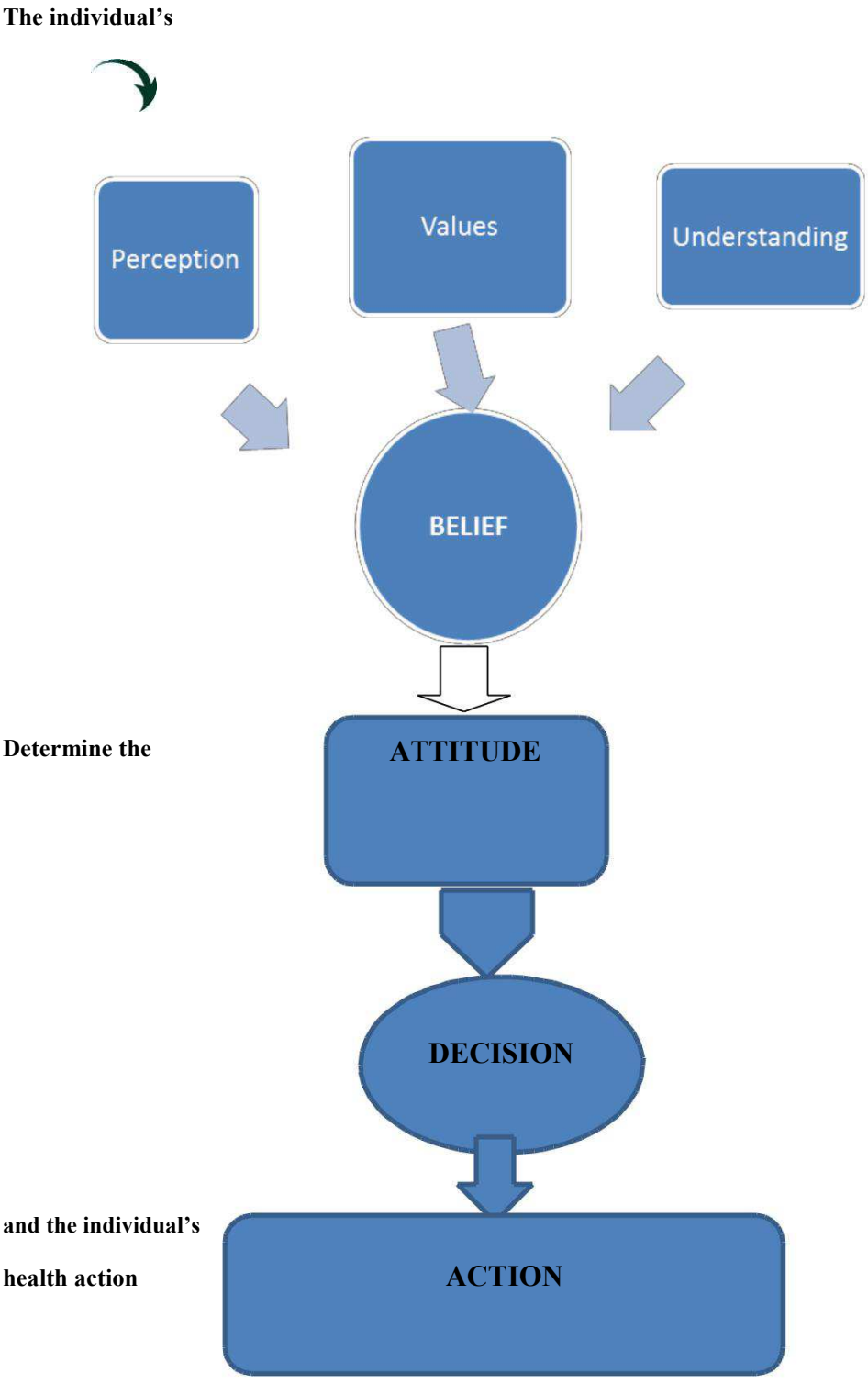

Figure 1. Adapted HBM as a conceptual framework.

Health Belief Action Model Constructs	**Independent Variables** Individual's perceptions and modifying factors	**Justification** Resulting Actions Based on Health Belief Constructs

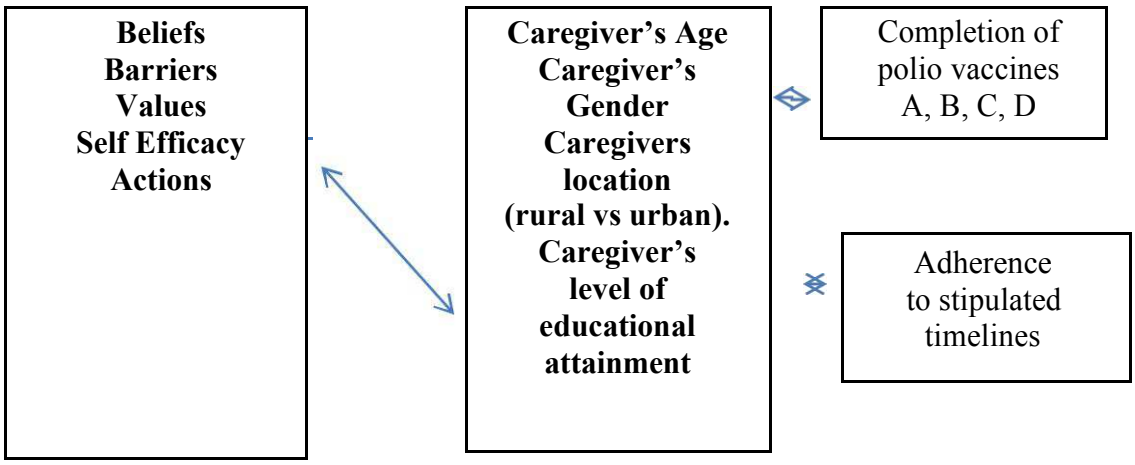

Figure 2. Conceptual framework model

Justification of HBM as Conceptual Framework

The HBM is a dynamic theoretical model that lends itself to adaptations and modifications to study various aspects of the phenomenon of human actions and behavior. The theory's foundation is laid on human attributes such as beliefs, values, and perceptions, which are the basis for human decisions. Human decisions typically consummate in an action, actions like receipt of polio vaccinations. Completion of the recommended doses and adhering to guided timelines are usually informed by the individual's beliefs, values, and perceptions, making the intrinsic constructs of the HBM an applicable framework for this study.

This study's fundamental questions examined caregiver compliance with the uptake of four doses of polio and adhering to the recommended timelines for this uptake. Caregiver actions regarding polio vaccination and their demographic attributes tie in appropriately with the use of the HBM as an appropriate conceptual and theoretical framework. The vastness of the model's human attributes supports its adaptability to frame the constructs and findings in this research. Similarly, several authors have adapted the HBM to examine how its fundamental attributes result in human action or inaction. Specifically, D'Alessandro et al. (2012) adapted the HBM to quantitatively study the determinants of the refusal of A/HN1 pandemic vaccination among a high-risk population in a hospital in Paris, France. Also, Rahji and Ndikom (2013) utilized the HBM framework in their examination of determinants of mothers' compliance with childhood immunization in Ibadan, Nigeria. Likewise, for this study I adapted the HBM model to examine compliance of caregivers with the recommended four doses of polio vaccine and their adherence to the timeline. Also, this study assessed possible associations between caregiver demographic attributes of age, gender, location of residence (urban vs. rural), and the level of caregiver compliance, which were their actions in terms of polio vaccination uptake.

Some scholars may argue that the HBM measures constructs like belief, perceptions, and attitudes that are not the direct questions this study addressed. It is important to remember that the constructs—beliefs, perceptions and attitudes—are not always stand-alone concepts in the human behavioral matrix. These constructs are ingredients that result in a decision being made and an action being taken. In the context

of this study, the HBM is applicable because I have adapted it to measure the ultimate outcome of invisible constructs as a decision or a health action being taken. Rahji & Ndikom. (2013) adaptation of the HBM show that caregivers' underlying beliefs, perceptions, and attitudes affect their actions about polio vaccines specifically or immunizations in general.

The efficacy of behavioral theories and their application in research lies in their generalizability. The HBM is thus an expandable and expedient theoretical lens that few studies have so far utilized in measuring resulting human actions based on intangible internal dynamics of factors that guide decisions and actions. Although this study may not be unique in applying the HBM framework to measure behavioral health actions like immunization compliance and adherence, it is one of the initial few to extend the application of this theory to the associative effect of demographic attributes and immunization decisions and actions. I anticipate that more researchers will apply this framework to the study of health actions and especially as they relate to immunizations.

Table 2

Integration of Dependent and Independent Variables

Variables	Polio Doses DV1	Timeline Adherence DV2	Age In Years IV1	Gender IV2	Location of Residence IV3	Level of Educational Attainment IV4
Polio Dose A	Yes/No 1/0	1) At Birth 2) Other Yes=1 No = 0	1. 01 -19 2-20 - 29 3. 30- 39 4. 40 - 49 5. 50 -59 6. 60- 69 7. 70- 79 80 - above	Male/Female Male = M Female=F	Rural/ Urban Rural = R Urban = U	1. No Formal Education 2. Primary School Education 3. High School Education 5. Associate College Education 6. College Education. 7. Post College Education
Polio Dose B	Yes/No 1/0	1) 6 weeks 2) Other Yes=1 No=0	1. 01 -19 2-20 - 29 3. 30- 39 4. 40 - 49 5. 50 -59 6. 60- 69 7. 70- 79 80 - above	Male/Female Male = M Female=F	Rural/ Urban Rural = R Urban = U	1. No Formal Education 2. Primary School Education 3.Secondary/High School Education 5. Associate College Education 6. College Education. 7. Post College Education
Polio Dose C	Yes/No 1/0	1) 12 weeks 2) Other Yes=1 No =0	1. 01 -19 2-20 - 29 3. 30- 39 4. 40 - 49 5. 50 -59 6. 60- 69 7. 70- 79 80 - above	Male/Female Male = M Female=F	Rural/ Urban Rural = R Urban = U	1. No Formal Education 2. Primary School Education 3.Secondary/High School Education 5. Associate College Education 6. College Education. 7. Post College Education
Polio Dose D	Yes/No 1/0	1) 2 years of age 2) Other Yes=1 No = 0	1. 01 -19 2-20 - 29 3. 30- 39 4. 40 - 49 5. 50 -59 6. 60- 69 7. 70- 79 80 - above	Male/Female Male = M Female=F	Rural/ Urban Rural = R Urban = U	1. No Formal Education 2. Primary School Education 3.Secondary/High School Education 5. Associate College Education 6. College Education. 7. Post College Education

Definitions

The following are operational definitions and acronyms used in this study.

*Wild poliovirus s*trains of poliovirus that have not been incorporated into the common vaccines used in disease prevention.

Vaccine-derived poliovirus v(DPV) Strains of polioviruses that mutate from the strains currently incorporated into either the OPV or the IPV. These strains of vDPV are easily recognizable as mutants of poliovirus type 1, type 2, or type 3. Often they are associated with suboptimal immune development of children who have received one or more doses of the recommended polio vaccine. The vDPVs usually detected in excretions of carriers within the first 7 days of receiving the immunization and within 7 to 60 days in people who become infected through close contact with the carriers of the vDPV. In 1 case per million, people with vDPV will actually suffer vaccine-associated paralytic poliovirus where full blown paralytic limbs are observed.

Detailed Explanation of Acronyms

BCG: Bacillus Calmette-Guerrin (vaccine to prevent tuberculosis) given in combination with the poliovirus vaccine at birth.

bOPV: Bivalent OPV. This vaccine contains a mixture of two strains of poliovirus.

CDC: Centers for Disease Control and Prevention. Primary agency over public health issues in the United States.

CFP: Canadian Foundation for Poliomyelitis. Canada's foremost agency to prevent polio infections.

DPT: Diphtheria, pertussis, and tetanus. A combination vaccine to prevent deadly childhood diseases diphtheria, pertussis (whooping cough), and tetanus.

EPI: Expanded Program on Immunization. The Program launched to combat preventable childhood diseases in Nigeria and other third world countries.

GPEI: Global Polio Eradication Initiative. A collaborative effort of international and governmental agencies to effect the elimination of polio from the globe.

HPV: Human papilloma virus. A virus sexually transmitted that is linked with ovarian cancer in females.

IPV: Inactivated polio vaccine. A polio vaccine made from attenuated live virus and injected into humans to stimulate the body's production of antibodies against polio infections

ISEP: Intensified Smallpox Eradication Program. A program similar to the GPEI targeted at eradicating small pox.

LGA: Local Government Area. A jurisdictional area in Nigeria, similar to a county in the United States.

mOPV 1, mOPV3: Monovalent OPV containing poliovirus type 1 and type 3.

OPV: Oral polio vaccine. A polio vaccine dose containing dead poliovirus which is administered through the mouth to stimulate antibody production against the disease.

UNDP: United Nations Development Program. An intergovernmental development agency

UNICEF: United Nations Children Education Fund. An intergovernmental agency focusing on the welfare of children.

USAID: United States Agency for International Development. An agency of the United States providing aid to other countries.

Polio Dose A: This is the initial dose of polio vaccine recommended to be received by children at birth. This is typically a shot of the OPV in polio endemic countries like Nigeria, although in most Western countries like the United States, this dose is a shot of IPV and is less likely to result in a vDPV infection.

Polio Dose B: This is shot of IPV or OPV given between 6 to 8 months of age to stimulate children's production of antibodies against polio infections.

Polio Dose C: This is a dose of polio vaccine either as IPV or OPV given to consolidate childhood immunity against polio infections. This dose is recommended for uptake between 6 to 18 months of age.

Polio Dose D: A dose of polio vaccine to ensure comprehensive immunity against polio disease. This dose is recommended to be received between ages 2 to 6 years by children.

Assumptions

In collecting data for this study, I broadly assumed that there were no errors in the records of the vaccines received by the child and that caregivers' memory recall of the information would be reliable. The acceptance of the data as reliable and valid rests on the expectation that records and recollections are true. I also assumed that demographic information supplied by the caregivers would be reliable and true.

Scope of the Study

This research study focused specifically on caregiver compliance with the WHO's (1998) recommended polio vaccine doses and adherence to the scheduled timelines for their uptake. Incomplete vaccinations and timeliness of vaccine uptake have all been identified as factors that affect the development of immunity to infectious diseases like polio. De Vries et al (2011). In this study, I explored caregiver actions and sought to uncover associations between their demographic attributes of gender, age, level of education, and location of residence (urban/rural) and their completion of the recommended number of polio doses, as well as their compliance with the scheduled timelines.

This research study was not an evaluation of the success of the polio program in the research area or among the study population. Rather it focused on providing a snapshot of the status of adherence to schedules and completion of the recommended doses in Lagos State, Nigeria. Findings revealed how many polio doses children in the particular LGAs studied received and when they did so. Forecasting the levels of herd immunity through calculating percentage compliance among the study population was also beyond the scope of this study, although it is recommended that future researchers explore these issues.

Limitations

Limitations in research studies are prevailing factors and influences that are beyond the researcher's control. Due to reasons of expediency, the research in this study could only be conducted within a limited identified survey area. Whereas Lagos State,

Nigeria, geographically has 20 local governments (counties) and 37 local government development areas, the study was conducted in eight of these LGAs. This limited the sample size to a fraction of the possible areas in Lagos State. The choice of eight out of the possible 20 LGAs was one of expediency and to limit the scope of the research within the context of a dissertation. A convenience sampling bias may also exist in the choice of LGAs selected for this study because it was easier to access data in some LGAs than others. Consequently, broad generalizations from the data obtained in this research may be limited.

Nevertheless, being a pioneering effort in documenting actual compliance with polio vaccine regimen specifically, findings from this study should provide primary data and create insight into the status of polio vaccinations in Lagos State. The study can also serve as a template for much broader investigations that can be reported as official findings on the status of compliance with polio vaccine regimen in Lagos and possibly other states in Nigeria. Understanding caregiver compliance will provide valuable insight into their actions and help in the planning of future immunization programs in Lagos State and Nigeria.

Delimitations of Study

Generalizations from this study may be limited by the following factors:

Data sourced from immunization cards and caregiver answers on survey questionnaires may have generated information about other childhood vaccinations received beyond the scope of this study. Information not specifically aligned to the research questions in this study was omitted.

The definitions of rural versus urban in this study may not conform to typical assumptions. Population distribution in Lagos State is dense. Therefore, an area may be classified as rural, whereas the population may fall within the parameters of urban in the context of another study. For instance, Epe LGA with a population of 181,409 people is considered a rural LGA based on the population to size using density as a parameter. The LGA spans 1,185 so km, so the spatial distribution is sparse and rural when compared with that of Shomolu LGA, which has a population of 402,673 in distributed across only 12 so km of land. These unique classifications may limit the overall generalization of the findings of this study.

Significance of Study

The WHO (2012) observed that "As long as a single child remains infected with polio, children in all countries, are at risk of contracting polio". Until polio reservoirs in endemic countries are identified and eliminated, the scourge of polio may not be removed from the children of the world. (WHO,, 2001)..Incomplete vaccination regimen has been closely linked incomplete population immunity and poliovirus mutations. Mensi and Pregliasco (1998) reported outbreaks of poliomyelitis amongst vaccinated populations in Finland in 1984. Similar outbreaks were also reported in Senegal and Brazil in 1986, and Israel and Oman in 1988. (Mensi & Pregliasco, 1998), mentioned also, epidemic outbreaks in Bulgaria in 1991 amongst populations that had used OPV similar to those been dispensed in Nigeria. Sustainable elimination of polio in the Nigeria depends on the availability of data on dosage fulfillment to prevent freak outbreaks resulting from immunity lapses in populations.

Nigeria may yet experience a similar epidemic from under immunized members of the population who may have compromised immunity. Compromised immunity has no defense against mutated versions of the wild poliovirus, especially polio type 3. Data from this study will hopefully refocus attention towards ensuring that vaccines are not only received, but that caregivers do this within specified timelines to procure wholesome immunity. This study also yielded data that can inform program planners and policy makers about the true status of polio vaccine uptake in Nigeria. Hitherto, the most reliable data on population health status in the country are from the NDHS. The NDHS generates the most comprehensive data about immunizations in Nigeria, though the NDHS data are collected at regional levels and not state as this research did. Consequently, immunization data available about Nigeria are limited to what were obtained from a geopolitical zone as opposed to a focused state basis. This study provided primary information about Lagos State, Nigeria's most populous and most diverse state. Lagos State is a microcosm of Nigeria, incorporating all the subtle nuances of the country's diverse population in every demographic consideration.

Up-to-date information about the status of polio in Lagos State provides program planners information on areas needing more focus to maintain the elimination of polio from the country. Research continues to be insufficient about polio, specifically amongst the preventable childhood diseases in Nigeria, even though enormous resources made available to the country are spent on combatting poliomyelitis disease. Unequivocally, caregivers are the bedrock on which the continued success of polio elimination in Nigeria rests. Understanding associations between their demographic attributes and their

compliance levels enhances more targeted program effort in the service delivery and program implementation in Nigeria.

Study Summary

I began with a discussion of the origin and the effect of polio on the human population and the successful use of vaccination to eradicate and reduce the scourge of deadly childhood diseases like polio. I reviewed studies that have attested to the effective use of vaccines in combating and eradicating infectious diseases. The gap in research and literature about caregiver demographics and their compliance with the recommended polio vaccine regimen in Nigeria were examined. The lack of primary data on the compliance of caregiver with receipt of polio vaccine doses and the record of their adherence to recommended timelines were the problem statement necessitating this study. I delineated the nature of the study and introduced the research methodology and research population.

Secondly, I discussed the recent deletion of Nigeria from the list of polio endemic countries while highlighting necessary actions and strategies required to sustain the polio-free status in Nigeria. I emphasized the possibilities of polio re-infection through delicate elimination of poliovirus from Nigeria, stating the possibilities and consequences that could be derived from caregiver failure to comply with fully recommended immunization dosages. An in-depth explanation of the adoption of the HBM as the study's conceptual framework was discussed with justification from gaps in the literature. All these factors provided a background for the necessity and significance of the study. It is imperative to develop new strategies and different approaches to ensure acceptance and compliance

with the full regimen of doses of polio vaccine to attain optimal immunity amongst the population.

Finally, I explained the methodological approach to this research, identifying and describing the dependent and independent variables and how data collected were statistically analyzed. Assumptions made in conducting the study and the possible limitations of the study findings in terms of sample size, study location, and generalization of data and delimitations of the study were also addressed in this chapter.

In Chapter 2, I describe the literature search and review of previous research that provided a relevant literature basis for this research. I also discuss the modalities of the literature search, the Boolean keyword and search engines consulted to source articles, and publications researched to provide the scientific platform upon which this study is built. I explored further merits of the HBM as the conceptual framework for the study, stating the historical antecedents of the HBM. I reviewed studies that utilized the HBM in detail. Similarly, I highlighted the works of authors who have conducted research on immunizations in general and polio vaccinations in particular. I noted and explored the similarities and points of divergence between their works and findings with the results of this research study.

In Chapter 3, I restate the research questions and hypotheses in detail. I identify the study population, the demographic distribution of the study population, and the census figures that guided the sample size for the study. I also state the research design (cross sectional quantitative), the participant recruitment methods, the data collection strategy and timelines, as well as the survey instrument and the ethical considerations for

the research process. The data analysis software and the process are also discussed in this chapter.

In Chapter 4, I present the results of the data collected, the tables depicting the analysis of the data, and describe the statistical tests and processes by which the answers to the research questions were derived. I also enumerate the findings from the data and discuss the presence or lack of associations between the dependent variables and the independent variables in the study. I discuss if the null hypotheses were rejected in answer to each of the research questions.

In Chapter 5, I elaborate on the results from the study and examine these in light of previous research on the subject of polio immunizations and caregiver actions or decisions and their demographic attributes in a discussion narrative. In this chapter, I also postulate the social change implication from this research and draw conclusions on the study.

Chapter 2: Literature Review

Introduction

Polio has historically decimated and disabled human childhood populations. Faber (1950). Vaccines and mass immunizations have succeeded in the global elimination of other deadly diseases like smallpox. Daley & Glanz (2011). Polio continues to challenge global public health efforts due to its annual incidence especially in endemic countries - Afghanistan and Pakistan, and its resurgence in countries where it has been previously eliminated like Nigeria. Caregivers make the decision if a child is immunized against polio or not. Therefore, it is important to understand caregiver actions regarding polio vaccination and how this may be associated with their demographic attributes. Every insight into caregiver actions provides ammunition to finally eradicate polio from the world.

Compliance with statutory mandates regarding mass immunization programs has been broadly studied, but the issues of caregiver compliance with polio vaccine regimen remains largely an uncharted terrain. Issues relating to immunization compliance have deep historical antecedents. For a panoramic view of issues relating immunizations, a historical background search about the scourge of infectious diseases (of which polio was second to smallpox in terms of the resulting human mortality figures) Roser, Max (2016) was necessary. Also necessary was the review of the biology and clinical manifestation of poliomyelitis symptoms, and the scientific documentation of how caregiver actions about immunization and polio vaccinations have been shaped over the years in several countries, especially in Nigeria.

Many factors have been associated with community compliance with immunization mandates of various vaccine-preventable diseases. Some trends have emerged in the execution of such mandates, and barriers and successes were also recorded over the years. Reviewing publications on these barriers and successes informed the null and alternate hypotheses derived from the research questions in this study.

A theoretical basis is germane to scientific research. This chapter, therefore, enumerates the adoption of the HBM as the theoretical basis for this research study. I wrote a brief historical discussion about the HBM and included how the HBM framework was incorporated into various scientific studies, - Orji, Vassileav and Mandyrk (2012) and other studies with dependent and independent variables similar to those considered in this study. The main objective of this review was the identification and examination of published information about the importance of caregivers' compliance with the WHO's recommended polio vaccination regimen and timelines globally and in Nigeria specifically. Literature background for this study included scientific studies, observations, field reports, opinions and suggestions about immunization, vaccines, and the human factor elements involved in the success or failure of preventing communicable diseases worldwide.

Scientific peer-reviewed journals, institutional bulletins, and news articles on the issues of vaccines and parental action were examined. Because much of the information disseminated to the public about polio is not always scholarly, the scope of this review was broadened to include gray literature such as news reports, newspaper reports,

institutional bulletins of intergovernmental organizations like the WHO bulletins, CDC–MMWR, as well as GPEI documents.

Review Strategy

A broad-based search was conducted on databases including Medline, Science Direct, and ProQuest with the search terms *vaccines, polio vaccines, eradication of polio, polio status in Nigeria*, and *compliance with vaccine regimen*. *HBM* and the Boolean operator *and caregivers*, as well as sociodemographic variables—*age, gender, rural/urban*, and *level of educational attainment*—were incorporated into the search query.

Chapter Outline

In this chapter, I discuss articles reviewed in three sections and subsections. The first section begins with the examination of the theoretical basis adopted to undergird this study—the HBM. It begins by examining the history and formulation of the HBM and continues by examining articles related to the HBM as a behavioral framework and theory. With regard to the applications of the HBM to issues about caregivers and immunizations in general and wherever applicable, articles that examined issues focusing on polio vaccinations were incorporated.

The second section includes discussion of literature on immunization mandates, challenges, and successes in the area of community compliance on a global and local levels. While this section begins with a broad view of mandates across several communicable diseases, the focus gradually narrows to polio diseases on a global level and dovetails into the publications that report on polio in Nigeria specifically.

Subsections review issues that shed light on the historical background of caregiver compliance in Nigeria. Particularly, the review examined publications reporting on the initial boycott of polio vaccine and the effect of rumors.

The third section of this review examined in detail research findings of childhood immunization in Nigeria as it relates to caregivers and their actions. I reviewed research studies documenting the status of polio vaccine in Nigeria. I examined the gaps in literature that created the need for this study. I also discussed the significance of this study and how it will enrich scientific knowledge about caregiver actions regarding polio vaccinations in Nigeria.

Theoretical Basis

Wholesome scientific theories must be both generalizable and testable (DiClemente, Crosby, & Kegler, 2002). The HBM was first developed and utilized in scientific research by Rosenstock (1966, 1974). Irwin Rosenstock, Geoffery Hockbaum and Stephen Kegels were public health personnel in the U.S Public Health Service in the 1950s. These scientists observed that the response by adults in a particular community to a free mobile tuberculosis screening center was very poor. The researchers wanted to know what factors influenced human health decisions and decided to interview the adults who responded positively to the tuberculosis screening. The interviews focused on revealing factors that motivated participants' response and action to the tuberculosis screening and to understand how health behavior decisions were made. These researchers developed and utilized the HBM to study health behavior and factors that guide decisions made by people regarding their health and that of others in their care. Rosenstock and his

colleagues are considered fundamental philosophers in the study of health actions and behaviors and factors related to them.

Rosenstock (1974) opined that people's perceptions of susceptibility to a disease and their perceptions about the likely severity of the disease motivated the level of action they took to prevent such illness. Consequently, decisions and actions that include compliance with governmental or political mass immunization mandates remain subject to the level of people's perception of severity or susceptibility to diseases being advocated for or any health condition. Rosenstock (1974) determined that associations exist between people's demographic attributes such as age, gender, ethnicity, and socioeconomic status and their actions regarding preventive health behaviors and use of health services. Age and gender are two of the demographic variables that I tested with polio vaccine compliance and timeline adherence, making the HBM an applicable tool in uncovering these facts.

Rosenstock, Strecter & Becker (1988) also noted that the HBM is effective in assessing preventive actions like immunizations, centering this argument on the self-efficacy construct and expendable application of the five fundamental constructs of the HBM framework. Self-efficacy constructs measure the capability of the individual to make the decision guided by their perceptions, values, and beliefs. Stretcher, DeVellis, Becker and Rosenstock (1986). Taking the necessary action stretches the basic constructs of the HBM into the empowering and individual ability that results in a health action or behavior that is mathematically and scientifically measurable. Similarly, studying caregiver compliance using the HBM framework extends the foundational constructs into

the cumulative effect and a measurable health action or behavior. Strecther, DeVellis, Becker and Rosenstock also corroborated the usefulness of the HBM as a tool for studying reasons for noncompliance with recommended health procedures. Caregiver actions regarding preventing polio are a cumulative result of their perceived fears of the scourge of polio and the perceived benefits of the vaccine in preventing the adverse effects of polio. While this study focused on the outcome rather than the underlying perceptions and attitudes, the HBM as a value expectancy theory was expedient and relevant to this study. It provided a measurement of the compliance with recommended regimen for polio vaccinations and revealed the caregiver adherence to the timelines allotted for the uptake of each dose of the polio vaccine. Once a mathematically measurable amount can be computed from a health action (in the case of this study, compliance = 1 and noncompliance = 0), numerical weights allow for a statistical test for associations. The HBM was, therefore, a framework that could be adapted to achieve the necessary statistical computations that provided the answers to the research questions in this study.

Although caregivers, who were the primary focus of this particular study, are not making decisions regarding their health, they handle decisions on what immunization children they care for receive and when they do so. The caregivers' beliefs, perceptions, values, understanding, and decisions result in actions that affect the children in their care, making the theoretical examination of their actions using the HBM relevant to achieving this study's research goals.

Adopting the HBM as the theoretical basis for this study was based on the theory's proven testability and generalizability as the valid and reliable tool for understanding human approaches towards health decisions and behaviors. Rosenstock (1966). The HBM incorporates fundamental attributes within its constructs—perceived susceptibility; perceived severity; perceived barrier; perceived benefits; and self-efficacy—that are very cogent to the attributes and decision of caregivers about immunizations. The HBM has been widely used to understand, measure, and sometimes predict health behavior and outcomes in several research studies across a broad spectrum of health issues.

HBM and Caregiver Health Actions

Chen et al. (2011) affirmed the HBM as a theoretical model viable in the study of short- and long-term actions and health behaviors amongst diverse populations. In their study of the factors that influence parental acceptance of influenza vaccination among caregivers in southern Taiwan, Chen et al. utilized a methodology similar to that in this study. The participants' n = 2,778 were caregivers who were recruited from 33 health centers and 40 government-owned clinics. The study data were collected using government-issued vaccination cards, and caregiver demographic information was also collected using a simple demographic health questionnaire. Multiple logistic regressions confirmed a clear association between the age of caregivers and their positive decision in influenza vaccine uptake. Their study also showed a positive association between the residence of the caregiver and a compliant action regarding influenza vaccine acceptance. Chen et al. concluded that parental influenza vaccination decisions and actions can be

understood better when the foundation of such actions and decisions were studied within the HBM framework.

Health actions are usually a cumulative response to the undergirding stimulus. Caregiver actions arise from cumulative decisions that are dependent on their perceptions, values, beliefs, and attitudes. (Rosenstock, 1974). Perceptions and beliefs set parameters that determine values. Values influence decisions and decisions result in actions. The five key constructs of the HBM are relevant to caregiver actions on completion and timeliness of polio vaccine immunization. This study's goal of determining if these constructs are common amongst caregivers who fall within similar demographic categories was achieved using the HBM as an underlying template. The HBM can be used to measure actions based on demographic similarities. The adoption of the HBM as the theoretical basis for the accomplishment of research goals outlined in this study was based on its utilitarian premise. Donadiki et al, (2014). Vaccine acceptance and timeline adherence are actions resulting from personal knowledge, values, perceptions, attitudes, and beliefs of people.

Caregivers are proxy decision makers about the health and wellness of their children or wards. Onyeneho, Igwe, Aronu and Okoye (2015) conducted a cross-sectional study amongst caregivers' participants' $n = 600$, regarding their uptake of the diptheria, pertussis, and tetanus vaccine (DPT3) in southeast Nigeria. Data revealed an association between the age of caregivers and their compliance with the uptake of this recommended vaccine. Onyeneho et al. utilized the HBM as the conceptual framework for their study and concluded that parental attitudes and actions are associated with their vaccine

compliance. Their study also found that certain demographic attributes like caregiver age are statistically proven predictors for the likelihood of children's uptake of the DPT3 vaccination.

Similarly, Smith et al. (2011), conducted an evaluative study on parental delay or refusal of vaccine doses amongst parents of children who were aged 24 months. The authors used the HBM as their framework to assess associations between parental compliance with full childhood immunization regimen in the United States. Data consisted of the National Immunization Survey reports in 2009. The authors reported that 60.2% among the 11,206 parents surveyed were compliant not missing any recommended vaccinations. 25.8% of parents delayed vaccinations and were not adhering to the stipulated timelines. 8.2% of those surveyed refused the vaccinations entirely while 5.8% of parents both delayed and refused mandated vaccinations for their children. While this study examined issues about vaccinations, in general, the study reported a 76.9% coverage for polio vaccines amongst those who delayed childhood vaccinations. This number compares to 93.85% coverage amongst those who reported neither refusal nor delay in receiving childhood vaccinations. This study provided interesting insights into issues regarding vaccination timeline adherence and dosage compliance because it was conducted in the United States of America a country that has been certified polio-free for several decades.

Smith et al. (2011) suggested that there was an association between caregiver perceptions and their actions regarding vaccination uptake both in terms of dosage completion and timeline adherence. Justifying the choice of the HBM model, the authors

found the framework expedient in the determination of associations between caregiver compliance and their perceptions. However, their study did not consider if demographic attributes of caregivers were related to their decision to accept, refuse or delay timelines and vaccine acceptance.

HBM and Associations between Population Health Actions and Demographic Attributes

Katz et al (1997) framed their research on prevention of cardiovascular disease on the Health Belief Theoretical Model. Their study found that perceptions and actions about health decisions were hinged upon influences that are associated with demographic attributes of populations. They also report that values, another construct of the HBM, are similar among people who share the same demographic characteristics like gender, age, level of education. Similarly, one of this study's research objectives is to test if an association exists between caregiver demographic attributes and their actions regarding polio vaccine dosage compliance and timeline adherence.

Becker et al (1978) used the HBM as a conceptual framework for their study of mother's compliance with administering stipulated asthma medication regimen to their children in Baltimore, Maryland. Becker et al. interviewed 117 respondents to determine their perceived susceptibility of their children to asthma attacks. Mothers' actions were measured against their perceived benefits of following the recommended medication regimen to prevent or lessen asthma attack in their children. The authors reported an association between the mother's level of education about the preventative benefits of asthma medications and their compliance and adherence to the recommended did and

scheduled timelines. The study also revealed that compliance was significantly associated with the mother's general health motivations. The study also confirmed that compliance and adherence to asthma prevention medications regimen were significantly associated with the mother's perceptions of the threats of asthma and their perceived severity of the disease and its consequences.

The HBM has also been extensively used in predicting behaviors geared towards disease prevention. Oldridge and Streiner (1990) however, applied the model to study compliance with a chronic disease management regimen. Their study involved 120 male patients and the implementation of a cardiac rehabilitation program. The authors observed that the HBM was a useful tool to predict compliance with the prescribed 6-month regimen for rehabilitation. The authors found the five HBM constructs were associated with demographic attributes of those surveyed. The model also predicted group membership between compliers and non-compliers with the regimen with up to 64.6% accuracy.

An evolutionary set of factors and events undergird immunizations, vaccine acceptance and compliance, and these need to be included in a comprehensive literature search to engender understanding of the actions being studied in this research. Consequently, articles, publications and historical events that culminate in the status of polio vaccinations are included in this literature search.

Historical Background of Disease Preventing Vaccines and Polio Infections

The knowledge that human bodies can be prepared to develop resistance and immunity to infectious germs prior to infections, led to the invention and use of vaccines.

Vaccine has been considered as one of the greatest achievements of public health (Pollard & Jacobson, 2001). Before vaccines were invented, diseases like small pox, polio, and measles killed and disabled more than 300 million people around the world. The discovery of the smallpox vaccine attributed to Englishman Edward Jenner in 1796, brought untold relief and succor to generations of people. (Benbehani, 1983). Mass vaccinations have over the last century preserved more than a fifth of the current population of the world. By the beginning of the 20th century, mass vaccinations of entire populations had become mandated by several countries determined to stop infectious diseases in their tracks. Smallpox was the deadliest of the childhood infectious diseases, with 12 to 15 million cases and 2 million fatalities reported annually around the world. The WHO launched the Intensified Small Pox Eradication Program (ISEP) in 1967 (Choo, n.d). Mass vaccination campaigns of infants and young children 0 to 5 years of age resulted in the global eradication of small pox in 1979. (Koplow, 2003). Immunization campaigns achieved the global elimination of small pox except in Pakistan where small pockets of infections continue to be reported periodically. Health officials around the world were encouraged to use this success as a template to target the elimination of polio, the second deadliest of childhood infectious diseases.

British physician Dr. Charles Underwood made the first recorded clinical note of the disease poliomyelitis in 1768. Oshinsky (2005). By the 1800s, polio had become a widespread disease of epidemic proportions in many countries on all continents, especially in Europe. Polio was first recorded in the United States in 1894 with 132 cases in Vermont. (Smithsonian, n.d.). In 1938, a widespread and ravaging epidemic of polio

infections left more than 22,000 people paralyzed and 6000 people dead across all states in the United States. Sabin (1951), De Jesus, (2005). Community efforts to care for its victims including US President Franklin Roosevelt led to the formation of the National Foundation for Infantile Paralysis (NFIP; known today as the March of Dimes). This organization raised funds to support polio victims, and fund research into finding a cure for the disease. (Barreto, Van Exxan, & Rytty 2006). Research into finding a cure for the disease got a boost when Jonas Salk developed a polio vaccine in 1955. (Blume & Geesink, 2000).

The Salk vaccine consisted of weakened polioviruses. These were injected into the bodies of children to stimulate the production of antibodies against the disease. Laboratory tests showed that the polio vaccine protected 60% to 90% of children who received it from polio infections. The NFIP threw its weight behind the invention and launched a mass vaccination program across the country. The success of the mass vaccination campaigns recorded in the United States soon spread all over the western world. Canada established the Canadian Foundation for Poliomyelitis (CFP) in 1949. Barreto et al. (2006). The vaccination process was made even easier by the approval of Albert Sabin's OPV in 1960 (Horaud, 1993; Sabin & Boulger, 1973). The oral vaccine involved the use of three drops of attenuated (weakened) poliovirus into the mouths of babies and infants causing their bodies to develop immunity against the disease. The concerted effort by government, nongovernmental and nonprofit organizations in the mass immunization campaigns using both the Salk and Sabin vaccines were very successful. They resulted in a drastic reduction of the epidemic of polio in many

countries around the world. In the United States, the incidence of polio was drastically reduced initially by more than half of the usual annual epidemic cases. With optimal immunization coverage, this has steadily declined until the last case of polio infection recorded in the United States was in Arkansas in 1979. Based on the worldwide success of mass vaccination programs, the Pan American Health Organization (PAHO), launched an immunization campaign in 1985 with a target to eliminate polio from the Northern Hemisphere by 1990. By 1988, there were 650,000 cases reported among countries in the Americas. After the vaccination program had been launched, the numbers of polio cases were drastically reduced to 350,000 cases within a 5-year period. (Rey & Girard, 2007). Before the launch of the GPEI in 1988, polio paralyzed several thousands of children daily across the globe. (GPEI, 2012). Armories of four different types of polio vaccines were made available to immunize children against polio. These are OPV, the Monovalent OPV (mOPV1, mOPV3), Bivalent Polio Vaccine (bOPV) and the IPV.

Since the GPEI was launched, more than 2.5 billion children have been immunized against polio through vaccination in 200 countries. All but nine countries in the world were declared polio-free. In spite of the concerted global mass vaccination program, the nature of infectious disease elimination is such that the program's success is only a strong as its weakest link. As long as Nigeria remains a polio endemic country, public health practitioners and policy makers agree that no stone must remain unturned to extract information that can strengthen the levels of childhood immunity in Nigeria. Knowing the associations between caregiver demographic attributes and their compliance

with polio vaccine regimen is an imperative exercise in the winning of this century-old war against the disease.

Vaccines, Immunization Mandates, and Population Compliance

The past is the foundation upon which the future is laid. Caregivers played a pivotal role in the elimination of diseases that have been successfully eradicated from the world like small pox. Perisic & Bauch (2009). Furthermore, the WHO (2012) opined that polio would not be collectively eliminated as long as one child in the world still has an active polio infection. The threat and possibility of re-infection of most of the 2.5 billion already immunized still exists. Grier & Grier (2002). Prevention of polio in each child depends largely on the caregiver's decisions. Reviewing historical antecedents regarding the scourge of polio as a childhood disease and the invention and use of vaccines to prevent the spread of polio reiterates the need to ensure a polio-free world. The introduction of mass immunization mandates, the approaches to influence compliance and the setbacks and successes that was recorded in the progress towards polio eradication provide the deep understanding of caregiver action.

Polio will continue to exist until caregivers take the appropriate action to prevent the spread of the disease amongst children. Rosenstock (1974), noted that caregiver actions depend on their knowledge and perceptions. He also observed that their compliance with health regimens and are also associated with their level of understanding of the benefits of the health regimen or action in question. The huge economic outlay invested in eradicating polio from the world make learning and understanding caregiver behavioral patterns regarding health decisions important. This section of the literature

search provides a panoramic view of publications and records that document events from the origin of polio as a disease to the discovery of polio vaccines. It discusses the adoption of the vaccines and incorporation of mass immunizations backed with statutory mandates to understand compliance amongst caregiver populations regarding polio.

Mandates and Their Effect on Mass Vaccination Campaigns

Caregiver compliance is a direct response to government mandates about vaccinations and mass immunizations. Many studies have discussed vaccination mandates and the population tendency to comply or reject the mandates. Keane, Stanton, Horton, Arronson, Galbraith and Hoghart (1993), Lanzano- Ponce, Riviera, Artillo-Santallian, Salmeron, Hernandez-Avila & Munoz (2001), Mays, Sturne, & Zimet (2004). These actions are linked to the populations' perceptions of the government's motives in creating such mandates. Where people perceive a mandate to be a positive health protective tool, community compliance has been recorded to be high. Countries and political entities resolved to mandate immunizations among populations to achieve the dual goals of disease prevention and eradication.

Streefland, Chowdhury, and Ramos-Jimenez (1999) studied vaccination patterns in Bangladesh, Ethiopia, India, Malawi, the Netherlands and the Philippines. The authors identified two types of political mandates regarding vaccination and recorded their effectiveness and challenges. The study revealed two types of approaches to mandating vaccination by policy makers. The "promotive approach", and a "prescriptive approach". The Netherlands adopted a "promotive mandate approach" to requiring vaccination compliance. In this approach, the government stimulates compliance and adherence by

promoting vaccinations as a popular thing to do and allowing those who choose to opt out, the freedom of choice to do so. All Dutch parents, however, are provided with necessary information to support and encourage parental choice to vaccinate their children as soon as the children are born. The government also promotes acceptance of vaccination by following up with parents of new born infants with a home visit from health workers who will also promote the need to have the children vaccinated. This approach recorded a high vaccination compliance average amongst the population because many people assumed vaccinations were just an automatic thing to do.

Conversely, the governments in Ethiopia, India, and the Philippines adopted a prescriptive approach to vaccination acceptance. In these countries, vaccination records were required for children to be enrolled in schools, and to obtain other social services. In these countries, many caregivers just approached vaccination as the normal thing to do. Compliance ratios were also significant although other factors like difficult terrain, disconnections in the provision of services, and health worker issues resulted in some partially immunized children.

Salmon et al. (2005) observed that the elimination of most infectious diseases in the United States of America has been attributed the legal mandates by federal, state, county and city health departments. Community cooperation and compliance with the legislated immunization mandate are essential for the success of mass vaccination programs (Mukerhji et al., 2005). Without wholesome community cooperation, the global elimination of small pox could not have been achieved. Several authors have reported the effect of community compliance, on the success of health programs and initiatives.

Becker and Maiman (1975) reviewed literature detailing the impact of health beliefs on individual and community compliance with medical care recommendations. These authors found that communal perceptions regarding the seriousness of the disease, faith in the efficacy of care had a significant effect on compliance with health and medical mandates. Peterson (1987) observed that the format and medium used in communication with people affected the levels of the community's compliance with immunization mandates. Donovan and Jalleh (2000) and Manjunath,& Parakeet (2003) also reported that community vaccine compliance tended to increase with more parental involvement and clearer understanding of health goals. Szilagyi, Rodewald, Savageau, Yoos, and Doane (1992) studied mother's compliance with influenza vaccination for their children. Their findings revealed that parental fear and worry influenced decisions to have children vaccinated. They also noted that positive compliance with vaccination mandates was more dependent on how much parents feared the disease or its consequences than the stipulations of the law.

Community demographics and geographical location of parents' residence have also been reported to influence compliance with childhood immunization mandates. Hountouw and Carlson (1993) reported compliance rates of 70% among mothers in rural Arkansas compared to a 50% national average of compliance rate in the United States. Despite the fact that children who were not immunized against vaccine preventable childhood diseases have a 35% more chance of contracting one of such diseases, community compliance with vaccination mandates has not been wholly embraced.

Salmon et al. (2005), in their study in the state of Michigan in the United States, reported that parents did not vaccinate 5.7% of students entering school for the first time.

Also, Donadiki et al. (2014) observed that age was associated with compliance with vaccine mandates. Their study examined compliance with mandated HPV vaccines amongst female university students aged between 18 and 26 years of age in Spain. The authors noted that younger students aged between 18 – 20 years of age tended to be more compliant in receiving the full dose of the HPV vaccine. This age bracket was also more compliant in their timely uptake of the vaccines than students who were in the 21 to 26 years of age bracket.

Health worker knowledge, attitude, perceptions, practice, and immunization mandates. Perle and Ferrance (2006) also noted that medical provider biases against immunization could also affect community compliance despite statutory mandates. These authors reported that some chiropractors in the area studied, tended to dissuade their patients from receiving vaccinations. Arulogun and Obute (2007) conducted a cross-sectional mixed methods study among service providers in Gombe State Northern Nigeria. The study reported that health workers' beliefs and perceptions caused misconceptions about vaccine acceptance. These misconceptions were sometimes passed on to caregivers affecting caregiver acceptance of the vaccines and their compliance with the prescribed regimen. In their study (n = 265), 8.3% of participants perceived the OPV to be harmful to repeated administration. 9.8 % believed OPV to have sterility properties, and 14% thought the OPV contained harmful materials. 43 % of these health workers agreed that immunization rejection could be due to the belief that it OPV cause sterility,

and 35.5% believed that HIV contamination could occur from receiving the OPV vaccine.

Among health 436 workers in 6 hospitals in Florence Italy, Taddei et al (2014) reported variance in the attitudes of health workers towards preventive immunization against certain diseases than others. The authors found that majority of the health workers that included physicians, nurses, midwives and nurse aides had a positive attitude towards being immunized against measles and rubella. Amongst the respondents to this survey, 63.3% said they were immunized to prevent measles, 46.9% against rubella and 26% were protected against mumps. Only 14.9% had been immunized to prevent varicella, and 14.5% had received the immunization to prevent against pertussis. Lack of compliance amongst health workers put the patients they treat at risk of contracting these preventable childhood diseases. Non-compliant health workers are less likely to influence positively, the uptake of vaccines by their patients who include caregivers of young children.

Ethical Considerations and Immunization Mandate Compliance

Ethical considerations are one of the several factors that have been identified to influence vaccination uptakes, refusals or noncompliance. Becker and Maiman (1975) identified ethical considerations as one of the significant influences on individual and community noncompliance with vaccination and other health mandates. Verweij and Dawson (2004) reported that government and policy maker prioritization of diseases for which mandates are issued, will ensure that members of the public are allowed some ethical freedoms to choose and protect public health at the same time. The authors noted

people were more likely to comply with the mandate for this particular vaccination if they are given a choice to receive or reject that other vaccination. Giving the example of mandating the uptake of measles vaccination for every child while giving the parents an option in obtaining the tetanus toxoid elicited higher percentage of cooperation among caregivers.

Salmon et al. (2006) concluded after studying the ethics of vaccination legislation among European countries spanning a 100-year timeframe that higher percentages of vaccination coverage could be achieved without punitive government mandates. The authors cited countries like-Denmark, Norway, Netherlands, Sweden and the UK that had devised more liberal ways to achieve high percentages of vaccination coverage without punitive consequences for noncompliance.

Childhood Immunization Compliance in Nigeria

The third section of this review focused on factors related to childhood vaccines and immunization in Nigeria. While most publications and research document childhood vaccines holistically, some articles studied factors that affected caregiver decisions about polio vaccine as an embodiment of the mandated childhood immunization regimen. Lack of polio immunization-specific research creates a data gap that these researches study is designed to fill. A brief historical documentation of the process of polio vaccine in Nigeria was reviewed with a view to better understand why polio continues to be endemic in Nigeria despite huge financial, human and material resources invested in combatting the disease in Nigeria.

Factors Affecting Caregiver Compliance

Existing research identified several factors relating to caregiver compliance with general immunization schedules. Five key articles were reviewed which discussed issues relating to childhood vaccinations and caregivers (mostly mothers') attitudes and actions towards childhood immunizations in Nigeria. A variety of research design approaches were employed however, there was no specific article identified that dealt solely with issues relating to polio vaccine specifically. Rather, childhood immunization was studied as a conglomerate of preventive action against several childhood diseases. While these articles provided a basis to understand possible predictors of findings of caregiver immunization behavior and status, the problem of polio in Nigeria is more serious than the country's status regarding other preventable childhood diseases. Nevertheless, this literature search examined and reported the findings from these research studies hoping to provide at least some framework with which the research questions and hypotheses proposed in this study can be framed.

Odusanya et al. (2008) conducted a cross-sectional study on maternal knowledge about the EPI, which included their knowledge of the polio vaccine regimen. In the study $n = 338$, the authors reported a 61.9% compliance rate with the mandated childhood immunization regimen amongst these rural dwelling mothers in South Western Nigeria. The study also revealed a correlation ($p = 0.006$) and ($p < 0.001$) between mothers' knowledge of immunization and obtaining such vaccinations from a privately funded health facility. The authors noted that rural caregivers tended to be more compliant in receiving vaccinations when visiting private rather than public owned facilities health

facilities. Odusanya et al. reported a significant correlation between mothers' knowledge about immunization regimen and their completion of the mandated regimen. The authors recommended increased strategies to increase mother's knowledge of immunization regimen to program planners.

Oladokun et al. (2010) utilized a semi-structured questionnaire methodology to study reasons mothers gave for not completing required childhood immunization among low socioeconomic mothers in Ibadan South Western Nigeria. The participants $n = 248$ had children aged between 12 and 23 months of age. Mothers gave several reasons for their noncompliance. 13.7% of those who were noncompliant with the immunization schedule reported this was due to inconvenient the location of the service clinic. This study showed that mothers who had no formal education were six times more likely than those who had some formal education to be noncompliant in completing scheduled vaccination regimen. Mothers with higher levels of education knew more about the benefits of childhood immunization than those who were less educated by a ratio of 6: 1. Levels of educational attainment of the mothers' also affected their levels of motivation in completing vaccination regimen by a statistical value of (95% CI OR = 1.88 17.93).

Babalola (2011) reported that noncompliance with childhood vaccination schedules amongst mothers in Northern Nigeria were related to their beliefs and perceptions emanating from rumors that vaccination contradicted the practices of their religious beliefs. Babalola observed that partial immunization amongst mothers in Northern Nigeria was influenced by the lack of vaccine supply. The author also noted

that mother's presence lack of compliance did not translate to the absence of a future plan to receive the vaccines at a later date.

Rahji and Ndikom (2013) conducted a cross-sectional study among nursing mothers in Ibadan South West Nigeria. Participants $n = 153$, were asked factors that affected their compliance with childhood vaccination regimen and schedules. The findings from the study reported that 62.8% of mothers interviewed were compliant with the vaccination regimen while 37.2 were not compliant with the regimen. 19.6% of mother's in this study did not take any vaccination for their children. The authors noted that maternal compliance with vaccine regimen was influenced by their levels of education- in terms of some years of schooling they had. Mothers who had at least secondary school level education were more compliant with vaccination regimen than those who had only primary level education. Some mothers also attributed their noncompliance to concerns about side effects of vaccinations. Other mothers stated they could not complete vaccination regimens due to conflict with their work schedules.

Fatiregun and Okoro (2012) studied participants' $n = 525$, in Southeast Nigeria to determine maternal completion of childhood immunizations. By verifying immunization uptake with information extracted from the state issued immunization cards the authors found that 32.4% of the children in the study had completed the recommended number of immunizations. While this was far below the recommended optimum percentage of 80% of the population, this percentage was far higher than the recorded national rate of 23%. The study reported regional disparity in the uptake of the DPT -3 the third dose of the polio vaccine. Uptake was at 18.7% in the Southeast while a similar study conducted in

northern Nigeria where reported only 16% of children in similar age group had received the DPT – 3 vaccinations. There was no demographic information about the attributes of the mothers neither was an association between their compliance and demographic attributes examined. The authors, however, reported that 19% of the mothers in their study did not complete vaccinations based on non -availability of the vaccine at their most accessible point of service. This study also found that the number of children a mother had and their birth order reduced the probability of their completion of the vaccination regimen.

Most healthcare mandates especially in the developed world, include an "opt-out clause", especially for reasons related to religious beliefs. Several authors published articles about the pros and cons of the "opt out" clause as it affects various vaccines. Javitt, Berkowitz, and Gostin (2008), studied response to HPV mandates in the United States. Cook (2008), Gendel, (2009) all argued for and against the HPV mandate. The most disconcerting fallout from the opt-out clause regarding immunization mandates was the fact that many parents took the "liberty for a license" and rejected vaccinations.

Rumors. Although statutory "opt-out" laws were not common in governmental immunization mandates in the "third world" countries where polio and other infectious disease were almost endemic, religious organizations have been reported to call for mass abstinence from vaccination programs. Samba, Nkrumah & Leke, (2004), Jegede, (2007), Leo & Okafor (2012) reported on the effect of rumors on polio vaccine acceptance. Particularly the call by "Muslim clerics to boycott polio vaccinations in Northern Nigerian States. Community resistance for various reasons are more problematic to

immunization compliance in polio endemic countries than the exercising of the individual right to opt out. Shah (2011) also reported on the effect of rumors on vaccine rejection in India. Rumors were observed by Osowole and Obute (2005) as a factor wielding significant influence on parent's willingness to comply with the statutory mandate for polio vaccination on national immunization days. These authors reported parental noncompliance despite extreme efforts by the state employed health workers who went looking for absentee parents at home. In Gombe State in Northern Nigeria, parents reported they had heard rumors that polio vaccinations were laden with contraceptive chemicals, and they were declining to avoid becoming infertile.

Nigeria was not alone in bearing the burden of negative effect of rumors on the success of its polio immunization program. Chaturvedi et al, (2009) in a qualitative study utilizing in-depth interviews, focus group discussions, and informal observations and interactions with mothers in Morabadab and JP Nagar districts in the Indian State of Uttar Pradesh, reported that the polio program in India had suffered relapses and re infections because of rumors that had been spread amongst populations. Especially among minority tribes who tended to be socially isolated ones in this region of the country. While their findings showed significant parental awareness and support of the idea of vaccination, many parents still avoided the polio vaccines because of rumors which claimed its relationship with infertility, or negative experiences with post vaccination polio paralysis. Fortunately, India has overcome this resistance, and the country was declared polio-free in May 2012 since the last reported case of polio infection was more than 12 months ago.

In Pakistan, the effect of rumors about the polio vaccine being laden with sterilizing substances targeted to reduce conception amongst Moslems by Western countries – specifically United States of America resulted in the shooting and fatal death of a Pakistani WHO doctor and severe wounding of a Ghanaian doctor in the outskirts of Gadap, a poor and slummy area near Karachi (Roberts, 2012). Religious warlords in Afghanistan, leaders of the Taliban were also reported to have banned the dispensing of polio vaccinations among people belonging to their tribes. Rey and Girard (2007) also reported rejection of polio vaccines in northern India due to rumors about it been contaminated with HIV viruses aimed at eliminating non-Caucasian people.

The influence of cultural, religious and social factors on parental vaccine acceptance and compliance decisions appear to be a common thread in polio endemic countries like Pakistan, and Afghanistan. The same was true of Nigeria until concerted efforts wer employed ot have Muslim cleric go out on the vaccination stomps with the health workers. This makes it imperative that research be done amongst these populations to ascertain how and why these factors continue to affect the polio eradication program in the world. While rumors about the contamination of polio vaccines with sterilizing or contraceptive chemicals may remain unproven, there is documented evidence of vaccine related polio infections that have also created community resistance to the acceptance of polio vaccines. Okonko et al. (2009) reported cases of post-vaccination infantile paralysis in Nigeria and several other countries in the world.

Post-vaccination Polio Infections and Paralysis

The Sabin type of polio vaccine (OPV) contains attenuated polio viruses that have been weakened. When introduced into the human body, it triggers an immune response that makes it unable to waste away nerves cells and result in paralysis. The OPV was hailed as the most effective and convenient weapon against polio when it was discovered in the 1960s. Indeed, it delivered the fatal blow to the menace of polio in several countries at the onset of mass vaccination campaigns against the disease. By the year 2000, more than 5 billion children under the age of 5 years had received the three recommended doses of OPV. However, with time, strains of the polio virus began to mutate causing them to become infectious and resulting in paralysis even amongst children who have been vaccinated. When this happens, vDPV results, this strain can cause paralysis in children Immuno-deficient children who are very susceptible to vDPV infections. Most of these children also lived in densely populated areas, where the birth rates were high, and sanitation was poor. Often, gastro enteric problems including diarrhea were also prevalent in these places (Modlin, 2012).

Several countries have reported cases of vDPV from 2009 to 2011, Nigeria has reported three separate outbreaks totaling 315 cases of type 2 vDPV (CDC, 2011). Wassilak et al. (2003) also reported that some parents in Kaduna State of Nigeria admitted to being wary of complying with vaccination mandates due to fear of their children contracting the vDPV. Siddiqi, Khan, Nisar, and Siddiqi (2007) reported some parents in Pakistan refused vaccination because of the doctors or health official's bad

attitude and carelessness. These parents believed the bad attitude could adversely affect their children's health.

Parental compliance has also been reported to be affected by other factors like lack of access to health care services. Especially those parents who lived in low socioeconomic areas or in regions that were not easily accessible or were isolated due to a terrain. Demonstrated political commitment and increased government support in terms of human and material resources that enhance the efforts of international agencies like the WHO GPEI staff resulted in greater coverage of rural and underserved areas. Annand and Barnighausen (2007) observed a significant association between health worker density and vaccine coverage area. Bonu et al., (2004) reported an increase in children immunization compliance in Kenya, Malawi, Tanzania, Rwanda and Zimbabwe. This increase was found to be synonymous with increased government support and coverage for the EPI and mass polio vaccination campaigns in low socioeconomic areas.

In Nigeria especially, issues related to polio eradication and immunization against childhood disease carry very subtle political undertones. Chen (2008), studied the overall ramifications of polio eradication efforts in Nigeria and recorded that Nigeria appears polarized politically and culturally in terms of polio vaccinations. The northern part of the country bears the burden of the preponderance of polio infections although a few cases were reported in the southern states. Also, parents all over the country were more receptive of vaccinations against other diseases like measles but many in the northern area were skeptical about polio vaccines. Specifically, Renne, (2006) reports being told by parents in Zaria, a city in Kaduna State that they were baffled at the priority and

resources being invested into polio vaccinations because they were of the opinion that measles was a more pressing health issue. This observation can account for the fact that parents in northern states of Nigeria were reported to be highly compliant with mandates to protect their children against diseases like measles and meningitis. They also explained that they were more receptive to these immunization programs due to the distribution of incentives like bathing soap, mosquito nets and other fringes they received from health workers.

Guo et al. (2015) did a review literature on immunodeficiency vDPV infections reported from 25 countries over five decades, from 1962 to 2012. The authors noted that the report of 68 immunodeficiency vDPV cases amongst predominantly male victims. 57% of the cases also occurred amongst patients with antibody immune-deficiencies in which more than 60% of the victims died. High income countries reported more cases of the immunodeficiency vDPVs than middle to low income countries and there was also a higher age disparity amongst the victims in high-income countries. These findings are significant because it shows that unless polio vaccine regimen is fully complied with in the prescribed timeline, the cases of vDPV infections over time cannot be ruled out.

Summary of Chapter 2

This chapter outlined the theoretical basis for this study—the HBM, documents the history of the HBM Framework and discussed its relevance to the research goals of this study. The chapter also examined several articles that utilized the HBM in examining variables or topics relevant to the goals of this study. The chapter also outlined similarities between articles and research that adapted the HBM in the study of health

behaviors and actions regarding immunizations. A systematic strategy for the location and selection of articles deemed relevant to the research goals of this study was outlined and the literature review procedures utilized to locate and examine relevant articles and studies was explained. Beginning with studies that focused on vaccinations and immunization, articles were chronologically reviewed to detail historical documentation and findings from the status and issues pertaining populations and immunizations. How did mass vaccination campaigns about polio fare among various populations in comparison to their response to diseases like small pox that was successfully eliminated? Additionally, the review looked at statutory mandate" a practice whereby governments legislates to enforce the acceptance of vaccines to protect against certain diseases amongst their population. Published population, behavioral patterns towards vaccination mandates, observed practices both statutory and individual towards immunizations and vaccination mandates, were delineated. Successes attained by public health practitioners in combatting and eradicating preventable childhood diseases were discussed, and public resistance or rejection of immunization despite statutory mandates were noted and where possible explained.

The literature reviewed revealed that statutory mandates achieved above average success although due to concern about infringement on individual rights, many governments had to incorporate opt out clauses. Some segments of the population in many countries especially the Western Countries seem to exploit the "opt out" clauses to decline the mandated immunization requirements. Studies also showed that in areas where the parents opted out, there was higher than usual increase in the incidence of the

diseases the vaccines could have prevented. Also, due to the use of opt-out clauses, some diseases that had not recorded outbreaks over many years like measles have re surfaced although, small pox seems to have been truly eliminated from the world. Consequences and outcomes of "opt-out clauses" and the effect that rumors had on why parents opt out of mandated immunization requirements was discussed. The "opt-out clauses" were included in legislation to protect the rights of parents who may decline certain health services due to holding contrary religious beliefs or persuasion. Nevertheless, studies reported that "rumors" some which may stem from religious roots, influenced parental opt-outs more than just personal or individual philosophical beliefs leading parents to abstain. Some parental concerns leading to vaccine rejection were traced to evidence of post-vaccination infections with diseases that were being prevented. In particular, the most widely used OPV recorded mutations in certain strains resulting in full-blown paralysis (vaccine-associated paralytic poliovirus), in children who have received polio vaccination at birth. While most of the affected children were reported to be clinically immune deficient, few parents were conversant with this clinical analysis. They told other parents that the vaccines were ineffective, and some even proclaimed them to be out rightly dangerous.

Several articles that focused primarily on immunization status in Nigeria in particular, were examined in detail to highlight the research and data gaps this study was designed to fill. Overall, the information gleaned from the literature reviewed, provided the researcher a solid background on which a framework of investigation about the caregiver compliance with the polio vaccine regimen in Lagos State can be constructed.

Issues raised from reviewed literature enable the strengthening and sometimes broadening the scope of research questions included in the questionnaire to be administered to caregivers in this study.

Chapter 3: Research Method

Overview of the Chapter

Chapter 3 builds on the previous academic and social parameters previously examined about immunization and vaccines in general, focusing mainly on the polio vaccination process in Nigeria. The chapter briefly addressed research methods and strategies that provided answers to the questions this study sought to answer. The chapter also includes discussion of the nature and scope of the study, the geographical locations where the research was conducted, and the study population and sample. Furthermore, it addresses the study design and instrumentation, and anticipated ethical challenges and precautions are discussed and explained in this chapter. Also, the chapter enumerates the ethical applications in the participant selection process, the selection criteria, and maintenance of ethical standards in the research process. Finally, the chapter includes techniques of data collection, data pilot testing, the data analysis and dissemination.

Theoretical Framework

Human interactions have resulted in values that have evolved from the shared and communal conversations and influences over a broad spectrum of affairs and across a large scope of existence (Lincoln & Guba, 1985). While the specific experiences may not be the same, communal values manifest in behaviors, and such similarities and differences are often observed in studies conducted by researchers. The language that enables researchers to anchor these observations for further comparative analysis is defined as theory (Rudestam &Newton 2007). Enclosing these theoretical languages within a comparative framework guides the choice of an appropriate mindset to view the

researcher's observations. Fortunately, these frameworks can be applied across the board to similar studies, making them what researchers classify as generalizable. Theoretical perspectives typically guide the choice of appropriate research methodology. This study employed the HBM as the guiding framework or perspective to consider the issues I sought to uncover using numerical information. The anchoring base for the HBM is the understanding of the role of belief in the execution of human actions or health decisions. The theory enumerates that "belief is a composite derivative of personal values, culture, and understanding. These influence a person's attitude, which inevitably affects their decisions and actions. Rosenstock, (1966).

Polio, although recently eliminated from Nigeria, was endemic for centuries in the country because people were non -compliant with the statutory mandate for early childhood immunizations. Yahaya, (2007). The programs and concerted effort of the government of Nigeria and its collaborators at all levels seem to take one step forward and two backward with regards to polio eradication. Setbacks were often a result of inadequate vaccination uptake and incomplete doses of the vaccines. This makes it imperative and important to understand caregiver demographics and to assess the polio vaccination compliance among the people to ensure optimal and wholesome community immunity to the disease poliomyelitis.

Research Design

This study was a cross-sectional quantitative research that utilized a purposive sampling procedure. Participants in the study were recruited from public health centers in eight LGAs of Lagos State in the southwest region of Nigeria. A simple demographic

survey questionnaire was used to collect demographic information about the caregivers. Caregivers were encouraged to refer to the records from government-issued children's immunization records to buttress their recall. Participants were recorded as noncompliant if there was no recall or evidence from their government-issued immunization cards that the polio dose was administered on their child within a specific time period. The number and timing of the polio vaccine dose received was recorded in the survey questionnaire.

Research Objectives

This study's main objectives were as follows:

- To identify the demographic attributes of caregivers in Lagos State, Nigeria. Data provided information about the age, gender, geographic location of residence (rural vs. urban), and level of educational attainment of participating caregivers.
- To examine the demographic attributes of caregivers to verify if a statistically significant relationship exists between the caregiver attributes and their level of compliance with the uptake of the recommended four doses of polio vaccine.
- To examine caregiver compliance with the receipt of each of the recommended polio vaccines A, B, C and D within the stipulated timelines for their uptake.

As the research, I ascertained information about how many of the four doses of polio vaccines the child has received and when. Recall of vaccination receipts were compared to the stipulated timeline to assess compliance with the recommended time schedules.

Furthermore, demographic attributes of the caregivers were obtained from the brief questionnaire and plotted as independent variables against compliance with doses of polio vaccine and timelines of uptake. Participants were recruited from caregivers attending public well-baby clinics in eight LGAs of Lagos State, Nigeria. The number of Polio Doses A, B, C, D, and the WHO-prescribed timelines in months and years were the dependent variables in this study. The dependent variable was coded and entered as compliance no/yes (0/1). The missing of any of the polio doses was counted as noncompliance. Nonadherence to the timeline for any of the polio doses was also counted in a no/yes (0/1) manner. These statuses were then plotted against the caregiver demographic attributes of age, gender, geographical location of residence (rural vs. urban), and their level of educational attainment, which were the independent variables. Possible associations between the independent and dependent variables were statistically derived using chi square analysis and multiple logistic regression analysis.

Research Questions and Hypotheses

There were two sets of research questions in this study. Data were obtained in a two-pronged manner. The dependent variables were derived from data obtained about children's completion of the four polio vaccine doses and doing so within the specified timelines of uptake. The independent variables were the caregiver demographic data obtained from questionnaires.

Dependent Variables

DV 1 = How many of the recommended four doses of OPV were received by each child?

DV 2= How timely are the caregivers' receipts of these doses of polio vaccines?

Independent Variables

IV 1 = Age of caregivers

IV 2 = Gender of caregiver.

IV 3 = Geographical location of caregivers' residence (rural vs urban).

IV 4 = Level of caregivers' educational attainment.

Dependent Variable Coding

DV 1: The number of the four doses of the polio vaccine received by each child whose immunization card is accessed. Were recommended four doses received? Yes (compliant) = 1. No (noncompliant) = 0.

DV 2: How compliant was the receipt of each dose of polio within the specified time line of uptake? Were four doses received timely? Yes (timely) = 1. No (not timely) = 0.

Two broad research questions were answered by the data obtained in this study. They are written out in two sets plotting each dependent variable against the four independent variables being examined. This grouping tested for an association between each dependent variable and the four independent variables.

Research Questions Set 1

RQ1: What is the association between caregivers' age and their receipt of four doses of polio vaccine?

$H_0$1: There is no association caregivers' age and their receipt of four doses of polio vaccine.

H_a1: There is an association between caregivers' age and their receipt of four doses of polio vaccine.

RQ2: What is the association between caregivers' gender and their receipt of four doses of polio vaccine?

$H_0 2$: There is no association caregivers' gender and their receipt of four doses of polio vaccine.

$H_a 2$: There is an association between caregivers' gender and their receipt of four doses of polio vaccine.

RQ3: What is the association between caregivers' geographical location of residence (rural vs urban) and their receipt of four doses of polio vaccine?

$H_0 3$: There is no association between caregivers' geographical location of residence (rural vs urban) and their receipt of four doses of polio vaccine.

$H_a 3$: There is an association between caregivers' geographical location of residence (rural vs urban) and their receipt of four doses of polio vaccine.

RQ4: What is the association between caregivers' level of educational attainment and their receipt of four doses of polio vaccine?

$H_0 4$: There is no association between caregivers' level of educational attainment and their receipt of four doses of polio vaccine.

$H_a 4$: There is an association between caregivers' level of educational attainment and their receipt of four doses of polio vaccine.

Research Questions Set 2

RQ1: What is the association between caregivers' age and their timely uptake of four doses of polio vaccine?

$H_0$1: There is no association between caregivers' age and their timely uptake four doses of polio vaccine.

H_a1: There is an association between caregivers' age and their timely uptake of four doses of polio vaccine.

RQ2: What is the association between caregivers' gender and their timely uptake of four doses of polio vaccine?

$H_0$2: There is no association between caregivers' gender and their timely uptake of four doses of polio vaccine?

H_a2: There is an association between caregivers' gender and their timely uptake of four doses of polio vaccine?

RQ3: What is the association between caregivers' geographical location of residence (rural vs urban) and their timely uptake of four doses of polio vaccine?

$H_0$3: There is no association between caregivers' geographical location of residence (rural vs urban) and their timely uptake of four doses of polio vaccine?

H_a3: There is an association between caregivers' geographical location of residence (rural vs urban) and their timely uptake of four doses of polio vaccine?

RQ4: What is the association between caregivers' level of educational attainment and their timely uptake of four doses of polio vaccine?

$H_0$4: There is no association caregivers' level of educational attainment and their timely uptake of four doses of polio vaccine?

H_a4: There is an association between caregivers' level of educational attainment and their timely uptake of four doses of polio vaccine?

Study's Population

The study was conducted within the boundaries of Lagos State, one of 36 states in Nigeria and the most densely populated of all the states. Lagos State is a microcosm of Nigeria as it reflects the true ethnic, cultural, and economic diversity that typifies the country. The broad-based diversified characteristics of the demographics in Lagos State provided a closely accurate picture of the issues relating to health practices and vaccination compliance among clusters of the population in Nigeria. Lagos State comprises 20 LGAs and 37 local government development areas. These 20 LGAs are situated across urban and rural communities. Economically, the LGAs also demonstrate varying levels of socioeconomic classifications. There are LGAs that are considered economically high levels in terms of social and economic factors like Eti Osa, Ibeju /Lekki LGAs. There are also LGAs like the Lagos Island LGA, which demonstrates associated characteristics of highly urban, high density, and high poverty amongst its residents. LGAs like the Ikorodu, and Epe, which can be classified as rural.

Sample Size

Lagos State has a population of 9 million people (NDHS, 2013). These populations spread across urban and rural cities and villages. A stratified sampling approach was used basing population estimates on the records in the Nigeria NDHS

conducted in 2013. The research population consists of people in eight LGAs. These selected LGAs are presumed to be reflective of the possible demographic characteristics that obtain within the state. Most LGAs have 2 or more "clinics" where the well-baby visits are conducted. Study participants were recruited from LGAs representing high socioeconomic category, medium socioeconomic category, high urban, low SES and a rural and low SES LGA. This variation in demographic classes provides a broad spectrum that enhances comparative analysis of the data collected.

Sample Size Formula

$$(\hat{p} - 2\sqrt{0.25/n}, \hat{p} + 2\sqrt{0.25/n})$$

http://www.raosoft.com/samplesize.html

Estimated sample size was derived from the National Population Census Figures for each LGA. The census data was entered into the Raosoft Inc Sample Size Calculator software to estimate targeted sample size for each area. Since clinic size vary, larger clinics may yield a disproportionate larger sample size than smaller or rural clinics. A weighted sampling method was therefore employed to ensure equitable ranking among the study population. Weighing the sample size will minimize the differences in population distribution by streamlining the amount of data collected from each location in the study. These census figures were entered into a web-based software to derive the sample size using appropriate statistical formulas. Although participants will be drawn from a convenience sample – (caregivers who are visiting the well-baby clinics) randomization was achieved by visiting clinics on alternate days over a 10-week period.

Table 3

Sample Size Calculations Based on 2013 Census Figures

Local Government Area	Census Population	Geographic classification Rural or Urban	Number of clinics	Targeted Participant recruitment sample size	Positive response sample Size
Agege	459,939	Urban	8	394	190
Epe	181,409	Rural	4	185	93
Ikorodu	535,619	Urban	7	402	201
Ifako Ijaiye	427 878	Urban	6	380	190
Oshodi Isolo	621 509	Urban	10	325	163
Badagry	214 093	Rural	4	162	81
Ojo	598071	Urban	6	420	210
Lagos Island	209437	Urban	4	123	62
Total					1200

Table 4

Data Recoding of Dependent Variable- Polio Dose A

Variable *D.V 1*	Variable Type	Measure(s)	Initial Coding	Recoding D.V 2
D. V Polio Dose A	Categorical Tables	Dose received Yes or No Q 5. Did the child receive the first dose of polio vaccine?	Polio Dose A	Timeline of Receipt 1) At Birth 2) Other Yes = 1 No = 0

Note. D.V = Dependent Variable

Table 5

Data Recoding of Dependent Variable – Polio Dose B

Variable ***D.V 1***	**Variable Type**	**Measure(s)**	**Initial Coding**	**Recoding D.V 2**
D.V Polio Dose B	Categorical Tables	Dose received Yes or No Q 6. Did the child receive the second dose of polio vaccine?	Polio Dose A	Timeline of Receipt 1) 6 weeks 2) Other Yes =1 No = 0

Note. D.V = Dependent Variable

Table 6

Data Recoding of Dependent Variable- Polio Dose C

Variable ***D.V 1***	**Variable Type**	**Measure(s)**	**Initial Coding**	**Recoding D.V 2**
D. V Polio Dose C	Categorical Tables	Dose received Yes or No Q 7. Did the child receive the third dose of polio vaccine?	Polio Dose A	Timeline of Receipt 1) 12 weeks 2) Other Yes = 1 No = 0

Note. D.V = Dependent Variable

Table 7

Data Recoding of Dependent Variable – Polio Dose D

Variable ***D.V1***	**Variable Type**	**Measure(s)**	**Initial Coding**	**Recoding DV2**
D. V Polio Dose D	Categorical Tables	Dose received Yes or No Q 8. Did the child receive the fourth dose of polio vaccine?	Polio Dose A	Timeline of Receipt 1) 2 years of age 2) Other Yes = 1 No = 0

Note. D.V = Dependent Variable

Table 8

Data Recoding of Independent Variable – Caregivers' Gender

Variable	**Variable Type**	**Measure(s)**	**Initial Coding**	**Recoding**
I.V 2 Gender	Demographic	Caregiver Gender Question 1 Are you male or female?	Gender	Gender 1- Male 2- Female

Note. I.V = Independent Variable

Table 9

Data Recoding of Independent Variable- Caregivers' Age

Variable	Variable Type	Measure(s)	Initial Coding	Recoding
I.V 1 Age	Demographic	Caregiver Age Question 2 What is your age range?	Age	Age 1. 1 - 19 years of age 2- 20 -29 years of age 3. 30- 39 years of age 4. 40 - 49 years of age 5. 50 -59 years of age 6. 60- 69 years of age 7. 70- 79 years of age 8. 80 years and above

Note. I.V = Independent Variable

Table 10

Data Recoding of Independent Variable – Location of Caregivers' Residence

Variable	Variable Type	Measure(s)	Initial Coding	Recoding
I.V 3 Caregiver residence	Demographic	Caregivers' Residence Where do you Live? Rural or Urban Area? Rural - 2 - 50000 Urban - 50000 - 1 million	Residence	Location of residence 1- Rural 2- Urban

Note. I.V = Independent Variable

Table 11

Data Recoding of Independent Variable- Level of Caregivers' Educational Attainment

Variable	Variable Type	Measure(s)	Initial Coding	Recoding
I.V 4 Level of Formal Education	Demographic	Caregiver Education Question 3 How much formal education have you had?	Level of Education	1. No Formal Education 2. Primary School Education 3.Secondary/High School Education 5. Associate College Education 6. College Education. 7. Post College Education

Note. I.V = Independent Variable

Data Collection Strategy

Data was collected by the researcher at the selected LGA clinics, namely Agege, Badagry, Epe, Ifako / Ijaiye, Ikorodu, Lagos Island, Ojo, and Oshodi/Isolo. Participants were recruited from caregivers present at the location on that day. The researcher prominently displayed a large banner in a visible area of the clinics. Recruitment flyers were also prominently displayed at the clinic sites and handed out to caregivers to seek participants for this study. Voluntary participation was sought from caregivers at each location. Verbal and written consent were obtained from those willing to participate in the study. There was no monetary or any other form of incentives offered for participation in the study.

Caregivers, who volunteered were led to a secure area to fill out the survey questionnaires or be interviewed by the researcher. Caregivers who had their children's immunization card were encouraged to refer to these to enhance their recall of the information required for the research. All caregivers who are present at the clinic with children aged 0 to 6 years of age were eligible for inclusion in this study regardless of their compliance status. Every caregiver present were collectively addressed and approached to participate in the study. Only those who signified their consent to participate were given the survey questionnaires or interviewed by the researcher. Once consent was obtained, the caregivers were moved to a private secluded area where they read and or received the consent form (Appendix A). Respondents were given the opportunity to ask any clarifying questions, and were informed of their right not to answer any questions if they so desire. They were also made aware of their rights to

choose to decline participation if they so wish. Once consent was given, and survey questionnaires have been completed participants exited the interview area by themselves or were escorted back if they so requested. Appendix B is a sample of the survey questionnaire utilized in this study. Collected data was stored in a safe place following ethical data security procedures in the clinics and the LGA data safety policies as outlined in the recruitment and interview forms. (see Appendix A).

Pilot Test

A pilot study was conducted in three LGAs of Lagos State namely – Alimosho, Mushin and Surulere. The pilot study was to evaluate the reliability and validity of the short self- designed demographic survey instrument. A total of 77 respondents including caregivers who were recruited at the clinics and especially clinic personnel who were demographically qualified to participate in the study were interviewed or given the questionnaire to complete. Minor adjustments were made to the questionnaire as some participants found some of the questions confusing. Especially, question 3 which asked about the level of educational attainment of the participants. There were too many options asking whether they had some or completed a certain level of education. The questionnaire was simplified from 9 options for question 3 a) No Formal Education, b). Some Primary School Education, c). Completed Primary School Education, d) Some Secondary School Education, e) Completed Secondary School Education, f) Some College Education, g) Completed College Education h) Some Post College Education. These 9 options were reduced to 6. a) No formal education, b) Primary level education, c) Secondary /high school education, d) Associate college level or professional certificate,

e) College level education and f) Post college level of education. Also, the question about marital status was retained on the questionnaire as the consensus of opinions was that it was a valid question although marital status was not included among the independent variables measured in this study.

Questions in the survey instrument are simple direct demographic questions that have been proven valid and reliable in numerous studies. (Appendix C). The ideal goal was to recruit participants from LGAs within designated demographic parameters to facilitate ample comparison of the data collected and enhance generalization within the context of what obtains in the population of Lagos State. The pilot LGAs were those that shared similar demographic distribution with the eight LGAs where the actual study was done. These pilot LGAs were chosen to demonstrate the variety in the social, economic and demographic characteristics of the eight LGAs selected for the study. The study included local governments with – a) urban demographics with high poverty rates, b) a sub urban demographics with middle-class population, c) a rural demographic with high poverty population and d) a semi-rural demographics with middle-class population. Recruitment procedures for the pilot study were similar to those used in the actual study. Volunteer participants were sought at the well-baby clinics in the pilot test LGAs. While clinic used in the actual study were visited for several days over a period of time, those used in the pilot study were visited just once. Results from the pilot study provided information to the researcher about the participant selection process and the applicability of the survey instruments. Also, the percentage of survey volunteers gave an insight into how many visits were likely required to the study selected locations to achieve reach an

acceptable sample size. The pilot test provided insight into the appropriateness of the survey questions, and served as a template to ensure seamless research. Since survey instrument is a simple self- designed questionnaire, pilot study was tested for validity and reliability. The Cronbach alpha coefficient for the pilot study was above 0.70 which denotes acceptability for reliability and validity by general social science standards.

Research Questions and Hypotheses

Two research questions guided this study. A two-pronged data collection approach was employed. The dependent variables were derived from data obtained about the children's immunization records on the completion of the four polio vaccine doses and doing so within the specified timelines of uptake. The independent variables were the demographic data obtained from questionnaires applied to caregivers.

Dependent Variables

DV 1 = How many of the recommended four doses of OPV were received by each child?

DV 2 = How timely are the caregivers' receipts of these doses of polio vaccines?

Independent Variables

IV 1 = Age of caregivers

IV 2 = Gender of caregiver.

IV 3 = Geographical location of caregivers' residence (rural vs urban).

IV 4 = Level of caregivers' educational attainment.

Dependent Variable Coding

DV 1: The number of the four doses of the polio vaccine received by each child whose immunization card is accessed. Were recommended four doses received? Yes (compliant) = 1. No (noncompliant) = 0.

DV 2: How compliant was the receipt of each dose of polio within the specified time line of uptake? Were four doses received timely? Yes (timely) = 1. No (not timely) = 0.

Two broad research questions will be answered by the data obtained in this study. They are written out in two sets plotting each dependent variable against the four independent variables being examined. This grouping tested for an association between each dependent variable and the four independent variables.

Research Questions Set 1

RQ1: What is the association between caregivers' gender and their receipt of four doses of polio vaccine?

$H_0$1: There is no association caregivers' gender and their receipt of four doses of polio vaccine.

H_a1: There is an association between caregivers' gender and their receipt of four doses of polio vaccine.

RQ2: What is the association between caregivers' age and their receipt of four doses of polio vaccine?

$H_0$2: There is no association caregivers' age and their their receipt of four doses of polio vaccine.

H_a2: There is an association between caregivers' age and their receipt of four doses of polio vaccine.

RQ3: What is the association between caregivers' geographical location of residence (rural vs urban) and their receipt of four doses of polio vaccine?

$H_0 3$: There is no association between caregivers' geographical location of residence (rural vs urban) and their receipt of four doses of polio vaccine.

$H_a 3$: There is an association between caregivers' geographical location of residence (rural vs urban) their receipt of four doses of polio vaccine.

RQ4: What is the association between caregivers' level of educational attainment and their receipt of four doses of polio vaccine?

$H_0 4$: There is no association between caregivers' level of educational attainment and their receipt of four doses of polio vaccine.

$H_a 4$: There is an association between caregivers' level of educational attainment and their receipt of four doses of polio vaccine.

Research Questions Set 2

RQ1: What is the association between caregivers' gender and their timely uptake of four doses of polio vaccine?

$H_0 1$: There is no association between caregivers' gender and their timely uptake of four doses of polio vaccine?

$H_a 1$: There is an association between caregivers' gender and their timely uptake of four doses of polio vaccine?

RQ2: What is the association between caregivers' age and their timely uptake of four doses of polio vaccine?

H$_0$2: There is no association between caregivers' age and their timely uptake of four doses of polio vaccine.

H$_a$2: There is an association between caregivers' age and their timely uptake of four doses of polio vaccine.

RQ3: What is the association between caregivers' geographical location of residence (rural vs urban) their timely uptake of four doses of polio vaccine?

H$_0$3: There is no association between caregivers' geographical location of residence (rural vs urban) their timely uptake of four doses of polio vaccine?

H$_a$3: There is an association between caregivers' geographical location of residence (rural vs urban) their timely uptake of four doses of polio vaccine?

RQ4: What is the association between caregivers' level of educational attainment and their timely uptake of four doses of polio vaccine?

H$_0$4: There is no association caregivers' level of educational attainment their timely uptake of four doses of polio vaccine?

H$_a$4: There is an association between caregivers' level of educational attainment their timely uptake of four doses of polio vaccine?

Data Analysis

The data were entered in an Excel Spreadsheet and incorporated into the SPSS statistical software for analysis. Descriptive statistics including frequency tables was used to analyze demographic variables like gender, age, level of educational attainment and

location of residence (rural versus urban). Chi square analysis was employed to compare compliance with each of the four doses of the polio vaccine to caregiver demographic attributes - age, level of education attained and rural or urban dwelling.

The chi square table were 2 by 2 tables for each variable, for example, Age vs Polio Dose A, B, C, D, and a 3 by 4 table for all variables – Age, Education, Rural/Urban and Polio Dose A, B, C, D. They stated the

- Degree of Freedom for each of the squares in the chi square
- *P* value
- Confidence interval level of 95% was assumed.

Each hypothesis in the study was tested using the chi square test table to determine if significant association existed between the variables. Because the chi square analysis does not calculate the strength of associations even if they exist, logistic regression, and multiple logistic regression analysis was also calculated to assess the strength of associations that were significant.

Logistic Regression Modeling

Logistic regression analysis was employed plotting the dependent variables against the independent variables and controlling for confounders. Both dependent variables are coded binary as yes (1) and no (0). With each dependent variable, all significant variables derived from binary regression analyses were entered in the multiple logistic regression modeling analysis to build the best parsimonious model explaining the variation in the related dependent variable.

Ethics

Ethical considerations have become paramount in the planning, design and execution of research studies. According to (Quinn, 2004), researchers need to ensure their design and implementation protects human subjects. They also must be objectively assured that the benefits of the research study far outweigh the risks if any, to the population among whom it is being conducted. The Department of Health Education and Welfare in 1979 set forth universal guidelines for the conduct of research involving human subjects in The Belmont Report.

This study acknowledged and agreed with the principles adopted in The Belmont Report and conforms to the stipulations therein. Furthermore, this research study was conducted under the guidance of the faculty and staff of Walden University. The College has set guidelines including approval of all research protocol and methodology by an Institutional Review Board. (IRB). This study will follow and comply absolutely with the guidelines set forth by the Walden University policies.

Ethical Approval Process.

The Walden University IRB process involves the submission of each research proposal after defense and approval by the dissertation committee, to go through further review by a University constituted IRB. The Walden University IRB reviewed proposed research methodology and issued approval to conduct research with approval number 02-23-16-0118907 before commencement of the field work.

Protection of Participants' Rights

Every humanly possible effort was made to ensure the protection not only of the privacy of the participants in this study, the confidentiality of the information provided, opinions and ideas shared or expressed was also carefully protected. Informed consent was sought from each participant. This was done orally and documented. The Research consent form briefly described the title of the research study, the name and contact information of the researcher, the name of the university and the contact information of the University IRB specialist in case the participant wanted further enlightenment or had questions about the study or their participation in it. All this information was made available to the participants before commencement with data collection. It was assumed that completion of the questionnaire after this process implied consent. Furthermore, participants were informed they could keep a copy of their signed consent form for their records. There is minimal risk exposure for any participant in this research study. The information in the questionnaire was designed to make the participant anonymous and the responses cannot be traced to anyone in particular since no names or signatures were required from respondents.

Verification of Data

Each participant will be assigned numerical identity. Initial verification of the data can be obtained by direct comparison of the transcripts with the demographic information relevant to the participant. Transcripts will also be compared to the set research questions to ascertain that exhaustive and germane information had been generated from the

discussion. Opportunity was given to participants to confirm that their information has been clearly stated, reported and documented.

Validity and Reliability of the Research Data

Each researcher owns the responsibility and bears the burden to ensure the compliance of their findings with professional and university prescribed standards. To achieve credibility, the researcher needs to truthfully acknowledge bias and protect against its influence coloring the findings. The researcher eschewed bias in selection as all caregivers present were given equal opportunity to volunteer and participate in the study as long as they had children whose age was within the cut off for the study which was 0 to 6 years of age. Mangal et al. (2014) authenticated the veracity of that data extracted from vaccination cards. The authors noted the congruence between initial numbers extracted and the numbers recorded after a 60-day follow-up data comparison.

Summary of Chapter 3

This chapter explained the study's choice of a quantitative methodology and the corresponding theoretical framework guiding the research process. Furthermore, the chapter stated the research goals and the questions to be answered from surveying the participants. A brief description of the population to be studied was also given. The steps to estimating the sample size were delineated, and the instrumentation for data collection was explained. A pilot study was proposed to validate the research tool – survey and to ensure the ease of the research process. Data collection, the study's assumptions and ethical considerations for the research were also explained in this chapter.

Chapter 4: Results

With this cross sectional quantitative study conducted in Lagos State, Nigeria, I intended to assess caregiver compliance with the regimen of four doses of polio vaccine and ascertain if these were received within the specified timelines for uptake. Primary data were collected from 1,220 participants recruited from well-baby clinics in eight LGAs of Lagos State. Caregivers were asked to recall and record the number of polio vaccine doses their wards had received at the time of participation. While data were collected based on caregiver recall, most caregivers had in their possession written records of the information required in their government-issued immunization cards for each child. Many of the caregivers corroborated their answers with the records on their immunization cards assuring a high level of accuracy of the recalled information. A brief demographic questionnaire with questions about the caregivers' gender, age, level of educational attainment, and location of residence was also applied. Data were collected over a period spanning 10 weeks, during which time I visited various clinics to recruit participants.

Data collected were two pronged. The first set of data provided information that constituted the dependent variables in the study. These were as follows: (a) how many of the recommended four doses of polio each child received, and (b) whether the child received each of these doses of polio vaccine within the specified timeline for uptake: Polio Dose A = birth to 2 weeks, Polio Dose B = 6 weeks, Polio Dose C = 10 weeks, and Polio Dose D = 16 weeks after birth. The second set of data provided information that constituted the independent variables in this study. They were the demographic

information about the caregivers. These include their gender, age, location of residence (rural vs urban), and the level of their educational attainment. Variables for each set of research questions were coded on nominal and ordinal scales. The number of polio doses were coded as A, B, C, and D, and compliance or receipt of each was coded Yes or No (Yes =1 and No = 0). Demographic attributes included in the research questions were gender, coded Female = 1 Male = 2; age, coded less than 20, 20 to 29, 30 to 39, 40 to 49, 50 to 59, 60 to 69, and 70 or above; location of residence, coded Rural = 1, Urban = 2. The level of educational attainment had six categories: no formal education, primary or elementary education, secondary or high school education, associate's degree or professional certificate, college degree, and graduate and postgraduate degree. I present in this chapter tables of the results from the data analyses including frequency tables, chi square analysis to test for possible significant associations between each categorical independent variable, and logistic and multiple regression analysis.

Results Outline

A pilot study was conducted to validate the reliability of the demographic questionnaire applied in this study. I begin with the findings on the pilot study and the measurement of the reliability using the Cronbach alpha coefficient test results. Furthermore, I present the analyzed result from the research survey in a descriptive and inferential order. In the descriptive presentation, the univariate analysis of the frequency characteristics of the sample is presented. These include the overall demographic characteristics of the study sample in terms of the categories gender, age, location of residence (rural vs urban), and the level of educational attainment of the caregivers

interviewed. These include data on the caregivers' demographic attributes as well as the independent variables in the study. Next, I report on the baseline information obtained on the number of polio doses and the timelines for their receipt. Under this category, I enumerate what percentage of the 1,220 participants received each polio dose (were compliant) and how many of those doses were received within the specified timelines. Inferential statistical analysis findings from the results are discussed in alignment with the research questions of from the study. Each research question was recapped and the results of the statistical analysis to determine significant association and the relevant statistical tests utilized are discussed.

Pilot Study Results

A self-designed demographic questionnaire was utilized in this study. The questionnaire contained seven items: gender, age, location of caregivers' residence/clinic where interview occurred, level of caregivers' educational attainment, number of polio doses received, timeline of receipt of each dose of polio vaccine, and reasons or gap if a dose was missed or the timeline was not compliant. Three LGAs that were not included in the actual study were the location of the pilot study. The pilot study was conducted in Alimoso, Mushin, and Surulere. Somolu LGA was initially proposed as the fourth site for the pilot study. However, the first three LGAs yielded more participants than proposed (n = 76 instead of 60 proposed), so Somolu LGA was excluded. The Cronbach alpha coefficient calculated to ascertain the reliability of the questionnaire gave an overall figure of .669. While the rule of the thumb regarding alpha values propose a value of .70 and above to be generally acceptable as a reliable, .669 was also deemed acceptable as it

fell within the range with more broad support amongst scholars. Generally, the acceptance scale for the Cronbach's alpha test of reliability is $\alpha \geq 0.9$ (excellent), $0.7 \leq \alpha \leq 0.9$ (good), $0.6 \geq \alpha \leq 0.7$ (acceptable), $0.5 \leq \alpha$ (unacceptable). The Cronbach's alpha analysis of each individual question in this survey yielded various results on the impact of the deletion of each of the questions from the overall alpha rating. This is in line with the observed limitations of the Cronbach's alpha test because the test assumes that all the indicators on the questionnaire are equally reliable and carry the same loading in the analysis of a construct. This however is not always the case. Spiliotopoulou (2009), expatiating on this limitation, advocated the acceptance of values based on the context of a specific study as opposed to using a generalized rating. Overall, the α rating of .669 is close enough to the .070 scale and therefore makes this questionnaire reliable in the context of this study.

Table 12

Cronbach's Alpha Coefficient Test Result

Cronbach's Alpha Coefficient Reliability Score for Pilot Study Questionnaire	
Cronbach's Alpha	No of Items
.669	9

Descriptive Statistics

Table 13 presents the demographic characteristics of the 1,220 study participants.

Table 13

Demographic Characteristics of Study Participants

Independent Variable	*Frequency*	*Percentage of sample*
Gender:		
Female	1207	98.9
Male	13	1.1
Age:		
<20 years	17	1.4
21-30 years	483	39.6
31-40 years	648	53.1
41-50 years	55	4.5
51+ years	3	.3
Location of Residence		
Urban	859	70.4
Rural	361	29.6
Educational level		
No education	47	3.9
Primary education	101	8.3
Secondary/high school	580	47.5
Associate OND/Vocational	180	14.8
College/ Higher Diploma	290	23.8
Graduate	22	1.8
Total	1,220	100

The participants in this study were mostly women (99%) and only 1% male. More than half of the population were in the 31 to 40 age group with 40% in the 21 to 30 age group. More than 70% of the participants lived in urban areas with only 30% living in rural areas. Caregivers' who had high school or secondary education were in the majority amongst the study population (47.5%), and only 22 or 1.8% had graduate level education; 14.8% of the study participants had an associate or vocational degree with 23.8% having obtained a college degree.

Dependent Variable Results

The dependent variables for this study were (a) the number of children who received each of the four doses of polio vaccine and (b) the number of children who received each of the four doses of polio vaccines within the specified timelines. Tables 14 and 15 present the findings of the study regarding (a) each of the polio doses received by the participants and (b) caregivers' compliance with the receipt of each of the polio doses within the specified timelines.

Table 14

Data on Overall Receipt of Polio Doses and Percentages (N = 1,220)

Polio Dose	Number of those who received	Percent of total sample received	Number of those who missed	Percent of total sample missed
Polio Dose A	1173	96.1%	47	3.9%
Polio Dose B	1148	94.1%	72	5.9%
Polio Dose C	1144	93.8%	76	6.2%
Polio Dose D	1117	91. 5%	103	8.5%

A majority of the children received the polio doses; however, the receipt percentages declined from 96% for Polio Dose A, to 94% for Polio Dose C. Polio Dose D had the lowest percentage of 92%.

Table 15

Data on Overall Compliance with Timelines of Receipt of Polio Doses

Polio Doses	Number of those compliant (received dose within specified timeline)	Percent of total who were compliant in the sample	Number of those who were noncompliant (did not receive dose within specified timeline)	Percent of total sample who were noncompliant
Polio Dose A	1158	94.9%	62	5.1%
Polio Dose B	1173	96.1%	47	3.9%
Polio Dose C	1144	93.8%	76	6.2%
Polio Dose D	1053	86.3%	167	13.7%

Compliance with the specified schedule of polio vaccine receipt was the second dependent variable in this study. Results indicated Polio Dose D to be the most likely dose of polio vaccine not to be received in a timely manner by participants in this study. Of 1,220 people surveyed, only 1,053 or 86.3% of them were compliant with the timely receipt of Polio Dose D; 167 or 1.7% of caregivers did not receive this those at the stipulated time. Most participants reported being most compliant with the receipt of Polio Dose B in a timely manner. 96.1% of caregivers were timely in their receipt of Polio Dose B with only 3.9% being noncompliant with timely receipt of that dose. Polio Dose A and Polio Dose C had reported compliance levels of 94.9% and 9.8% respectively.

Inferential Statistical Analysis

The inferential statistical analysis derived from this study's data aimed to directly answer the research questions by rejecting or failing to reject the null hypotheses. There were two dependent variables in the study; therefore two sets of research questions were proposed, each having one dependent variable (number of polio doses received, and

compliance with stipulated timeline of receipt of each of the four doses of polio vaccine). These dependent variables were cross analyzed with each of the four independent variables (caregivers' gender, age, location of residence, and level of educational attainment). Thus, there were four research questions per set of dependent variables, each with a proposed null or alternate hypothesis. I separated each question into individual strands, providing the data answer to each question and the rejection of or failure to reject the null hypothesis for each strand of these questions.

Research Questions, Set 1: Caregivers' Receipt of Four Doses of Polio Vaccine

Research Question 1: Receipt of Four Doses of Polio and Caregivers' Gender

RQ1: What is the association between caregivers' gender and their receipt of four doses of polio vaccine?

$H_0$1: There is no association caregivers' gender and their receipt of four doses of polio vaccine.

H_a1: There is an association between caregivers' gender and their receipt of four doses of polio vaccine.

Chi square analysis showed no statistically significant association between the caregivers' gender and their receipt of Polio Dose A, B, and C. Because frequency for this variable was smaller than five, a Fisher's exact reading was also taken aiming at utmost accuracy. The Fisher exact readings also showed no significant association between the gender of caregivers and their receipt of the polio doses. The null hypothesis therefore could not be rejected for the association between gender and Polio Doses A, B, C, and D.

Table 16

Percentage Distribution of Doses Received by Caregivers' Gender

Independent variable GENDER	***Polio Doses***	***Received***	***Missed***	***Chi Square value***	***P Value***	***Fisher's Exact***		***Degree of Freedom***	***Total***
						2 Sided	*1 Sided*		
Caregivers' Gender	*Dose A*								
	Female	*1145*	*62*	*0.457*	*.499*	*1.00*	*.636*	*1*	*1,220*
	Male	*13*	*0*						
Caregivers' Gender	*Dose B*								
	Female	*1161*	*46*	*0.523*	*.470*	*.552*	*.552*	*1*	*1,220*
	Male	*12*	*1*						
Caregivers' Gender	*Dose C*								
		1133	*74*	*1.885*	*.170*	*.183*	*.183*	*1*	*1,220*
	Female	*11*	*2*						
	Male								
Caregivers' Gender	*Dose D*								
		1107	*100*	*3.641*	*. 056*	*.088*	*.088*	*1*	*1,220*
	Female	*10*	*3*						
	Male								

Note. Significant at $P < 0.05$

Research Question 2: Receipt of Four Doses of Polio and Caregiver's Age

RQ2: What is the association between caregivers' age and their receipt of four doses of polio vaccine?

$H_0$2: There is no association caregivers' age and their receipt of four doses of polio vaccine.

H_a2: There is an association between caregivers' age and their receipt of four doses of polio vaccine.

Table 17

Percentage Distribution of Doses Received by Caregivers' Age

Independent variable AGE		Received	Missed	Chi Square Value	P value	Degree Of freedom	Total
Dose A	>-20	17	0				
	21-30	455	28				
	31-40	616	32	2.006	.919	6	1,220
	41-50	53	2				
	51-above	17	0				
Dose B	>-20	17	0				
	21-30	460	23				
	31-40	626	22	3.141	.791	6	1,220
	41-50	54	1				
	51-above	16	1				
Dose C	>-20	17	0				
	21-30	446	37				
	31-40	614	34	5.379	.496	6	1,220
	41-50	52	3				
	51-above	15	2				
Dose D	>-20	16	1				
	21-30	433	7				
	31-40	602	63	4.682	.585	6	1,220
	41-50	51	4				
	51-above	15	2				

Note. Significant at $P < 0.05$

Results showed no significant association between caregivers' ages and their receipt of Polio Doses A, B, C, and D. The null hypothesis was therefore not rejected.

Research Question 3: Receipt of Four Doses of Polio and Caregivers' Location of Residence

RQ3: What is the association between caregivers' geographical location of residence (rural vs urban) and their receipt of four doses of polio vaccine?

*H*03: There is no association between caregivers' geographical location of residence (rural vs urban) their receipt of four doses of polio vaccine.

H_a3: There is an association between caregivers' geographical location of residence (rural vs urban) their receipt of four doses of polio vaccine.

A chi square analysis value of .041 as well as a Fisher exact value of .033 (2-sided) and .021 (1- sided) confirmed a significant association between the uptake of Polio Dose A and the location of caregivers' residence. The null hypothesis was thus rejected for the association relating to caregiver's residence and receipt of Polio Dose A. Nevertheless, no significant association was recorded between the location of caregivers' residence and their receipts of Polio Doses B, C, and D. Table 18

Percentage Distribution of Doses by Location of Caregivers' Residence

Independent variable	**Polio Doses**	**Received**	**Missed**	**Chi Square value**	**P Value**	**Fisher's Exact**		**Degree of Freedom**	**Total**
Location of Residence						2 Sided	1 Sided		
	Dose A								
Location of Caregiver's Residence	Rural	343	18	4.171	.041	.033	.021	1	1,220
	Urban	836	23						
Location of Caregiver's Residence	Dose B								
	Rural	345	16	.465	.495	.601	.303	1	1,220
	Urban	12	31						
Location of Caregiver's Residence	Dose C								
	Rural	333	28	2.046	.153	.671	.355	1	1,220
	Urban	811	48						
Location of Caregiver's Residence	Dose D								
	Rural	328	33	.324	.569	.239	.122	1	1,220
	Urban	789	70						

Note. Significant at $P < 0.05$

Research Question 4: Receipt of Four Polio Doses and Caregivers' Level of Education

RQ4: What is the association between caregivers' level of educational attainment and their receipt of four doses of polio vaccine?

$H_0$4: There is no association between caregivers' level of educational attainment and their receipt of four doses of polio vaccine.

H_a4: There is an association between caregivers' level of educational attainment and their receipt of four doses of polio vaccine.

Table 19

Percentage Distribution of Doses by Level of Caregivers' Educational Attainment

Level of Education		**Polio Dose A**		**Polio Dose B**		**Polio Dose C**		**Polio Dose D**	
		Received	Missed	Received	Missed	Received	Missed	Received	Missed
No Schooling	Total count	45	2	45	2	42	5	43	4
	Percent	95.74%	4.26%	95.7%	4.3%	89.4%	10.6%	91.5%	8.5%
Pry School	Total Count	97	4	95	6	84	17	90	11
	Percent	96%	4%	94.1%	5.9%	83.2%	16.8%	89.1%	10.9%
High School	Total Count	562	18	552	28	517	63	520	63
	Percent	77.9%	32.1%	95.2%	4.8%	89.1%	10.9%	89.7%	10.3%
OND Vocational	Total Count	177	20	175	5	169	11	169	11
	Percent	89.8%	10.2%	97.2%	2.8%	93.9%	6.1%	93.9%	6.1%
College Degree	Total Count	278	20	287	3	271	19	275	15
	Percent	93.2%	6.8%	99.0%	1.0%	93.4%	6.6%	94.8%	5.2%
Graduate	Total Count	20	2	19	3	18	4	20	2
	Percent	**90.9%**	**9.1%**	**86.4%**	**13.6%**	**81.8%**	**18.2%**	**90.9%**	**9.1%114**

Note. Significant at $P < 0.05$

Data revealed mixed results on the association between caregivers' level of education and their receipt of the doses of polio vaccine. A significant association was found between the level of education of the caregivers and their uptake of Polio Doses A and D. The null hypothesis was rejected for these two doses. No significant association was found between the caregivers' level of education their receipt of Polio Doses B and C.

Research Questions, Set 2: Timely Uptake of the Four Doses of Polio

Research Question 1

RQ1: What is the association between caregivers' gender and their timely uptake of four doses of polio vaccine?

$H_0$1: There is no association between caregivers' gender and their timely uptake of four doses of polio vaccine?

H_a1: There is an association between caregivers' gender and their timely uptake of four doses of polio vaccine?

Regarding compliance with the timeline of uptake of polio vaccine doses and gender, there was no significant associations recorded between caregivers' gender and their timeliness in receiving Polio Doses A, B, C, or D. Both chi square figures and Fisher's exact figures were higher than the *p*-value of > 0.05 set as the standard for significant association. The null hypotheses were not rejected for the interaction between these variables.

Table 20

Timeline Compliance of Polio Doses Uptake and Caregiver's Gender

Independent variable GENDER	***Polio Doses***	***Compliant***	***Not compliant***	***Chi Square value***	***P Value***	***Fisher's Exact***		***Degree of Freedom***	***Total***
						2 Sided	*1 Sided*		
	Dose A								
Caregivers' Gender	*Female*	*1145*	*62*	*.704*	*.402*	*1.00*	*.510*	*1*	*1,220*
	Male	*13*	*0*						
Caregivers' Gender	*Dose B*								
	Female	*1136*	*71*	*.076*	*.783*	*.552*	*.552*	*1*	*1,220*
	Male	*12*	*1*						
	Dose C								
Caregivers' Gender	*Female*	*1091*	*116*	*2.650*	*.104*	*.114*	*.114*	*1*	*1,220*
	Male	*10*	*3*						
Caregivers' Gender	*Dose D*								
	Female	*1044*	*163*	*3.245*	*.072*	*.087*	*.087*	*1*	*1,220*
	Male	*4*	*9*						

Note. Significant at $P < 0.05$

Research Question 2: Association Between Caregivers' Age and their Timely Uptake of Four Doses of Polio

RQ2: What is the association between caregivers' age and their receipt of four doses of polio vaccine?

$H_0$2: There is no association caregivers' age and their receipt of four doses of polio vaccine.

H_a2: There is an association between caregivers' age and their receipt of four doses of polio vaccine.

Table 21

Timeline Compliance of Polio Doses Uptake and Caregivers' Age

Independent variable AGE	Polio Doses	Received	Missed	Chi Square Value	P value	Degree Of freedom	Total
Dose A	>-20	17	0				
	21-30	455	28				
	31-40	616	32	2.598	.857	6	1,220
	41-50	53	2				
	51-above	17	0				
Dose B	>-20	17	0				
	21-30	454	29				
	31-40	608	40	1.811	.936	6	1,220
	41-50	53	2				
	51-above	16	1				
Dose C	>-20	17	0				
	21-30	430	53				
	31-40	590	58	3.646	.823	6	1,220
	41-50	49	6				
	51-above	15	2				
Dose D	>-20						
	21-30						
	31-40	15	2			6	1,220
	41-50	408	75	3.394	.271		
	51-above	567	81				
		49	6				
		14	3				

Note. Significant at $P < 0.05$

There were no associations found between the age of caregivers' and their compliance with receiving any of the four doses of polio vaccine. The null hypotheses were not rejected as chi square analysis did not show significant association between caregivers' age and compliance with stipulated timelines for polio vaccine uptake.

Research Question 3: Association Between Caregiver's Location of Residence and Their Timely Uptake of Four Polio Doses

RQ3: What is the association between caregivers' geographical location of residence (rural vs urban) and their timely uptake of four doses of polio vaccine?

$H_0$3: There is no association between caregivers' geographical location of residence (rural vs urban) and their timely uptake of four doses of polio vaccine?

H_a3: There is an association between caregivers' geographical location of residence (rural vs urban) and their timely uptake of four doses of polio vaccine?

The location of caregivers' residence was found to be significantly associated with their receipt of Polio Dose A. Chi square figures showed a *p*-value of .021, which was less than the $p > 0.05$ standard for proof of significant association. Further test for accuracy using the Fisher's exact test also recorded a 1- sided value of .041, still less than the $p > 0.05$ value, thus confirming a significant association between compliant with Polio Dose A timeline and location of caregivers' residence. The null hypothesis was thus rejected for this variable. Location of caregivers' residence was not associated with their receipt of Polio Doses B, C, and D so the null hypotheses was not rejected for these doses.

Table 22

Timeline Compliance of Polio Doses Uptake and Location of Caregivers' Residence

Independent variable Location of Residence	Polio Doses	Compliant	Not Compliant	Chi Square value	P Value	Fisher's Exact		Degree of Freedom	Total
						2 Sided	1 Sided		
	Dose A								
Location of Caregiver's Residence	Rural	335	26	4.778	.029	.060	.041	1	1,220
	Urban	823	36						
Location of Caregiver's Residence	Dose B								
	Rural	342	19	.376	.540	.638	.373	1	1,220
	Urban	806	53						
Location of Caregiver's Residence	Dose C								
	Rural	325	36	.868	.868	.118	.071	1	1,220
	Urban	776	83						
Location of Caregiver's Residence	Dose D								
	Rural	309	42	1.831	.176	.575	.298	1	1,220
	Urban	734	125						

Note. Significant at $P < 0.05$

Research Question 4: Association Between Caregivers' Level of Education and Their Compliance with Timely Uptake of Four Polio Doses

RQ4: What is the association between caregivers' level of educational attainment and their timely uptake of four doses of polio vaccine?

$H_0$4: There is no association caregivers' level of educational attainment their timely uptake of four doses of polio vaccine?

H_a4: There is an association between caregivers' level of educational attainment and their timely uptake of four doses of polio vaccine?

Significant associations were found between caregivers' level of educational attainment and their receipt of Polio Doses B, and C. Caregivers' educational level was not associated with their receipt of Polio Doses A and D. Therefore, the null hypothesis was not rejected for Polio Dose A and D, while the null hypothesis was rejected for doses B and C.

Table 23

Timeline Compliance of Polio Doses Receipt and Caregivers' Level of Educational Attainment

Dependent variable	Level of Education	Received	Missed	Chi Square Value	P value	Degree Of freedom	Total
Dose A	No school	45	2				
	Primary school	97	4				
	High school	562	18	4.700	.456	5	1,220
	OND/Vocational	177	20				
	College degree	278	20				
	Graduate degree	20	2				
Dose B	No school	45	2				
	Primary school	95	6				
	High school	552	28	15.162	.010	5	1,220
	OND/Vocational	175	5				
	College degree	287	3				
	Graduate degree	19	3				
Dose C	No school	42	5				
	Primary school	84	17				
	High school	517	63	11.459	.043	5	1,220
	OND/Vocational	169	11				
	College degree	271	19				
	Graduate degree	18	4				
Dose D	No school	43	4				
	Primary school	90	11				
	High school	520	63	8.789	.118	5	1,220
	OND/Vocational	169	11				
	College degree	275	15				
	Graduate degree	20	2				

Note. Significant at $P < 0.05$

Logistic Regression Analysis

Chi square analysis is effective in the description of the strength of an association between two variables. It is limited in predicting the effect of one variable over the other when one or more variables affect a dependent variable. Chi square analysis does not offer a predictive answer or an explanation as the cause of an association between two variables. Logistic regression enables more in depth understanding of the relationship between a dependent variable and more than one independent variable's effect on the outcomes. Data was analyzed using the logistic regression model to isolate the effect of each of independent variables on the overall outcome. The receipt of each of the Polio Doses A, B, C, and D were statistically plotted as a binary value (yes = 1, no = 0) against the four independent variables considered in this study- caregivers' gender, age, location of residence and educational levels to assess the predictability effect of each of these against the receipt of the doses of polio. A confidence interval of 95% or p-value of 0.05 was used to calculate the probability of occurrence. An Odds ratio (OR) expressed mathematically as P/1-P shows the strength of association between a dependent and an independent variable. An OR value greater than 1, denotes an increase in the odds of an outcome as the predictor increases when all other variables are held constant. Odds Ratio (OR) values less than 1 show that there is a decreased probability in the odds as the predictor decreases. OR > 1 predicts an increase in the odds probability and ratios less than 1 denote a decrease while those close 1 show that a unit increase in the independent variable does not affect the odds of its effect on the dependent variable. The results appear in Table 24.

Table 24

Logistic Regression Polio Dose A Receipt and Independent Variables

Variables								
	B	SE	Wald	df	Sig	Exp OR	Confidence Interval 95%	
							LL	UL
Gender	-898	1.059	.719	1	.396	.407	.051	3.246
Age	.140	.227	.379	1	.538	1.150	.737	1.793
Rural/Urban	.257	.139	3.411	1	.065	1.293	.984	1.697
Level of Education	.165	.317	.271	1	.602	1.179	.634	2.193

Note. Variable(s) entered on step 1: Gender, Age, Rural/urban, Education. B = B coefficient, SE = standard error, Wald = Wald test, df = degree of freedom, P=significant CI = 95% Confidence interval LL= Lower level, UL = Upper Level

The logistic regression findings show that all predictors do not significantly predict receipts of Polio Doses A and B. The result further shows that education, location (rural/urban) and age has higher odds of predicting Polio Doses A and B while gender and location significantly predicted recipient of Polio Dose C with higher significant odds while similar pattern was observed for Polio Dose D (see Tables 24 through 27).

Table 25

Logistic Regression Polio Dose B Receipt and Independent Variables

Variables	B	SE	Wald	df	sig	Exp95% Confidence Interval		
						OR)	LL	UL
Gender	1.153	.784	2.162	1	.141	.316	.068	1.468
Age	.077	.180	.181	1	.670	1.080	.759	1.536
Rural/Urban	.146	.110	1.780	1	.182	1.157	.934	1.435
Level of Education	.330	.248	1.768	1	.184	1.391	.855	2.264

Note. Variable(s) entered on step 1: Gender, Age, Rural/urban, Education. B coefficient, SE = standard error, Wald = Wald test, df = degree of freedom, P=significant CI = 95% Confidence interval LL= Lower level, UL = Upper Level

Table 26

Logistic Regression of Polio Dose C Receipt and Independent Variables

Variables	B	SE	Wald	df	sig	Exp95% Confidence Interval		
						(OR)	LL	UL
Gender	-1.338	.675	3.929	1	.047	.262	.070	.985
Age	.162	.158	1.058	1	.304	1.176	.863	1.603
Rural/Urban	.220	.096	5.239	1	.022	1.246	1.032	1.505
Level of Education	.086	.223	.148	1	.700	1.090	.704	1.688

Note. Variable(s) entered on step 1: Gender, Age, Rural/urban, Education. B coefficient, SE = standard error, Wald = Wald test, df = degree of freedom, P=significant CI = 95% Confidence interval LL= Lower level, UL = Upper Level

Table 27

Logistic Regression of Polio Dose D Receipt and Independent Variables

Variables	B	SE	Wald	df	sig	Exp (OR)95% Confidence Interval		
							LL	UL
Gender	-1.338	.675	3.929	1	.047	.262	.070	.985
Age	.162	.158	1.058	1	.304	1.176	.863	1.603
Rural/Urban	.220	.096	5.239	1	.022	1.246	1.032	1.505
Level of Education	.086	.223	.148	1	.700	1.090	.704	1.688

Note. Variable(s) entered on step 1: Gender, Age, Rural/urban, Education. B coefficient, SE = standard error, Wald = Wald test, df = degree of freedom, P=significant CI = 95% Confidence interval LL= Lower level, UL = Upper Level

Logistic Regression Analysis of Compliance/Timeliness Versus Polio Dose

Table 28

Logistic Regression of Polio Dose A Timeline Compliance and Independent Variables

Variables	B	SE	Wald	df	sig	Exp (OR)	95% Confidence Interval	
							LL	UL
Gender	18.192	11087.040	.000	1	.999	7.958E7	.000	.
Age	.151	.206	.541	1	.462	1.163	.777	1.742
Rural/Urban	-.018	.120	.022	1	.882	.982	.776	1.243
Level of Education	.557	.267	4.351	1	.037	1.745	1.034	2.943

Note. Variable(s) entered on step 1: Gender, Age, Rural/urban, Education. B coefficient, SE = standard error, Wald = Wald test, df = degree of freedom, P=significant CI = 95% Confidence interval LL= Lower level, UL = Upper Level

Table 29

Logistic Regression Polio Dose B Timeline Compliance and Independent Variables

Variables	B	SE	Wald	df	sig	Exp (OR)	95% Confidence Interval	
							LL	UL
Gender	-.374	1.052	.126	1	.722	.688	.087	5.409
Age	-.023	.178	.017	1	.897	.977	.689	1.385
Rural/Urban	.231	.112	4.255	1	.039	1.259	1.012	1.568
Level of Education	-.206	.277	.552	1	.457	.814	.473	1.400

Note. Variable(s) entered on step 1: Gender, Age, Rural/urban, Education. B coefficient, SE = standard error, Wald = Wald test, df = degree of freedom, P=significant CI = 95% Confidence interval LL= Lower level, UL = Upper Level

Table 30

Logistic Regression of Polio Dose C Timeline Compliance and Independent Variables

Variables	B	SE	Wald	df	sig	Exp (OR)	95% Confidence Interval	
							LL	UL
Gender	-1.153	.671	2.952	1	.086	.316	.085	1.176
Age	.004	.143	.001	1	.976	1.004	.759	1.329
Rural/Urban	.219	.089	6.001	1	.014	1.244	1.045	1.482
Level of Education	.007	.212	001	1	.975	1.007	.664	1.525

Note. Variable(s) entered on step 1: Gender, Age, Rural/urban, Education. B coefficient, SE = standard error, Wald = Wald test, df = degree of freedom, P=significant CI = 95% Confidence interval LL= Lower level, UL = Upper Level

Table 31

Logistic Regression Polio Dose D Timeline Compliance and Independent Variables

Variables	B	SE	Wald	df	sig	Exp (OR)	95% confidence level	
							LL	UL
Gender	-1.174	.617	3.622	1	.057	.309	.092	1.036
Age	.113	.126	.808	1	.369	1.120	.875	1.433
Rural/Urban	.291	.078	13.835	1	.000	1.338	1.148	1.559
Level of Education	-.313	.193	2.636	1	.104	.731	.501	1.067

Note. Variable(s) entered on step 1: Gender, Age, Rural/urban, Education. B coefficient, SE = standard error, Wald = Wald test, df = degree of freedom, P=significant CI = 95% Confidence interval LL= Lower level, UL = Upper Level

Results from Table 28 to 31 shows that level of education significantly predicted compliance and timeliness to Polio Dose A while gender has the highest odd of predicting compliance. The location of caregivers' residence had the highest significant odds of predicting compliance to Polio Doses B, C, and D.

Table 32

Summary of Association Between Variables and Rejection of Null Hypothesis

	Gender	Age	Location of Residence	Level of Education	Accept or Reject Null Hypothesis
Research Question Set 1. Caregivers' Receipt of Four Doses of Polio Vaccine					
Polio A	N	N	Y	N	Reject Null Hypothesis for Caregiver Location of Residence
Polio B	N	N	N	N	Accept
Polio C	N	N	N	N	Accept
Polio D	N	N	N	N	Accept
Research Question Set 2. Caregivers' Timeliness of Receipt of Polio Doses					
Polio A	N	N	N	N	Accept
Polio B	N	N	N	N	Accept
Polio C	N	N	N	N	Accept
Polio D	N	N	N	N	Accept

Note. Statistically significant association between variables Y = Yes N = No.

Summary of Findings

Two separate results were obtained from the data collected in this study. Baseline data on the actual number and percentages of caregivers who obtained each and every one of the recommended Polio Doses A, B, C and D, as well as how many of these doses

were obtained within the government recommended timelines. Data showed more than 90% of caregivers received each of the four doses of polio vaccines. Polio Dose A had the most uptake with 96% (N = 1,173) of the 1,220 participants in this study reporting their children obtained the first dose of polio vaccine. Participants also reported almost 90% compliance with the recommended timelines for the receipt of the four doses of polio vaccine. Polio Dose D or the fourth doses of polio was more likely to be missed than any of the other three doses. Only 86.3% of the participants reported obtaining this dose within the recommended timeline for uptake although no significant association was recorded between this level of compliance and any specific demographic attribute of the caregivers.

Associations between the number of polio doses received and compliance with timeline was found to be significant in the case of Polio Dose D and the gender of the caregivers', Polio Dose A and the location of caregivers' residence and Polio Doses B and C and the educational level of the caregivers. The uptake of polio vaccine was not found to be associated with the caregivers' gender, and age in anyway.

Compliance with the recommended timelines of polio vaccine receipt was found to be associated with the uptake of Polio Dose A and the location of caregivers' residence and Polio Dose B and C receipts were found to be associated with the level of caregivers' educational attainment. Otherwise caregiver's gender and age were not associated with their compliance with timely uptake of Polio Doses A, B, C, and D. The strongest inference that can be made from this study is that caregivers' location of residence and to some extent their levels of educational attainment are significantly associated with their

uptake of polio vaccine doses and complying with the timeliness recommended for the receipt of these vaccinations.

The interpretation of this research findings and the corresponding implication for social change as well as recommendation for further exploration of this topic are discussed elaborately in Chapter 5.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

Polio has dominated the priority lists of public health profession for more than a century. Eradicating polio has had shifting milestone target dates because of endemicity in four countries: Afghanistan, Pakistan, Nigeria, and India, where person-to-person transmission could not be interrupted. Breakthroughs were recorded as India attained a 356-day polio-free status in 2013. Nigeria reached that milestone in 2015 but recorded two new cases of paralysis in 2016. Efforts are still being intensified to attain polio-free certification in Pakistan and Afghanistan. Concerted efforts from both the government of Nigeria and intergovernmental agencies—UNICEF, USAID, WHO, CDC, and international nonprofit organizations like Rotary International, Bill and Melinda Gates Foundation—finally achieved a polio-free Nigeria. This was a significant milestone because Nigeria was the greatest source of re-infections in countries that had been previously certified polio-free in Africa and the Middle East. While Nigeria received polio-free certification last year, a lone case of WPV1 infection was recorded in Borno State in March 2016. The polio-free status of Nigeria remains in a delicate state.

Mass and complete immunization has been a proven tool in the elimination and eradication of infectious diseases. Atkinson, Hamborsky, Mellantyre & Wolfe (2009). Small pox, a deadlier disease than polio, has been globally eradicated through the use of vaccines. CDC. n. d (Accessed Online (2014) Receipt of the full dose of polio vaccines, which is at least four doses polio (A, B C, and D), are nonnegotiable if the battle against polio is to be won. It is not only important that complete immunization regimens are

achieved, timeliness of receipt also is necessary to confer immunity on children at an optimal level. Many researchers have studied polio in various ramifications. Few research studies still have been conducted to assess polio vaccine uptake and compliance with time guidelines generally and in Nigeria specifically. While intensified efforts target mass coverage and uptake, data are sparse about the actual number of polio doses received by children on national, state, or even local government or county level. The government and polio program planners focus is ensuring that each child is reached and obtains at least one dose of polio vaccine. This study is a pioneering effort in actually obtaining primary data on the actual number of polio vaccine doses that have been received in a specific area, Lagos State, and also recording the compliance with the recommended timelines for the uptake of the vaccines.

Interpretation of Findings and Discussion

Caregivers were interviewed to determine how many polio vaccine doses their children have received and also to relate if these doses were received within the timelines promoted by the government and health organizations. A brief demographic questionnaire was applied to caregivers to obtain information about their gender, age, location of residence (urban vs rural), and their level of educational attainment. The information obtained was statistically analyzed to determine if caregivers' demographic attributes were associated with their action on immunization uptake and compliance.

A pilot study was carried out to test the reliability of the survey instrument, which was a researcher-designed questionnaire applied in three LGAs of Lagos State, Nigeria, which were different from the eight local governments where the main study was located.

The questionnaire was found to be of acceptable reliability, recording a .67 on the Cronbach alpha value. A total of 1,220 participants were interviewed in the main study.

Results showed above 90% of participants obtained the four doses of polio vaccine. Polio Dose A had the highest uptake value with 96% of participants stating their children received the first dose of polio vaccine. Polio Dose D, the last recommended polio dose, had the lowest receipt value as only 91% of participants reported taking that dose. Compliance with vaccination timeline schedule also recorded above 90% adherence. Most participants did not only receive the recommended dose of polio vaccine, they did so within the stipulated timeline. However, only 86% of those surveyed obtained Polio Dose D in a timely manner.

Associations were found to be significant between the caregivers' location of residence and their educational level in relation to their uptake of four doses of polio vaccine and their compliance with the timeline prescribed. Gender and age of caregivers were not significantly associated with their polio vaccine receipt or timeliness of receipt. This research study aimed to provide primary data on the number of polio vaccine doses children in the eight LGAs of Lagos State, where participants were recruited, had received and to ascertain if these doses were received within the recommended timelines. Furthermore, the study demographically assessed caregiver attributes and their decisions and actions regarding polio vaccine uptake specifically. Two dependent variables—number of polio doses and compliance with timelines for receipt—were studied to test for a significant association with caregivers' demographic attributes. The null hypothesis proposed was the lack of significant association between caregivers' actions and their

demographic attributes. The results obtained from this study are described and compared with existing findings and reports on polio uptake in Nigeria specifically and globally as may be relevant to this discussion.

Similar to results from a previous study conducted in eastern Nigeria by Onyeneho et al. (2015), significant associations were observed between caregivers' location of residence and their immunization compliance. In this study particularly, there was an association between caregivers' residence and the obtaining of the first dose of polio vaccine. Caregivers in rural areas were more likely to miss out on the primary dose of polio vaccine. This could suggest that some children are birthed away from the mainstream maternity centers as this initial dose of polio vaccine is almost always administered if babies are born in a government hospital with the BCG at birth. While this study did not ask caregivers about the birthplace of the children, culturally women in the rural areas use traditional birth attendants. Sarmento, (2014). This is often because they are more affordable than government or privately owned clinics. Income and socioeconomic factors are covert influences in the uptake of Polio Dose A.

Secondly, the level of caregivers' educational attainment was also significant in terms of their uptake of Polio Dose B, C, and D. This is interesting as those are the doses dependent on caregiver choices. Polio Dose A is automatically administered to children at birth. Caregivers' location of residence had no significant association with their uptake or compliance with the secondary Polio Doses B, C, and D, but their level of education did. The choice to continue with the uptake of other polio vaccine was dependent on the caregivers' level of education. This was in consonance with reports by Smith,

Hunnington, Parnell, Vannice, and Salman (2010), who found the level of caregivers' educational attainment to be associated with their vaccination uptake. Unlike in this research, Smith et al. observed that caregivers with college level education were more likely to delay the timeliness for their children's vaccine uptake. This implies that there is a need to increase the educational empowerment of caregivers to aid their decisions and enhance their compliance. The more the caregivers' perception of the benefits of completion and compliance with the polio vaccine regimen, the less gaps there will be to fill in terms of uptake and the less likely threats of fresh outbreaks will be.

While few scholars have explored polio vaccine receipt and compliance specifically in Nigeria, there are publications on caregiver attributes, demographics, and actions vis-à-vis childhood immunization practice in the country. Several studies have reviewed immunization status in Nigeria. The results from this study were not at variance with most of the findings from previous research, although those previous studies did not target polio vaccine in isolation (Rahji & Ndikom, 2013), as I did in this study. Caregivers Rahji and Ndikom (2013) interviewed proffered different reasons for the lack of vaccination of their children than what was recorded in this study. Mothers in the Rahji and Ndikom study principally expressed the lack of convenience of the vaccination locations and clinic hours as the primary reason for non-vaccination of their children. Participants in this study also reported several reasons for the gap in the receipt of polio vaccine doses and lack of compliance with specified timelines of uptake. Reasons proffered were (a) child was sick. This was especially true in the receipt of Polio Dose A. Children who are sick or underweight were typically excluded from the receipt of the first

dose of polio vaccine. (b) clinics were reported to be on strike and this was a common reason for absences or gaps in the receipt or noncompliance with the timeline of receipt for Polio Doses B and C. Caregivers also reported the inconvenience of the time or location of their residence and distance to the clinics as reasons for the nonreceipt of Polio Doses B, C, and D. Many caregivers reported travelling away from their primary residence as cause of vaccination gaps for the second third and fourth doses of polio vaccines.

Table 33

Caregiver Reasons for Vaccination Gaps

Reason for Vaccination Gap	Number of Caregivers
Born abroad	2
Child healthy No need	6
Child premature	1
Child sick	33
Child underweight	1
Clinic did not have polio vaccine	10
Clinic did not give	3
Clinic too far	5
Did not know dose was needed	5
Different hospital	1
Different state gave vaccine	1
Got dose at home	34
Inconvenient	1
Mom busy	15
Mom was sick	8
Moved	1
No explanation why clinic did not give dose	1
No reason	11
Not sure of dates	1
Not recorded by clinic	3
No transportation to clinic	1
Primary Health Clinic was on strike	3
Private clinic provided dose	1
Rumors	2
Religion forbids	2
Obtained late at 6 weeks instead of first week	1
Obtained late on 16th day instead of first week	1
TOTAL	155

Findings from this study confirmed that gaps still exist in the uptake of polio vaccine doses, albeit commendable improvement has been made in the percentage of children who received the four doses of polio vaccine. There is a need to increase the uptake of Polio Dose D, especially in the rural areas where the location of caregivers' residence was associated with their uptake and timeliness of some doses. Also, compliance with timelines of uptake was not optimal, especially for the uptake of the last

dose of Polio Dose D. Many of the participants in the study reported taking some of the polio doses at home and a number of caregivers blamed the missing a dose or receiving one late on their schedules. Some caregivers also reported they were sick and could not bring in their children on time. Sheik et al. (2013) reiterated caregivers' convenience as a determinant of their compliance. In their study, which the authors conducted in Pakistan, caregivers signified a preference to obtain immunization doses at home. This would reduce the economic effect of a clinic visit even though the vaccines were provided at no cost if the children were taken there.

Limitations of Study

It is almost impossible for research to actually capture the exact status of the phenomenon being studied. While the purpose of this study was to provide actual data on the number of doses of polio children have received in Lagos State, the location of sampling sites at well-baby clinics may have excluded caregivers who never visit the clinics at all. Perhaps this study may have provided a closer reflection of the true population if the sampling location was not well-baby clinics. Nevertheless, there were still gaps found both in the uptake and compliance with the timeliness for the receipt of the polio doses. Caregivers who participated in this study were interviewed at well- baby clinics whom I assumed to be already compliant with receiving some immunization or the other for their children. It is difficult to determine if a more randomized selection of participants may locate caregivers' who do not receive immunizations at all, or have missed more doses than this study could record. The study was strengthened against this limitation with the broad based coverage of the number of clinics visited and the number

of local governments included in this study. The sample size was also increased to 1,200 to increase the randomization and make it more reflective of the state's population. Despite these limitations, randomization was enhanced by visiting different clinics at different times to increase the variety of caregivers interviewed. Also, a more in-depth interview could also reveal deeper underlying issues that might explain why vaccination gaps exist amongst noncompliant caregivers. A huge gender disparity was also observed in the distribution of caregivers. This has a cultural undertone as most males are the breadwinners in the culture and are not likely to be the ones taking children to the clinics for vaccinations. Maybe if the interviews were done in the home setting, there might be more male participation in the study.

Recommendations

The need to increase immunization education amongst caregivers is paramount. The study observed an association between the location of caregivers' residence and the likelihood of their uptake of the first dose of polio- Polio Dose A given at birth. It is not farfetched to assume that children who are not born in the government or privately owned hospitals are likely to miss out on this first and crucial dose of immunization. This reveals an opportunity for the government and health program planners to either train rural traditional birth attenders (TBA) in the dispensing of this dose of polio vaccine given at birth or within the first week of life. The doses of polio vaccines are provided at no cost if the children are birthed at government owned maternity hospitals and clinics. It is possible rural dwellers whose incomes are not likely to sustain the maternity charges are either delivering their children at home or utilize local TBAs. If the TBA's are equipped

to do the same thing (immunize children at birth) then these gaps are likely to be eliminated or reduced. Furthermore, there could be more training and equipment of Community Health Extension Workers (CHEW) in addition to the TBAs to ensure that children are covered against polio at birth. The first dose is an extremely important dose as it confers immediate immunity at birth. The third and last doses of polio are seen as boosters. Babies are more likely to get an infection as their immune systems are evolving.

Furthermore, there is no gainsaying that caregivers' convenience are crucial to children's' uptake of immunizations. Eliminating the need for clinic visits by delivering vaccinations at home is a worthwhile option to consider. This will ensure that the caregivers' schedule has little consequence on the child's immunization uptake and compliance. Although concerted efforts are being employed to ensure mass coverage of polio immunizations on supplemental immunization days nationwide, there is a need for documentation of administered polio doses. Some caregivers expressed concern that their children had received too many doses of polio vaccine. This is because every child under the age of 5 years is administered a dose of polio whenever and wherever they are seen. While this is a noble endeavor in terms of ensuring every child receives at least a dose of the vaccine, it is not a judicious use of resources. Most children have a government issued vaccination card. It is possible for health workers to request for that card and record the administration of that dose. This can be done in addition to the finger blot that prevents the child from receiving multiple doses of polio on the same day. Incorporating the documentation into the service provision will have the dual effect or better tracking of resources and provision of accurate records and data.

More researchers are needed to carry out longitudinal studies that will track the practices of caregivers' over time and to examine the generational influences of behavioral patterns of immunization compliance amongst families. Overall, the achievement of the Lagos State government in terms of polio vaccine coverage and immunization is highly commendable and these successes can be built upon with further refinement of the delivery system to optimize the gains of polio elimination in the State.

Social Change Implications of Research Study

The main objective of this research was to provide primary data on polio vaccine acceptance and compliance with recommended timelines of uptake. The pioneering effort of this study in providing research based primary data on the status of polio vaccine acceptance and compliance in Lagos State is a radical one. The focus of the polio program in Nigeria has been directed more at ensuring uptake than keeping track of the primary data from the caregivers' record. Program planning maximizes the resources and optimizes results when numbers are known. This study gives Lagos State and indeed other states and regions in Nigeria a template to work with in putting actual numbers to the amount of efforts and resources invested. It is significant to know that polio continues to be relevant as a priority in the health developments in Nigeria and consequently world -wide because the status of polio elimination in the country has proved to be a delicate one. Polio transmission was successfully truncated just for a year (no new cases in 2015) before fresh cases are reported in 2016. Studies like this one help to keep polio issue on the front burner and continue to challenge and motivate all those involved in eradicating polio to keep up the fight. Further research can build on this foundation to increase

knowledge on caregivers' challenges so there will be greater synergy between the health officials and the people they serve to achieve the common goal of a polio free country and subsequently a polio free world.

Conclusions

Polio is undoubtedly a major health care concern in Nigeria and indeed the world. The delicate status of the elimination of polio from Nigeria for a year and its subsequent resurgence within a year makes it imperative to employ every means to achieve the optimal immunization of children. Caregivers' are the crucial link to ensuring all recommended polio vaccine doses are received and done in a timely manner. Almost all the efforts towards immunization have been and continue to be directed at getting children immunized with no record of what or how many doses each child has received.

This study purposed to provide actual primary data on the number of polio doses children in Lagos State have received. Also the study aimed to discover possible associations between the number of polio doses received and demographic attributes of the caregivers'. The results from this study highlights an association between the receipts of Polio Dose A and the location of caregivers' residence. It is suggested that caregivers who do not give birth in the government owned maternity centers where the first dose of polio administered at birth is given freely maybe missing out on obtaining that crucial dose although they make up with other doses. The probability of this being a reason for gaps in Polio Dose A acceptance opens up a new dimension into an uncharted area in polio immunization delivery which involves the training and equipping of TBAs in the coverage of polio immunization. The study showed rural dwellers are more likely to miss

out on the first dose of polio. This could be due to the high costs of maternity care in government hospitals and their use of traditional birth attendants. Further research is encouraged to ascertain if indeed the immunization doses taken in the first week of life is available to children midwifed by traditional birth attendants.

Data also revealed the receipt of Polio Doses B, C, and D and compliance with the specified timelines is associated with the level of education of the caregivers. This buttresses findings from previous studies about the need to increase and improve caregiver education and knowledge not only about the benefits of childhood immunization, new strategies have to be employed that will translate knowledge or awareness to positive action regarding immunization. There is a heed also to emphasize not only receipt of vaccinations but complying with specified timelines that provide optimal immunity. The social change implications from the findings in this study is the need to incorporate previously unemployed but present resources in the immunization process to further reduce gaps and ensure optimal uptake.

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Appendix A: Map of Nigeria Showing 36 states including Lagos State

Retrieved on August 10, 2012 from http://www.nigeriamasterweb.com/index.html

Appendix B: Map of Lagos State Showing LGAs

Retrieved online on May 4 2014
athttp://www.nigerianmuse.com/20100527092749zg/sections/pictures-maps-cartoons/maps-of-various-states-and-their-local-governments-in-nigeria/

Appendix C: Population and Demographic Characteristics of LGA in Lagos State

	Name of LGA	Population	Area (km²)	Urban / Rural	Population Density
1	Agege	459,939	11	Urban	High
2	Ajeromi -Ifelodun	684,105	12	Urban	High
3	Alimosho	1,277,714	165	Urban	High
4	Amuwo Odofin	318,166	135	Urban	Low
5	Apapa	217,362	27	Urban	Low
6	Badagry	214,093	441	Rural	Low
7	Epe	181,409	1,185	Rural	Low
8	Eti -Osa	287,786	192	Urban	Low
9	Ibeju/Lekki	117,481	455	Urban	Low
10	Ifako-Ijaiye	427,878	27	Urban	High
11	Ikeja	313,196	46	Urban	Low
12	Ikorodu	535,619	394	Urban	Low
13	Kosofe	665,393	81	Urban	High
14	Lagos Island	209,437	9	Urban	High
15	Lagos Mainland	317,720	19	Urban	High
16	Mushin	633,009	17	Urban	High
17	Ojo	598,071	158	Urban	High
18	Oshodi-Isolo	621,509	45	Urban	High
19	Shomolu	402,673	12	Urban	High
20	Surulere	503,975	23	Urban	High

The total Population of Lagos State is 9.013, 534 with an area of 3475.km².

Source: Table was adapted form information in the Nigeria Demographic and Health Survey 2013.

Appendix D: Survey Information Sheet

Information Sheet

You are invited to take part in a research study of Assessing Caregiver Compliance with WHO recommended Polio Vaccine Number of doses and timelines. Anyone who is the parent or caregiver of a child aged between 0 – 6 years of age can participate in this research study. You will be required to complete a survey questionnaire as a participant in this study. If you choose to participate, your completion of this survey will indicate your consent. Please keep a copy of this form for your records.

This study is being conducted by a researcher named Grace Salako Smith who is a Ph.D student of Walden University based in Minneapolis USA.

Background Information:

The purpose of this study is study how many of the four doses of polio vaccination children in your local government area have received and when they did so.

Procedures:

If you agree to participate in this study, you will be asked to fill out a survey which may take no longer than 10 minutes of your time.

Voluntary Nature of the Study:

This study is voluntary. Your participation in this study is greatly appreciated. However, there will be no negative or any consequences if you choose not to participate. No one will treat you any different or punish you in any way if you choose not to participate in the study.

Risks and Benefits of Being in the Study:

Being in this type of study does not pose any risk to you or your wellbeing although you will be asked some questions which you may prefer not to answer. This study will allow researchers to know how many children in your area have received the four doses of polio vaccine recommended by the government and when they did so.

The benefit of participating in this study included the fact that the results of this study will be presented to the Local Government officials in your area as well a staff of Lagos state Ministry of Health and will be available to officials who plan the polio immunization program if they request it. This will enable these officials plan and implement the polio vaccination better through their knowledge of the status of the program in their community. The overall benefit of participating in this study is that more knowledge will be created about polio disease and help in eliminating it from Nigeria and the world.

Payment:

There will be no payment in exchange for your participation in this research study.

Privacy:

Any information you provide in this study will be kept anonymous. That means there will be no way of knowing you were the one who gave the information. To further protect your privacy, no names or signatures are required on the survey instrument. Once completed, all survey forms are kept in a secure and locked briefcase. This is then locked in a file cabinet where the researcher is the only one who has the key to open the cabinet. Data will be kept for a period not exceeding 5 years as required by Walden University. After 5 years data collected will be destroyed by shredding.

Contacts and Questions:

You may ask any questions you have before completing the survey. If you still have further questions, you may contact the researcher Grace Salako Smith by telephone at 080 230 51044 If you want to talk privately about your rights as a participant, you may call Dr. Leilani Endicott at Walden University at 1-800-925-3368, extension #1210.

Appendix E: Survey Instrument Questionnaire

Survey/Instrument

Thank you for taking part in this survey. Your responses provide information about the number of polio doses children in your community have received and when they did so. The results of the study will be used in improving the health of children in your community and the country and protecting them against poliomyelitis. Participation in this survey is voluntary and your responses are anonymous (no one will be able to identify you by your responses). By completing the survey, it is assumed that you have given your consent to participate in the study.

Demographic Characteristics

1. Q. Gender . What is your gender?_____Male _____Female

2. Q. Age: What is your age?

- 1 -20 years old
- 21-30 years old
- 31-39 years old
- 40- 49 years old
- 50 -59years old
- 60- 69 years old
- 70- 79 years old
- 80- years and older

3. Q. Education: What is the highest degree or level of school you have completed? *If currently enrolled, highest degree received.*

- No schooling completed
- Some elementary education
- Some high school, no diploma
- High school graduate, diploma or the equivalent (for example: GED)

- Some college credit, no degree
- Trade/technical/vocational training
- Some college, no degree.
- College degree.
- Post college.

5. Q. Location of residence. Clinic Location _____ Local Government Area_____ Town _____

6. Q. How many doses of polio vaccine has your child received? When did this happen?
Polio Dose A Y. N Timeline_____Compliant Y N Gap --------
Polio Dose B Y. N. Timeline_____Compliant Y N Gap--------
Polio Dose C Y. N. Timeline_____Compliant Y N Gap--------
Polio Dose D Y. N. Timeline_____Compliant Y N Gap---------

Q. Reasons for Gap

- _____Don't know dose was needed
- _____Child is healthy does not need it
- _____Child was sick
- _____Clinic too far
- _____Clinic did not have polio vaccine
- _____Cannot afford the cost of vaccine
- ____ Clinic staff rude
- _____Changed mind because of rumors

Appendix F: Research Participant Recruitment Form

Survey Recruitment Poster

VOLUNTEERS NEEDED

Are you the parent or caregiver of a child between Age 0 – 6 years of age?

Would you be willing to participate in a research study about Polio Vaccine Immunizations?

Please Join Grace Salako Smith a Ph.D Student at Walden University at the conference hall to answer a few questions about the number of Polio vaccinations your child has received.

Venue – conference room at the clinic

Date – Every Tuesday and Thursday

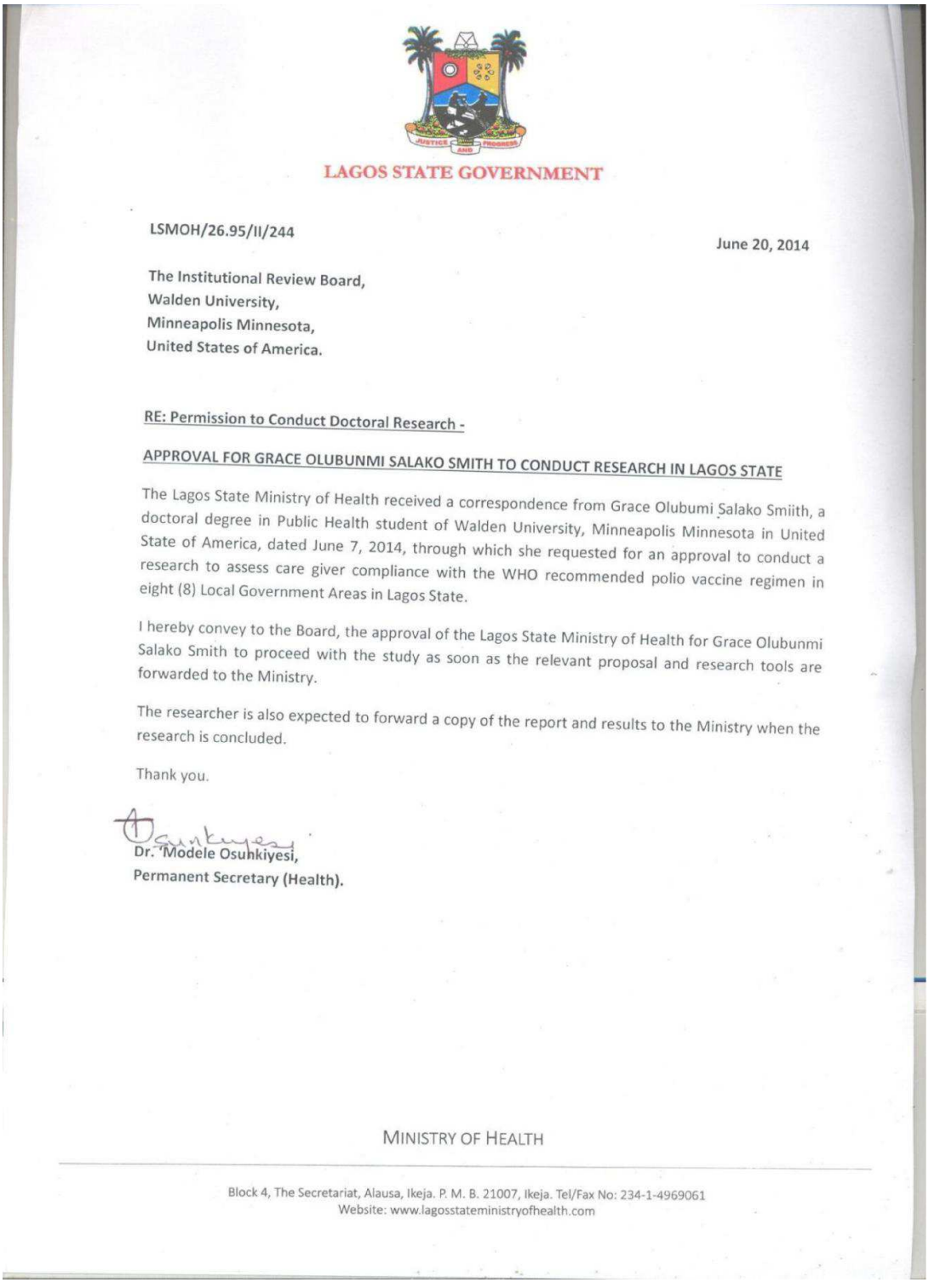
Time – 10am – 2pm.

You can walk in anytime in that period.

Participation is entirely voluntary. There will be no compensation paid for your participation although the results will be made available to the Clinic and Local Government Office.

Thank You

Appendix G: Letter of Authorization to conduct research from Lagos State Of Nigeria



LAGOS STATE GOVERNMENT

LSMOH/26.95/II/244

June 20, 2014

The Institutional Review Board,
Walden University,
Minneapolis Minnesota,
United States of America.

RE: Permission to Conduct Doctoral Research -

APPROVAL FOR GRACE OLUBUNMI SALAKO SMITH TO CONDUCT RESEARCH IN LAGOS STATE

The Lagos State Ministry of Health received a correspondence from Grace Olubumi Salako Smiith, a doctoral degree in Public Health student of Walden University, Minneapolis Minnesota in United State of America, dated June 7, 2014, through which she requested for an approval to conduct a research to assess care giver compliance with the WHO recommended polio vaccine regimen in eight (8) Local Government Areas in Lagos State.

I hereby convey to the Board, the approval of the Lagos State Ministry of Health for Grace Olubunmi Salako Smith to proceed with the study as soon as the relevant proposal and research tools are forwarded to the Ministry.

The researcher is also expected to forward a copy of the report and results to the Ministry when the research is concluded.

Thank you.

Dr. Modele Osuhkiyesi,
Permanent Secretary (Health).

MINISTRY OF HEALTH

Block 4, The Secretariat, Alausa, Ikeja. P. M. B. 21007, Ikeja. Tel/Fax No: 234-1-4969061
Website: www.lagosstateministryofhealth.com