

**SCHOOL OF PUBLIC HEALTH**

**COLLEGE OF HEALTH SCIENCES**

**UNIVERSITY OF GHANA**

**TRENDS OF ACUTE RESPIRATORY TRACT INFECTIONS AT THE AGOGO**

**PRESBYTERIAN HOSPITAL WITH THE INTRODUCTION OF**

**PNEUMOCOCCAL VACCINE IN GHANA**

**BY**

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**THIS THESIS / DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF  
GHANA, LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR  
THE AWARD OF MASTER OF SCIENCE IN CLINICAL TRIALS DEGREE**

**JULY, 2014**

**DECLARATION**

I hereby declare that this dissertation is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

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.....

**EUNICE TEWIAH**

**DATE**

STUDENT

**CERTIFICATION**

I hereby declare that this dissertation is conducted under my supervision in accordance with the rules and regulations of the university.

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**DR. SAMUEL SACKY**

**DATE**

SUPERVISOR

## **DEDICATION**

This research study is dedicated to my lovingly husband Isaiah Boafo for his immense contribution and support to my education and my children Kwesi, Abena and Kwabena.

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**LIST OF ABBREVIATIONS**

ALRI	Acute Lower Respiratory Infection
ART	Acute Respiratory Infections
BNI	Bernard North Institute
CDC	Centers for Disease Control and Prevention
EPI	Expanded Programme of Immunization
KCCR	Kumasi Centre for Collaborative Research
LRTI	Lower Respiratory Tract Infection
NICE	National Institute for Health and Care Excellence
MICS	Multiple Indicator Cluster Survey
PCV	Pneumococcal Conjugate vaccine
RSV	Respiratory Syncytial Virus
UNICEF	United Nations Children's Fund
WHO	World Health Organization

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## DEFINITION OF TERMS

**Pneumonia:** An inflammation of one or both lungs, in which the air sacs (alveoli) become filled with liquid, which renders them useless for breathing. It is usually caused by bacterial (pneumococcal) or viral infection.

**Acute Respiratory Infections:** A disease of the lungs characterized especially by inflammation and consolidation of the lung tissue followed by resolution and by fever, chills cough and difficulty in breathing and that is caused especially by infection.

**Pneumococcal Vaccine:** A vaccine containing purified capsular polysaccharide antigen from the most common infectious types of Streptococcus, used to immunize against pneumococcal disease.

**Pneumococcal Infections:** Are caused by Streptococcus pneumonia bacterium.

**Trend:** A general direction in which something is developing or changing.

## ABSTRACT

Worldwide, acute respiratory tract infections is the most common cause of illness in children under five years of age and a major cause of death. Most (70%) of these deaths occur in African and Asian countries.

The current study determined association between the introduction of pneumococcal vaccine into the Expanded Programme of Immunization (EPI) and morbidities due to acute respiratory tract infections in the Agogo Presbyterian Hospital. The study was a retrospective study involving records of all children less than five years that reported with acute respiratory tract infections at the pediatric wards and the out-patients department of the Agogo Presbyterian Hospital from May, 2010 to April, 2014. The study population was made up of health facility records on the children. Inclusion criteria were all children under 5 years who received care and exclusion criteria were children with incomplete data related to age, sex, date of admission and date of discharge for acute respiratory tract infection. Data was collected and checked for accuracy and completeness before entries were done in Epidata version 3.1. After the double entries, the validated data was exported into STATA 12 for analysis.

A total of 48,356 children attended the hospital during the period 2010-2014, out of which 5,550 records on children under five years were reviewed. A total of 4488 were children with respiratory tract infections and pneumonia was 616 for outpatients and 546 admissions. The children aged from 0- 59 months. The highest pneumonia admission was in children aged 11 months (39.75%). There were more male (54.02%) than female (45.98%) children, and the average duration of stay on admission was 4 days. The rate for respiratory tract infection was 17.8% and pneumonia outpatient was 2.33% and 10.45% for admissions. There was an increase in both respiratory tract infections and pneumonia cases after the introduction of the

pneumococcal vaccine and all the cases appear to be high in the month of October. There was a short term change after the introduction of the pneumococcal vaccine.

It was concluded that acute respiratory tract infections increased after the introduction of the pneumococcal vaccine.

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background

Worldwide, acute respiratory tract infections are the most common cause of illness in children and a major cause of death. It occurs among children under five years of age and three to five million deaths that occur annually are attributed to it, of which 75% are from pneumonia, (Smith, Samet, Romieu, & Bruce, 2000). Acute respiratory tract infections are common in children and decreased with increasing age, (Shek & Lee, 2003). It is also a frequent cause of paediatric morbidity and mortality and a common reason for both outpatient visits and hospitalizations, (Arden, McErlean, Nissen, Sloots, & Mackay, 2006). In terms of lost healthy life years measured as disability adjusted life years (DALYs), acute respiratory infection biggest impact in young children is the chief cause of global ill health. It diminished dramatically due to the administration of the vaccines and antibiotics, (Smith et al., 2000).

Acute respiratory tract infections is a disease of the lungs characterized especially by inflammation and consolidation of the lung tissue followed by resolution and by fever, chills cough and difficulty in breathing and that is caused especially by infection. They are usually caused by viruses but can be caused by bacteria. Viruses are the major causes of pediatric acute respiratory tract infections and they are frequently associated with lower respiratory tract infections among children which may necessitate assisted ventilation. Examples of these viruses are human rhinoviruses (HRVs), respiratory syncytial virus (HRSV) and parainfluenza viruses (HPIVs), (Arden et al., 2006). Pneumonia is caused by both bacteria and viruses, (Simoes et al., 2006).

## **Classification**

Acute respiratory tract infections are classified as upper respiratory tract infections (URIs) or lower respiratory tract infections (LRIs). The upper respiratory tract consists of the airways from the nostrils to the vocal cords in the larynx, including the paranasal sinuses and the middle ear. The lower respiratory tract also covers the continuation of the airways from the trachea and bronchi to the bronchioles and the alveoli. The common lower respiratory tract infections in children are pneumonia and bronchiolitis, (Simoes et al., 2006).

## **Risk Factors**

The risk factors for acute upper and lower respiratory tract infections are age, gender, birth characteristics, ethnicity, breastfeeding, socioeconomic factors, housing conditions, crowding, passive smoking, and child care, (Koch et al., 2003). It was also defined in patients with one or more of the following clinical features upon consultation; bronchiolitis, pneumonia, asthma, lower respiratory tract infection, wheezing, pneumonitis or laryngotracheobronchitis, (Arden et al., 2006).

## **Signs and Symptoms**

The early symptoms of acute respiratory tract infection usually appear in the nose and upper lungs which includes congestion, either in the nasal sinuses or lungs, runny nose, sore throat, body aches and fatigue. Other symptoms includes fever, chills, rigors, or both and myalgia. Cough and headache are also common in more than fifty (50) percent of patients. Other common findings are lymphopenia, thrombocytopenia, and elevated lactate dehydrogenase and creatine kinase levels (Lee et al., 2003). On physical examination of the

chest, crackles and dullness on percussion are detected in most patients. (Tsang et al., 2003a).

### **Diagnosis**

In a respiratory examination the doctor focuses on the patient's breathing. The breath sounds in the lungs are checked for fluid and inflammation and also peer into the nose and check the throat if the infection is advanced, an X-ray may be needed to check the condition of the lungs. Lung function tests are diagnostic tools for prognosis purposes and sputum is requested to check for the type of virus causing the disease (Tsang et al., 2003b).

### **Complications**

Complications of acute respiratory infection are extremely serious and can result in permanent damage and even death. They include; respiratory arrest, respiratory failure, congestive heart failure.

### **Prevention**

Prevention is the best method to ward off harmful respiratory infections. Practice good hygiene by doing the following: washing of hands frequently especially after visiting the public place. Avoid touching faces, especially the eyes and mouth to prevent introducing germs into the system.

### **Interventions**

The interventions to control acute respiratory infections can be divided into four basic categories: They are immunization against specific pathogens, early diagnosis and

treatment of disease, improvements in nutrition, and safer environments, (E. A. Simoes et al., 2006).

### **Pneumococcal vaccines**

A pneumococcal conjugate vaccine was licensed by the Food and Drugs Administration for use in young children in the United States in February, 2000. The vaccine was recommended for all children 0- 59 months who have certain chronic illnesses and there had been a large decrease in invasive disease, including infections caused by resistant strains, (Kyaw et al., 2006).

To see whether the effects of pneumococcal conjugate vaccine on pneumonia are working, the Centers for Disease Control and Prevention (CDC) monitored pneumonia hospitalizations by using data from the Nationwide Inpatient Sample. They reported that the incidence rates for all-cause pneumonia hospitalizations among children aged less than two years were 9.1 per 1000 and 8.1 per 1000, respectively in 2005 and 2006. Then in 2006, the rate for all-cause pneumonia among children aged less than two years was approximately 35% lower than during 1997-99. The decrease in the condition occurred soon after the vaccine was licensed in 2000, and the rates have remained relatively stable since then, (Grijalva, Griffin, Nuorti, Walter, & others, 2009). In Ghana, the pneumococcal vaccine was introduced in May, 2012.

### **1.2 Problem Statement**

Globally acute respiratory tract infections considered very important public health problem and remain the most important cause of infant and child mortality as well as frequent hospitalizations. These infections are mostly bacterial in origin and are the leading cause of death in children less than five years. In developing countries one-third of all patient consultations and one-fourth of all pediatric admissions are of acute respiratory

infections (Bulletin of the World Health Organization 1998). Globally, a high proportion of deaths occur in the first two years of life and pneumonia accounted for 81% (Walker et al., 2013).

Ghana introduced the pneumococcal vaccine into its national childhood immunization program in May, 2012 to tackle pneumonia which is the important disease in children under five years of age. The anticipated reduction in morbidity due to pneumonia in children less than five years was between 92% (Cutts et al, 2005; Klugman et al, 2003).

The trends analysis of the effect of the pneumococcal vaccine incorporated into the national childhood immunization is important for two reasons. Firstly, the routine immunization occurs in real-world conditions is different from ideal clinical settings. Thus, monitoring post licensure impact on pneumonia is important for ensuring that appropriate gains in terms of expected vaccination benefits is being attained. Secondly, the changes in the disease might occur in the post licensure era, such as shifts in average age at infection, and seasonality of the disease after vaccination.

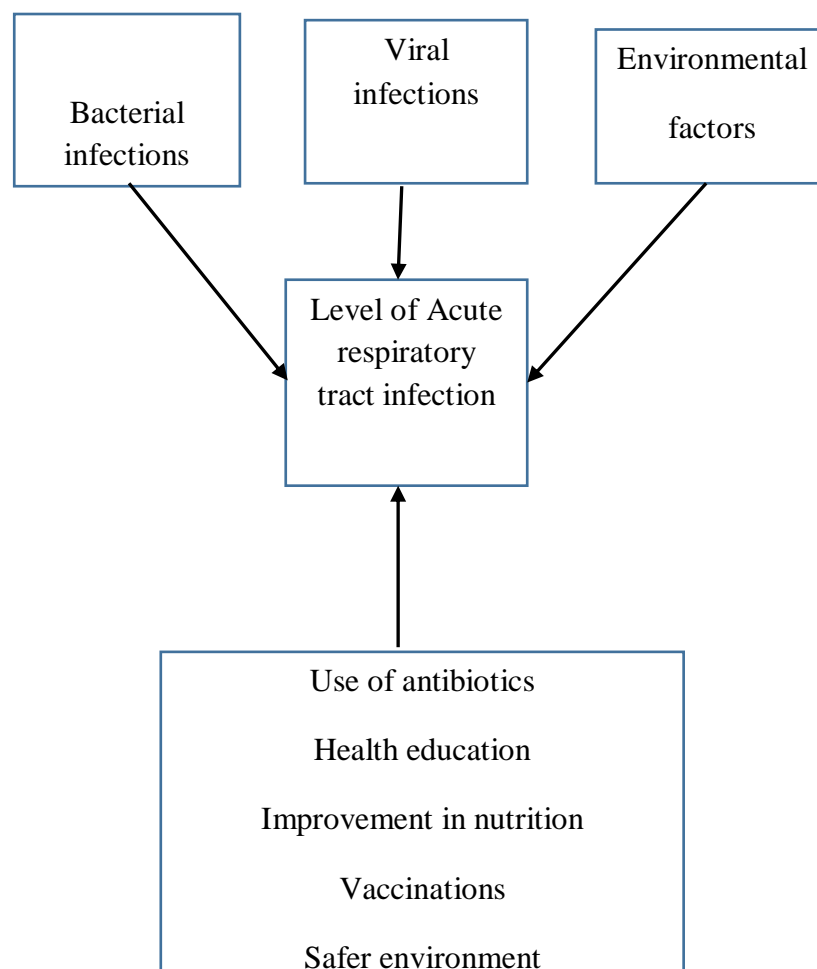
Although little studies have been done on pneumococcal vaccines which have even lead to some policy intervention to control acute respiratory infections in Ghana, there is the need to find out more the impact of the pneumococcal vaccine among children under five since it was introduced in May, 2012.

The findings of the study will serve as a baseline for the better understanding of the impact of pneumococcal vaccine since it was introduced to improve the health of the under-fives in Ghana. The data also will help policymakers in the area of disease management, counseling and also improve patient care. This study determines the trend in acute respiratory tract infections in children under five years before and after the introduction of the pneumococcal vaccine.

### 1.3 Conceptual Framework

The conceptual framework describes ways in which acute respiratory tract infections can occur in children less than five years of age. The framework identifies that, children less than five years can contract acute respiratory tract infections through: bacterial infections, viral infections, and other environmental factors that might accelerate the rate of infections. It also addresses various methods of managing acute respiratory tract infections which include: safer environment, improvements of nutrition, and the use of antibiotics. The use of vaccination in the prevention of acute respiratory tract infection is also recognised by the framework.

**Figure 1.1: Conceptual Framework of Acute respiratory tract infections in children under five attending Agogo Presbyterian Hospital with the introduction of pneumococcal vaccines.**



## **1.4 Objective of the Study**

### **1.4.1 General Objective**

To determine association between the introduction of pneumococcal vaccine into the Expanded Programme of Immunization (EPI) and morbidities due to acute respiratory tract infections in the Agogo Presbyterian Hospital.

### **1.4.2 Specific Objectives**

1. To determine the trends in acute respiratory tract infections in children under five years before and after the introduction of the pneumococcal vaccine.
2. To determine any short term change in the pattern of respiratory tract infections in children under five years after the introduction of the pneumococcal vaccine in Agogo Presbyterian Hospital.

## CHAPTER TWO

### LITERATURE REVIEW

Acute Respiratory Infections may cause the inflammation of respiratory tract anywhere from the nose to the alveoli. May be classified as acute upper respiratory infection (common cold, pharyngitis & otitis media) or acute lower respiratory infection (epiglottitis, laryngitis, bronchitis, and pneumonia).

Worldwide, acute respiratory infections (ARIs) constitute the leading cause of acute illnesses and responsible for nearly four million deaths every year, mostly in young children and infants in developing countries. The main infectious agents responsible for acute respiratory infections (ARIs) include influenza virus, respiratory syncytial virus (RSV) and parainfluenza virus type 3 (PIV-3), (Girard, Cherian, Pervikov, & Kieny, 2005).

#### **History of Pneumococcal Disease**

The streptococcus pneumoniae causes bacterial infection and the bacterium was also called pneumococcus which was first isolated by Pasteur in 1881 from saliva of a patient with rabies, Friedlander and Talamon in 1883 described the association between the pneumococcus bacterium and lobar pneumonia. The effort to develop effective pneumococcal vaccine began as early as 1911. However when penicillin was introduced in 1940s, the interest in the vaccine declined, until it was observed that patient still died from the antibiotic treatment. In the 1960s they made the effort again to develop a polyvalent pneumococcal vaccine. The first pneumococcal vaccine was licensed in the United States in 1977 and the first conjugate pneumococcal vaccine was licensed in 2000,(Atkinson, Wolfe, & Hamborsky, 2011).

### **Pneumococcal conjugate vaccine efficacy trials**

There was a study done in Northern California Kaiser Permanente trial to assess PCV9 impact on pneumonia and invasive disease. According to them vaccination reduced episodes of pneumonia confirmed by radiograph by 20% ,(Black et al., 2002).

A study conducted in the United State on the effectiveness of heptavalent pneumococcal conjugate vaccine in children younger than five years of age for prevention of pneumonia indicated that there was a greatest impact in children in the first to two years in life with a 32.2% to 23.4% reduction. They concluded that the pneumococcal vaccine tested was effective, (Black et al., 2002).

Study in Bohol in the Philippines reported that 22.9% reduction of community acquired radiological confirmed pneumonia in children less than two years of age in the 11-valent tetanus- diphtheria toxoid-conjugated PCV vaccinated group was observed. There was a similar reduction as observed in other PCV trials, (Lucero et al., 2009).

A study conducted by Rückinger et al., (2009) in Germany on reduction in the incidence of invasive pneumococcal disease after general vaccination with 7-valent pneumococcal conjugate vaccine established that the incidence of IPD in German children younger than 2 years was significantly reduced approximately a year after the introduction of general vaccination with PCV7.

Study in South Africa on bacterial pneumonia vaccines and childhood pneumonia a meta-analysis of data from two randomized controlled trials of pneumococcal conjugate vaccine suggest that pneumococcal conjugate vaccine reduces the incidence of radiological pneumonia by 22% ,(Obaro & Madhi, 2006).

There was another study on efficacy of nine-valent pneumococcal conjugate vaccine against pneumonia and invasive pneumococcal disease in The Gambia. They reported that pneumococcal conjugate vaccine 9 reduced radiologically-confirmed pneumonia which attained an efficacy of 37% to 77%,(Cutts et al., 2005).

### **Post- licensure vaccine effectiveness and Impact**

The first country to introduce pneumococcal conjugate vaccine was United State in 2000. Before the year 2007, sixteen countries were using PCV7 for all children (Australia, Belgium, Canada, France, Germany, Greece, Italy, Kuwait, Luxembourg, Mexico, Norway, Qatar, Switzerland, the Netherlands, United Kingdom, and United State). In the United State, the use of PCV7 has reduced the rates of invasive pneumococcal disease in children. The use of PVC7 also appears to reduced non-invasive pneumococcal infections, including pneumonia and otitis media, (Esposito et al, 2007; Grijalva et al, 2007; Poehling et al, 2004).

### **Relationship between age and respiratory tract infection**

Study conducted on global burden of acute lower respiratory infection due to RSV in children was reported that 3.4 million hospital admissions was as a results of severe respiratory syncytial virus (RSV) associate with acute lower respiratory infection. Globally, mortality from acute respiratory infections was estimated from studies as 0.28 episodes per child year, (Rudan, Tomaskovic, Boschi-Pinto, & Campbell, 2004).

Decline in pneumonia admissions after routine childhood immunization with pneumococcal conjugate vaccine in a time-series analysis in the United State found that the characteristics of patients admitted with pneumonia was among the young children, (Grijalva et al., 2007).

Study from Philadelphia, on ambulatory visit rates and antibiotic prescribed for children with pneumonia established that the highest rates of community acquired pneumonia occurred in children aged 1 to 5 years ranged from 32.3–49.6 per 1000. The rate of outpatient visits did not change after the introduction of the pneumococcal conjugate vaccine over the study period, (Kronman et al., 2011).

In South Asian, study on global and regional burden of hospital admissions for severe acute lower respiratory infections in young children in 2010 a systematic analysis estimated that acute lower respiratory infection (ALRI) resulted in hospital admissions in young children worldwide. Also the acute respiratory tract infections incidence of admissions was 1.3 times higher in infants aged 0–11 months than the overall rate in young children aged 0–59 months. It was also three times higher in neonates, (Nair et al., 2013).

Another study done in United Kingdom on epidemiology of community- acquired pneumonia in children reported that incidence for hospital admission was 12.2% and 28.7% respectively. Incidence for hospital admission of children 0–4 years of age are 13.5% and 32%. Whilst that of children less than 5 years the incidence of lobar pneumonia was 5.6/10000 per year and severe disease 19.4 /10000 per year, (Clark, Hammal, Hampton, Spencer, & Parker, 2007).

A study conducted in Europe and North America on community-acquired pneumonia in children reported that disease afflicts children throughout the world and the annual incidence of pneumonia was 34 to 40 cases per 1000 in children younger than five years of age, (McIntosh, 2002).

Also a study in Spain on viruses in community-acquired pneumonia in children aged less than 3 years old. Children with viral coinfection more frequently required hospital admission than those

with single viral infection concluded that viral coinfections are frequent in children aged less than 3 years old with community-acquired pneumonia ,(Cilla et al., 2008).

In Africa specifically Kenya a study conducted on respiratory syncytial virus infection and disease in infants and young children indicated that the adjusted incidence of ninety cases per 1000 estimated that lower respiratory tract infection (LRTI), severe lower respiratory tract infection (LRTI), and hospital admission occurred in children aged greater than 6 months, (Nokes et al., 2008).

Children in the youngest age groups greater than one and those from one to four years are among whom the incidence of invasive pneumococcal disease (IPD) is known to be high. They also have the highest admission rates for bacterial pneumonia. Although pneumococcal conjugate vaccine 7 was targeted at children aged < 2 years. The study shows evidence of herd immunity arising among older children since they found decreasing bacterial pneumonia admissions among all age groups,(Koshy, Murray, Bottle, Sharland, & Saxena, 2010a).

### **Relationship between sex and respiratory tract infection**

A study by Grijalva et al (2007) , in the United State of America reported that the characteristics of patients admitted with pneumonia differed by age and sex and among the young children studied, there were more male patients than female patients.

In England, a study was conducted on increasing hospital admissions for pneumonia and established that the age-specific incidence of hospitalization was 7% higher in male

patients than female patients over the study period,(Trotter, Stuart, George, & Miller, 2008).

A study conducted in South Asian on the global and regional burden of hospital admissions for severe acute lower respiratory infections in young children in 2010 estimated that acute lower respiratory infection (ALRI) was higher in males than in females,(Nair et al., 2013).

### **Duration of stay at the hospital**

Within United State of America there was a study conducted on an Invasive pneumococcal disease among infants before and after introduction of pneumococcal conjugate vaccine and reported that the median length of stay was six days ranging from 0-159 days. The median length of stay for pneumonia was five days ranging from 1-65 days, (Poehling et al., 2006). Study conducted by Grijalva et al (2007) reported that the median length of stay for all-cause of pneumonia was two days for children two to four years. Haddy et al (2005) reported that 2.22 years was the mean age for children under five years and a male to female ratio of 1.8:1.

In England, study was conducted on increasing hospital admissions for pneumonia on the length of stay on admissions. It was reported that 73% of acute pneumonia goes on admission. The median duration of stay by all the ages with pneumonia was 5 days. Whereas the median length of stay was 2 days each year in the study period. Also the median duration of stay in hospital increased with age,(Trotter et al., 2008).

In a research conducted in Spain on viruses in community-acquired pneumonia in children indicated that the mean hospital stay was  $6.5 \pm 3.4$  days,(Cilla et al., 2008).

### **Trends in Acute Respiratory Tract Infections in children less than five years before and after the introduction of the pneumococcal vaccine**

Within United State study conducted on hospitalizations for pneumonia after a decade of pneumococcal vaccination reported that the annual rate of hospitalization for pneumonia cases declined in children younger than two years of age before the introduction of the pneumococcal conjugate vaccine 7,(Griffin, Zhu, Moore, Whitney, & Grijalva, 2013).

Study on pneumonia hospitalizations among young children before and after introduction of pneumococcal conjugate vaccine reported that there was a decrease in hospitalizations and ambulatory-care visits for all-cause pneumonia. They came out with these findings; the incidence rates for children aged less than 2 years for all-cause pneumonia hospitalization were 9.1 per 1,000 and 8.1 per 1,000, respectively. The rate for all pneumonia case in children aged less than two years reduced by 35%.This decrease happened immediately after the vaccine was introduced in 2000. For children aged two to four years the rate for all the pneumonia cases did not reduce after the introduction of the pneumococcal vaccine,(Centers for Disease Control and Prevention(CDC), 2009).

Another study conducted by Pilishvili et al (2010) on a sustained reduction in invasive pneumococcal disease in the era of conjugate vaccine after the introduction of pneumonia conjugate vaccine 7 indicated that there was a dramatic reduction in invasive pneumonia disease. They also reported that it declined by fourth-five percent from 24.4 to 13.5 per 100,000 population and 94% from 15.5 to 1.0 case per 100,000 populations.

Another study conducted on the comparison of incidence of invasive streptococcus pneumonia disease among children before and after the introduction of conjugated pneumococcal vaccine was established that the trend for rates of invasive pneumococcal disease showed a significant decrease during the study period for all ages from two to five

years. However, the rates for invasive streptococcus pneumonia disease among children decreased significantly in the 2-year period after introduction of the heptavalent streptococcus pneumonia protein conjugate vaccine ,(Haddy et al., 2005).

Impact of pneumococcal conjugate vaccination of infants on pneumonia and influenza hospitalization and mortality in all age groups a study conducted by Simonsen et al (2011) stated that by the year 2005–2006 both invasive pneumococcal disease (IPD) and pneumococcal pneumonia hospitalizations decreased substantially in all age groups.

Another study on prevention of pneumococcal disease among infants and children by the use of 13-valent pneumococcal vaccine established that after the introduction of the pneumococcal vaccine there was a decrease in rates of hospitalizations and ambulatory care visits for community-acquired pneumonia in children less than two years. Among children aged under two years the rate of hospitalizations for pneumonia attributable to all causes decreased thirty- five percent, (Nuorti, Whitney, & others, 2010).

Another study on the national impact of universal childhood immunization with pneumococcal conjugate vaccine on outpatient medical visits. They found that there was no significant decrease in children less than two years with acute respiratory infections and pneumonia for the rate of outpatient visits after the introduction of the pneumococcal vaccine, (Grijalva et al., 2006).

Study on the effect of introduction of the pneumococcal conjugate vaccine on drug-resistant Streptococcus pneumonia was reported that after the introduction of the conjugate vaccine the rate of antibiotic-resistant invasive pneumococcal infections decreased in young children and older persons. Also there was an increase in infections caused by serotypes not included in the vaccine. Children under two years of age, the disease caused

by penicillin-nonsusceptible strains decreased from 70.3 to 13.1 cases per 100,000. Again the rates of resistant disease caused by vaccine serotypes fell 87%, (Kyaw et al., 2006).

Another study conducted on pneumococcal pneumonia and influenza indicated that the introduction of the pneumococcal conjugate vaccine decreased thirty-nine percent in the incidence of pneumonia in children,(Klugman, Chien, & Madhi, 2009).

Study in health care utilization for pneumonia in young children after routine pneumococcal conjugate vaccine use in the United States. They compared the rates in 2004 with those in the baseline period of 1997 to 1999 among children younger than 2 years. It was indicated that hospitalizations due to all causes of pneumonia declined from 52.4% and outpatient visit due to all causes of pneumonia declined from 41.1%. Rates of hospitalizations due to pneumococcal pneumonia declined from 57.6% to the rates of outpatient visit of 46.9% , (Zhou, Kyaw, Shefer, Winston, & Nuorti, 2007) .

An Invasive pneumococcal disease among infants before and after introduction of pneumococcal conjugate vaccine was a study done in the United State and they reported that there was total number of 146 cases of invasive pneumococcal disease where 89 before and 57 after the introduction of the pneumococcal conjugate vaccine 7. Mean rates of invasive pneumococcal disease for infants aged 0 to 90 days decreased 40% from 11.8 to 7.2 per 100 000 live births following pneumococcal conjugate vaccine 7 introduction. According to them 119 (82%) with invasive pneumococcal disease (IPD) were hospitalized and the 2 (7%) of twenty- seven infants who were not hospitalized were neonates, (Poehling et al., 2006).

The population-based impact of pneumococcal conjugate vaccine in young children was a study done in New York and Tennessee. The study indicated that there were 67 380 and 9485 child-years of observation in children aged less than two years from 2001 to 2002. It

was observed that only few visits with pneumonia cases per 1000 children. For outpatient thirty-three visited the New York clinic whilst for Tennessee twenty visited the emergency ward, (Poehling et al., 2004).

A study conducted on changing characteristics of invasive pneumococcal disease in Atlanta, Georgia, after introduction of a 7-valent pneumococcal conjugate vaccine was established that there have been relative risk of 0.80 significant decreases in the rates of invasive pneumococcal pneumonia since 2000 in children after the introduction of the vaccine, (Albrich, Baughman, Schmotzer, & Farley, 2007).

There was another study done in Tennessee on reduction in high rates of antibiotic-nonsusceptible invasive pneumococcal disease after introduction of the pneumococcal conjugate vaccine. It was concluded that the invasive pneumococcal disease rates peaked at 235 cases per 100,000 among children younger than 2 years before decreasing. Then after the introduction of vaccine it increased to 46 cases per 100,000. They also estimated that the rate of invasive pneumococcal disease due to nonvaccine serotypes increased among children aged two years and older. Also the rates of invasive pneumococcal disease due to pneumococcal conjugate vaccine associated serotypes declined after the introduction of the pneumococcal conjugate vaccine in all the age groups, (Talbot et al., 2004).

The impact of seven- valent pneumococcal conjugate vaccine programme on childhood hospital admissions for empyema and bacterial pneumonia from 1997 to 2008 was a study done in England. In their study it was indicated that from 1997 to 2006, admission rates for bacterial pneumonia and empyema increased then it declined in 2008. For Bacterial pneumonia rates it decreased to 1079 per million children and empyema also rates decreased to 14 per million children. In comparing 2006 with 2004 the rate ratio for

bacterial pneumonia admissions was 1.19 and 0.81, (Koshy, Murray, Bottle, Sharland, & Saxena, 2010b).

There was a study done in Poland on the significant decline in pneumonia admission rate after the introduction of heptavalent pneumococcal conjugate vaccine 7 in children under five years of age. They reported that there was a significant fall in the rate of two consecutive years after the introduction of the pneumococcal conjugate vaccine. Number of admission decreased in the two groups as 65% and 23%. Whilst only few percent fall in the admission in the second year. The result established that pneumococcal vaccine reduced the burden of pneumonia in Poland, (Patrzalek, Albrecht, & Sobczynski, 2010).

The worldwide study on the impact of the seven-valent pneumococcal conjugate vaccine reduced substantially after the introduction of the pneumococcal vaccine in the incidence of invasive pneumococcal disease and hospital admissions. Also the rates of overall and vaccine-serotype invasive pneumococcal disease show marked reductions after the introduction of the pneumococcal conjugate vaccine (Fitzwater, Chandran, Santosham, & Johnson, 2012).

In Denmark, there was a study on the impact of pneumococcal vaccination during the first three years after pneumococcal conjugate vaccine introduction in the childhood immunization programme. The overall incidence of invasive pneumococcal disease decreased from 26.7 to 16.3 cases per 100,000 in children under five years of age. When comparing the two periods the incidence of the disease and the invasive pneumococcal disease caused by vaccine serotypes declined significantly from 19.5 to 17.7 and from 7.7 to 3.8 cases per 100,000 persons (Ingels et al., 2012).

Impact of the 7-valent pneumococcal conjugate vaccine on invasive pneumococcal disease in infants younger than ninety days in England and Wales. They concluded that the PCV7

introduction resulted in 83% reduction in PCV7 IPD and a declining trend in overall IPD by 2009–2010 and the 256 cases diagnosed after PCV7 introduction (Ladhani et al., 2013).

Study on epidemiology of invasive pneumococcal disease in Kumasi, Ghana established that the disease was most prevalent among patients <5 years of age and immediately following the peak of the harmattan wind. Vaccination improve control of pneumococcal disease in Ghana, although modified vaccine formulations are required for local use (Holliman, Liddy, Johnson, & Adjei, 2007).

## **CHAPTER THREE**

### **METHODOLOGY**

#### **3.1 Study Design**

This was a retrospective study involving records review on all children less than five years that reported with acute respiratory tract infections at the pediatric wards and the out-patients department of the Agogo Presbyterian Hospital from May, 2010 to April, 2014. The study examined the trends in acute respiratory infection before and after the introduction of the pneumococcal vaccine into Ghana Expanded Programme of Immunization in May, 2012.

#### **3.2 Study Area**

##### **3.2.1 Study setting**

The Agogo Presbyterian hospital is the hospital setting in the Asante Akim North District of the Ashanti Region in Ghana. The hospital was established in 1931, and is the oldest and biggest Mission hospital in Ghana. It is also the second largest hospital in the Ashanti Region of Ghana and a referral center for many hospitals far and near. The hospital offers 24-hour Inpatient and emergency services for children and adults.

##### **3.2.2 Administration**

The hospital has a Medical Director who is assisted by the Deputy Director of Nursing Services. The total population of the staff of the hospital is 385 of which 19 are Doctors, 3 Medical Assistants, 5 Anaesthetist Assistants, 107 Nurses, 2 Pharmacists and 7 Biomedical Scientists. There are also two X-ray Technical Officers, 1 Physiotherapist, 238 other Paramedical, Administrative and Service Staff.

### **3.2.3 Services Provided**

The hospital has nineteen departments of which pediatric ward and the out-patient department is one. The hospital is well established with a lot of equipment. A Malaria Research Centre is attached to the hospital.

### **3.2.4 Infrastructure**

The hospital is accredited for many training. The hospital is one out of the two sites in Ghana and eight sites in Africa for Malaria Vaccine Trial. Forms of communication in the hospital include telephones, mobile phones and landlines.

### **Pediatrics Department**

Since the establishment of the hospital in 1931 there was no separate outpatient department (OPD) or ward for children. It was later that they established a separate outpatient department which is known as the Child Welfare Clinic, a neonatal intensive care unit (the nursery) and a ward for children.

### **Children Ward**

The children ward has 50 beds (30 medical and 20 surgical) and presently managed by the pediatric team of doctors supported by nurses, auxiliary nurses and many more.

### **Child Welfare Clinic**

The child welfare clinic was formerly called the under 5 Clinic, and now offers out-patient services to children from birth up to 13 years. It has basic children out-patient department (OPD) devices such as weighing scales, stadiometer, consulting tables and two examination couches. Managed by the paediatric team of doctors, nurses, health aids supported by administrative staff, fieldworkers, a runner and laboratory technician from Kumasi Centre for Collaborative Research (KCCR).

The department has accreditation from the Ghana Medical and Dental Council as well as the Ghana College of Physicians and Surgeons to train housemen and residents in paediatrics. The department has two paediatricians, residents in paediatrics, medical officers and house officers. The department apart from offering adequate clinical services to patients also involved in a number of clinical research works in collaboration with the Kumasi Centre for Collaborative Research (KCCR) which in itself was affiliated to the Bernard North Institute (BNI) in Hamburg - Germany, and the School of Medical Sciences KNUST, Kumasi, Ghana.

Statistics from the department revealed that, about 250 children pass through the outpatient department every month and approximately 11,279 seen from 2010 to May, 2014.

### **Nursery**

The nursery serves as the neonatal intensive care unit of the department. The Nursery was also handled by the Paediatric team of doctors supported health aids specially trained in neonatal nursing care.

## **3.3 Study Population**

The study population was made up of the health facility records of all children under five years of age with acute respiratory tract infections who attended Agogo Presbyterian Hospital (out-patients and in- patients) from May, 2010- April, 2014.

### **3.3.1 Inclusion Criteria**

All children under 5 years who received care for acute respiratory infection at the Agogo Presbyterian Hospital from May, 2010 to April, 2014.

### **3.3.2 Exclusion Criteria**

Children under 5 years with incomplete data related to age, sex, date of admission and date of discharge for acute respiratory infection.

### **3.4 Variables**

The variables of interest in the trend analysis of retrospective cases of all children less than five years that reported with acute respiratory tract infections at the pediatric department are age of children, sex of children, whether a child was treated as out-patient or was admitted in the ward, the duration of time being admitted.

The main dependent variable is acute respiratory tract infections.

Independent variables are;

Age

Sex

Diagnosis

Duration of hospitalization

**Table 3.1: Definition of variables and scale of measurement**

<b>Variables</b>	<b>Operational definition</b>	<b>Type of variables</b>
Acute respiratory tract infection	Number of acute respiratory infections cases recorded.	Dependent
Child's age	Difference between date of birth and the date of hospital attendance.	Independent
Child's sex	Presence of male or female genitalia	Independent
Diagnosis: malaria, respiratory tract infection, anaemia, diarrhoea, eye infection, ear infection, pneumonia, skin disease, urinary tract infection	Determination of the nature of the cause of a disease.	Dependent
Duration of stay at the hospital	Difference between date of admission and date of discharge	Independent
Season/ Date of attendance	The particular day on the calendar that the child was present at the hospital.	Independent

### **3.5 Data Collection Techniques and Tools**

Clinical data was recorded on standardized forms. Primary data was collected using the consulting room register, the admission and discharge book on age, sex, date of admission and discharge. The Agogo Presbyterian Hospital has a big consulting room and one Children's ward. The ward and the consulting room have separate attendance registers. Data collection started from the consulting room with twelve registers, after which the ward cases were collected. The data capture forms were used in data extraction for each of the registers. Children age less than five years, who came to the Out Patients Department have their personal data recorded in the consultation room registers after they have been examined by nurses and physicians. Data on child's sex, age, duration of stay, pneumonia, respiratory tract infection and other diagnosis were collected. Data on these variables were collected from Admission and Discharge registers as well.

### **3.6 Data Analysis Procedure**

Data was summarized as frequencies, percentages, mean and standard deviations. The difference in proportions was established using Z test for two proportions. A p-value less than 0.05 was interpreted as significant. Percentage changes were calculated by using May, 2010 to April, 2012 (before the pneumococcal vaccine) and May, 2012 to April, 2014 (after the introduction of the pneumococcal vaccine) data.

### **3.7 Training of Research Assistants**

The researcher recruited and trained two research assistants to help with the data collection. The research assistants were people who were experienced nurses and who have participated in previous research work in the hospital. The objective of the study was explained to them. They were taken through the consulting room register and the

admission and discharge book to ensure accuracy and consistency, as well as the data collection form.

### **3.8 Quality Control**

The data collected was given codes according to the year and register used. Double entry of raw data was organized in data analysis format.

### **3.9 Pretest**

With the help of two field research assistants trained, pre-test was carried out in the Agogo Presbyterian Hospital on the data collection tools and techniques. The pretest was done to determine the average number collected and completed in a day and hence determine the work load assigned to every individual in the course of the field work.

### **3.10 Statistical Analysis**

Data was collected and checked for accuracy and completeness before entries were done in Epidata version 3.1. After the double entries, the validated data was exported into STATA 12 for preliminary analysis and further analysis.

Descriptive statistics was used to summarize data and displayed in frequency distribution, cross-tabulation and graphs in the preliminary analysis for the demographic variables of participants. In order to answer some research questions, proportions of pneumonia and respiratory tract infection (RTI) were estimated based on outpatient and inpatient cases for years before and after the introduction of the pneumococcal vaccines in May, 2012. For the further analysis, trends analysis was performed to assess any short term change in the number of respiratory tract infections and pneumonia cases presenting at the Agogo Presbyterian Hospital before and after the introduction of the pneumococcal vaccines in May, 2012.

### **3.11 Ethical Consideration**

An ethical approval of the study was obtained from the Ghana Health Service Ethics Committee in compliance with International Conference on Harmonization/Good Clinical Practice.

#### **Approval from study site**

Before the commencement of the study permission was sought from the Chief Executive Officer and the Director of Nursing Services of the Hospital for the study to be conducted in the out-patients departments and the pediatric wards. Matrons in charge of the out-patients department and the pediatric wards and staffs were briefed on the purpose of the study to gain their support.

#### **Potential risks and benefits**

There are no known risks associated with the research protocol because there is no direct involvement of participant or respondent, since data for the study was collected using consulting room register, admission and discharge book. There are also no direct benefits to the participant.

#### **Privacy and Confidentiality**

The information collected was handled with strictest confidentiality and was not shared with third parties not directly involved in the research and this was used purely for academic purposes. All the Information collected was treated as confidential. The identity of the patients was not disclosed in writing the report. To ensure confidentiality of patients, serial numbers was used on the checklist instead of their names. The completed checklist was kept in a locked cabinet and apart from the members of the study team; no person had access to the information. Data entered into the computer database was protected such that unauthorized persons will not have access to them.

**Data Storage and Usage**

The checklists was kept in the original form under lock and key for one year before they are destroyed by burning. The data was stored on the pen drive and after one year storage the data on the pen drive was destroyed by reformatting it and the information stored on it cleaned. . The data collected was kept safe in a secure location and away from public access.

**Declaration of conflict of interest**

The researcher has no conflict of interest.

**Funding Information**

Self-funding.

## CHAPTER FOUR

### RESULTS

#### 4.1 Study Participants

A total of 48,356 children attended the Agogo Presbyterian Hospital from May, 2010 to April, 2014. Records on 5,550 children under five years of age for outpatient and inpatient attendance within the study period were reviewed. A child was included in the study if he or she was under five years of age and received care for acute respiratory tract infections at the Agogo Presbyterian Hospital from May, 2010 to April, 2014. Data were collected on children with acute respiratory tract infections and pneumonia cases under five years of age.

#### **The results of the record review**

The records review indicated that respiratory tract infection for the hospital attendance for the study period was 4488 by male and female children over the time period (Table 4.1). The male attendance was 2424(54.02%) and female children attendance was 2064(45.98%). There was no significant difference between the outpatient attendance before and after the introduction of the pneumococcal vaccine. Regarding the age, the children age ranged from 0-59 months. The study shows that most of the children who attended the outpatient department with respiratory tract infections were aged 48-59 months (46.71%, 2096/4488).

The records for pneumonia cases review revealed that the hospital attendance was 1162 for outpatient and inpatient attendance by male and female (Table 4.2). With gender the study shows 1162 pneumonia cases, 645(55.51%) were found to be males and 517(44.49%) were females before and after the introduction of the pneumococcal vaccine. The study shows that male children were more than the female children. However, no

significant difference for both the outpatient and the inpatient before and after the introduction of the pneumococcal vaccine.

The children ages were 0-11 months (18.66%, 217/1162), 12-23 months (19.44%, 226/1162), 24-35 months (20.14%, 234/1162), 35-47 months (17.22%) and 48-59 months (24.53%, 285/1162). Most of the children aged 48-59 months (24.53%, 285/1162) and the smallest age group was 36-47 months (18.66%, 217/1162) before and after the introduction of the pneumococcal vaccine. The highest pneumonia admission rate was seen in children aged 0-11 months (39.75%, 217/546).

Most of the children came from three districts namely Asante Akim North, Asante Akim South and Asante Akim Central. Also, most of the children came from Agogo in the Asante Akim North where the hospital is located. Some of the towns are Amanekrom, Hwidiem, Juansa Pataban, Onyimso, Wioso and others. A few from Asante Akim South, Konongo-Odumase the district capital, which comprises of Konongo, Odumase, Kyekyebiase and Patriensa. Some also came from Juaso.

The duration of stay on admission at the hospital ranged from 0 to 49 days and the most duration of stay was 15-49 days and the least was 4 days (Table 4.3).

Provisional, Principal and additional diagnosis were captured in most of the records hence a child could be diagnosed of two or more different conditions or diseases. These were counted separately as different diagnoses. This resulted in the total number of diagnosis being more than the number of eligible participants. The total diagnoses was 45,126 (Table 4.3) with outpatient 34,347 (76.12%) and inpatient 10,779 (23.88%). The most condition diagnosed was malaria 14313 (31.72%). Pneumonia and respiratory tract infection were 923 (2.05%) and 4488 (9.94%) respectively before and after the introduction of the pneumococcal vaccine over the study period.

**Table 4.1: Demographic characteristics for Respiratory Tract Infections of children < 5 at the Outpatient Department who attended the Agogo Presbyterian Hospital (May, 2010- April, 2014)**

<b>Variables</b>	<b>Before Vaccination</b> (May,2010 to Apr.,2012) N= 1368	<b>After Vaccination</b> (May 2012 to Apr.,2014) N=3120
<b>Sex</b>		
Male	749(54.75)	1675(53.68)
Female	619(45.25)	1445(46.32)
<b>Age(months)</b>		
0-11	0(0.00)	0(0.00)
12-23	71(5.19)	508(16.28)
24-35	119(8.69)	812(26.03)
36-47	238(17.39)	644(20.64)
48-59	940(68.71)	
<b>Community of residence</b>		
Agogo	1138(83.17)	2566(82.25)
Konongo	200(14.62)	468(15.00)
Juaso	22(1.61)	73(2.33)
Others	8 (0.58)	13(0.42)

**Table 4.2: Demographic characteristic for Pneumonia Out Patient Department and Admissions**

<b>Variables</b>	<b>Out-patient Department</b>		<b>Admissions</b>	
	Before Vaccination	After Vaccination	Before Vaccination	After Vaccination
	May,2010 Apr.,2012	May,2012 Apr.,2014	May,2010 Apr.,2012	May,2012 Apr.,2014
	N= 122	N= 494	N= 197	N=349
<b>Sex</b>				
Male	63(51.54)	257( 52.02)	124(62.94)	201 (57.59)
Female	59(48.36)	237(47.98)	73(37.06)	148(42.41)
<b>Total</b>	<b>122(100.00)</b>	<b>494(100.00)</b>	<b>197(100.00)</b>	<b>349(100.00)</b>
<b>Age(months)</b>				
0-11	0(0.00)	0(0.00)	84(42.63)	133(38.11)
12-23	3(2.46)	101(20.44)	40( 20.31)	82(23.50)
24-35	0(0.00)	132(26.73)	32(16.25)	70(20.06)
36-47	25(20.49)	130(26.32)	25(12.69)	20(3.73)
48-59	94(77.05))	131(26.51)	16(8.12)	44(12.60)
<b>Total</b>	<b>122(100.00)</b>	<b>494(100.00)</b>	<b>197(100.00)</b>	<b>349(100.00)</b>
<b>Community of residence</b>				
Agogo	98(80.32)	371(75.10)	139(70.56)	240(68.77)
Konongo	10(8.19)	71(14.37)	12(6.09)	86(24.64)
Juaso	6(4.91)	31(6.28)	15(7.61)	20(5.73)
Others	8(6.55)	21(4.25)	31(15.74)	3(0.86)

**Table 4.3: Diagnosis and duration of stay at the Hospital, (May, 2010 to April, 2014)**

Out Patients Department		Admissions		
Variable	Before Vaccination (May, 2010 – Mar., 2010)  N=122	After Vaccination (May, 2012 – Apr., 2014)  N=494	Before Vaccination (May, 2010 – Mar., 2012)  N=197	After Vaccination (May, 2012 – Apr., 2014)  N=349
<b>Diagnosis</b>				
Malaria	5000(25.48)	5008(33.99)	1205(40.65)	3100(39.66)
Anaemia	939(4.78)	904(6.14)	601(20.27)	550(7.04)
Diarrhoea	900(4.58)	608(4.13)	8(0.26)	470(6.02)
Eye Infection	1550(7.90)	1156(7.85)	16(0.53)	129(1.65)
Ear Infection	1500(7.64)	901(6.12)	41(1.37)	120(1.54)
Pneumonia	166(0.84)	274(1.87)	90(3.32)	393(5.03)
RTI	1368(6.96)	3120(21.18)	0(0.00)	0(0.00)
Skin Disease	1500(7.65)	1403(9.52)	250(8.42)	453(5.80)
UTI	5402(27.54)	1002(6.80)	203(6.83)	1100(1.28)
Others	1300(6.63)	1002(6.80)	203(6.83)	100(1.28)
<b>Total</b>	<b>19,617(100.0)</b>	<b>14,730(100.0)</b>	<b>2964(100.00)</b>	<b>7815(100.00)</b>
<b>Duration of stay at the hospital (days)</b>				
0-4			148(75.12)	284(81.38)
5-9			35(17.77)	54(15.47)
10-14			10(5.08)	9(2.58)
>14			4(4.03)	2(0.57)
Total			197(100.00)	349(100.00)

**Table 4.4: Reported Cases of Respiratory Tract Infections and Pneumonia at the Agogo Presbyterian Hospital before and after the Introduction of Pneumococcal Vaccine**

<b>Period</b>	<b>Total OPD Cases</b>	<b>Total RTI Cases</b>	<b>Proportion Percent</b>	<b>P-value</b>	<b>95% CI</b>
Before Vaccine Introduction	19291	1368	7.09		
After Vaccine Introduction	29065	3120	10.73	<0.0001	1.4,1.6
<b>Total</b>	<b>48356</b>	<b>4488</b>	<b>17.82</b>		

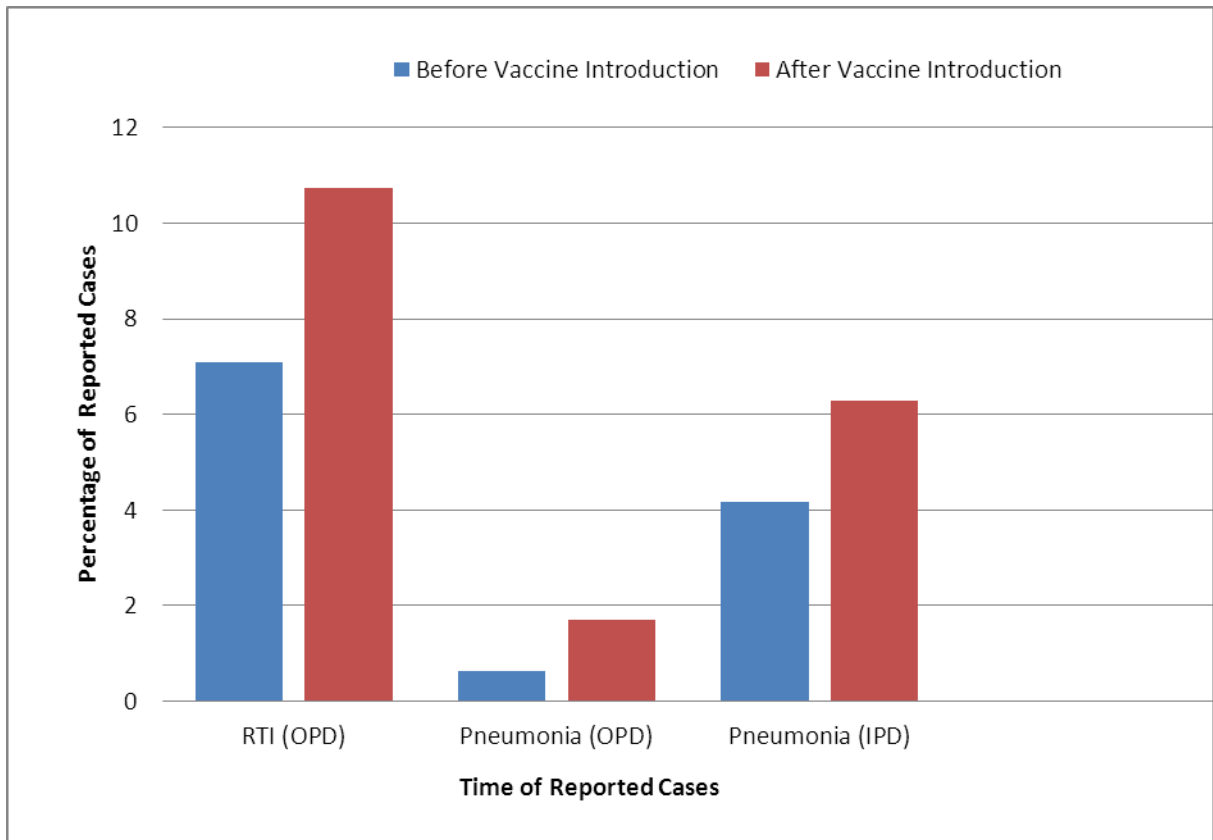
  

<b>Period of Vaccination</b>	<b>Total OPD Cases</b>	<b>Total OPD Pneumonia Cases</b>	<b>Proportion Percent</b>	<b>P-value</b>	<b>95% CI</b>
Before Vaccine Introduction	19291	122	0.63		
After Vaccine Introduction	29065	494	1.70	<0.0001	2.2,3.3
<b>Total</b>	<b>48356</b>	<b>616</b>	<b>2.33</b>		

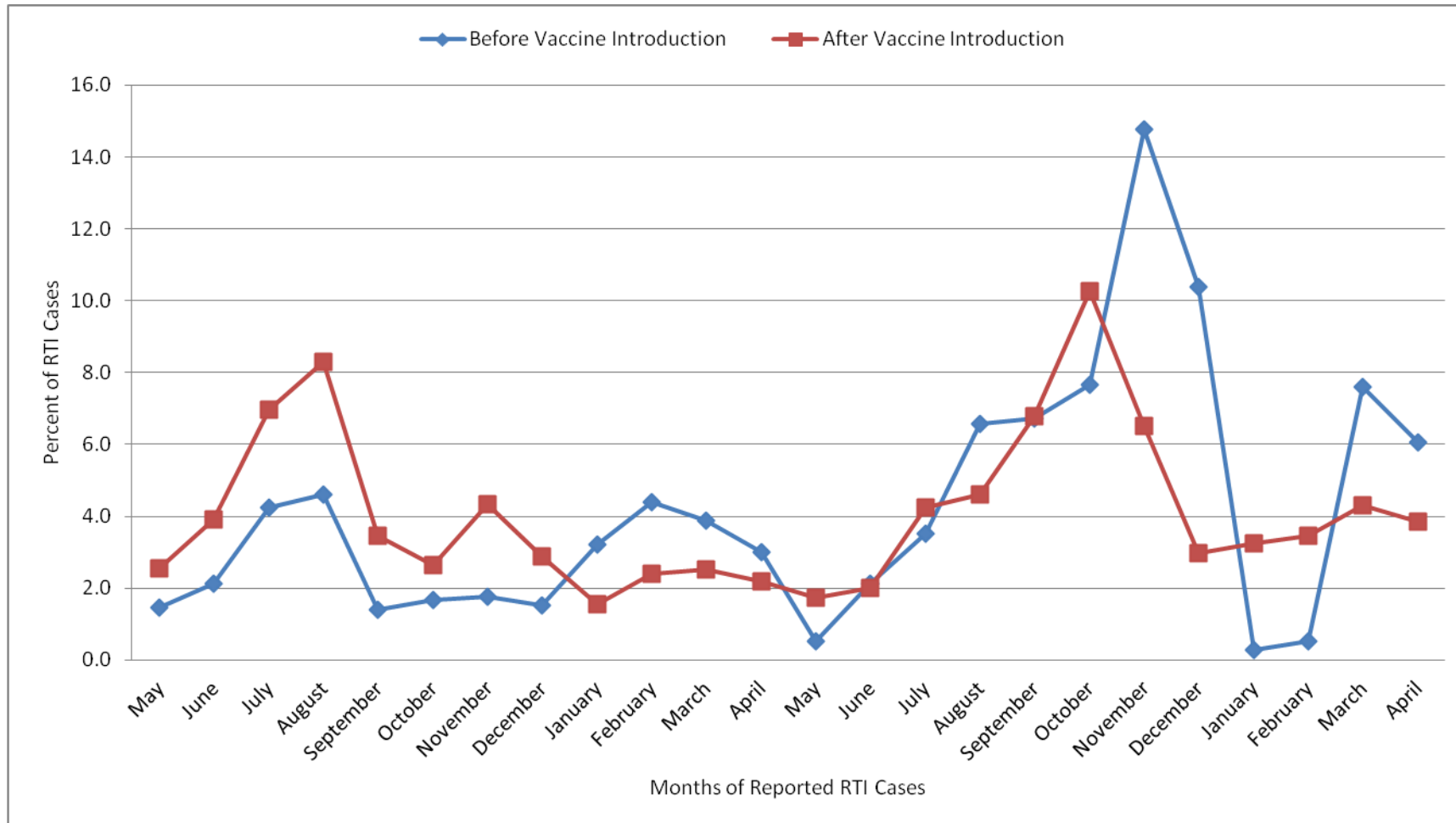
  

<b>Period of Vaccination</b>	<b>Total IPD Cases</b>	<b>Total IPD Pneumonia Cases</b>	<b>Proportion Percent</b>	<b>P-value</b>	<b>95% CI</b>
Before Vaccine Introduction	4729	197	4.17		
After Vaccine Introduction	5556	349	6.28	<0.0001	1.3,1.8
<b>Total</b>	<b>10285</b>	<b>546</b>	<b>10.45</b>		

**Figure 4.1: Reported RTI (OPD) and Pneumonia (OPD and Admissions) Cases before and after the introduction of the Pneumococcal Vaccine**



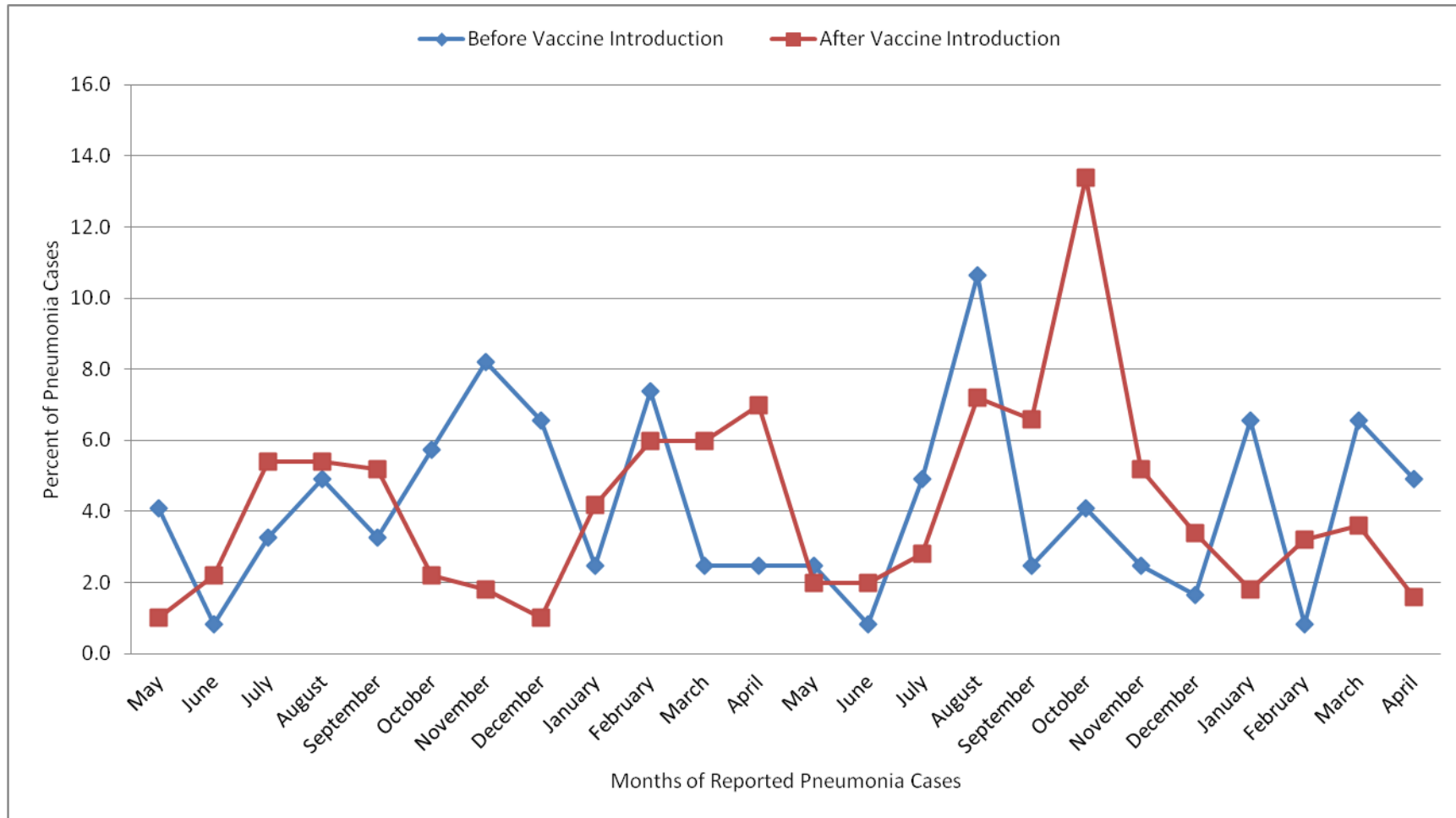
**Figure 4.2: Trends of Respiratory Tract Infections (OPD) before and after the Introduction of Pneumococcal Vaccine in Ghana in May, 2012**



#### **4.2 Trends in Respiratory Tract Infection before and after the Introduction of the Pneumococcal Vaccine.**

The above Fig. 4.2 shows that from May to August, 2010 the cases of respiratory tract infection increased after the introduction of the pneumococcal vaccine. From there it went up and suddenly dropped in May, 2012 when the pneumococcal vaccine was introduced. There was a short term change with the introduction of the pneumococcal vaccine in May, 2012 which was shown in September and December, 2013. The cases slightly reduced from January to February, 2014. The month of October, 2013 was found to be the highest number of cases after the introduction of the pneumococcal vaccine. The cases of respiratory tract infection generally reduced as compared to before the introduction of the vaccine from December, 2013 to April, 2014.

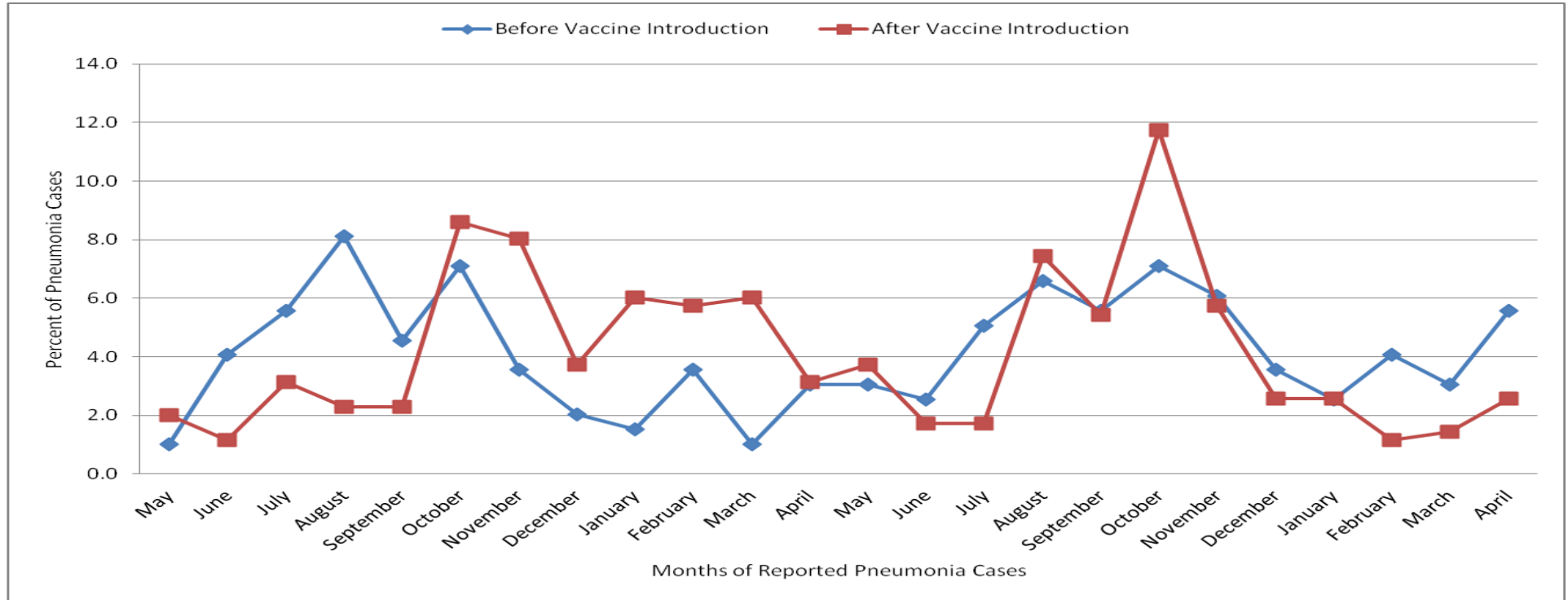
**Figure 4.3: Trends of Pneumonia Cases before and after the Introduction of Pneumococcal Vaccine in Ghana in May, 2012**



#### **4.3 Trends of Pneumonia Cases before and after the Introduction of the Pneumococcal Vaccine.**

The trends of pneumonia cases on outpatient department started rises from May, 2012 then reduced to December, 2012, and then it rises to April, 2013 then increases to October, 2013. The number of cases was higher in the month of October after the introduction of the pneumococcal vaccine as compared to August, 2011 before the introduction of the pneumococcal vaccine. From October it dropped to January, 2014 rises and reduced to April.

**Figure 4.4: Trends of Pneumonia Cases (Inpatient) before and after the Introduction of Pneumococcal Vaccine in Ghana in May, 2012.**



**Inpatient Reported Cases of Pneumonia at the Agogo Presbyterian Hospital before and after the Introduction of Pneumococcal Vaccine**

#### **4.4 Trends of Pneumonia Cases before and after the Introduction of the Pneumococcal Vaccine.**

The above Fig. 4.4 shows the monthly distribution of reported cases of pneumonia on admissions. The trends of pneumonia cases were from May, 2012 to September, 2012 then rises to October then dropped in June- July, 2013. It then rises to October where pneumonia cases were found to be high then it dropped to December, 2013 after the introduction of the pneumococcal vaccine. There was no significant change between the months of April – December, 2013 after which the cases of pneumonia reduced as compared to the period of before the introduction of the pneumococcal vaccine.

## CHAPTER FIVE

### DISCUSSION

This study examined trends in acute respiratory tract infections in children under five years with the introduction of pneumococcal vaccine into the National Expanded Programme on Immunization of Ghana. The study was carried out at the Agogo Presbyterian Hospital in the Asante Akim North District of the Ashanti Region of Ghana and covered the period from May, 2010 to April, 2014. The results of this study confirm the importance of acute respiratory tract infections as one of the major medical problems at the inpatient and the outpatient department of health facilities in Ghana. A short term change in the pattern of respiratory tract infection was also determined for the period, May, 2010, to April, 2014.

#### **5.1 Relationship between Age and Respiratory Tract Infection.**

The age range for this study was from 0-59 months and the children aged 48-59 months (46.71%) formed the highest attendants for respiratory tract infection. The highest pneumonia admissions were seen in children 0-11 months (39.75%). This age children have low immunity hence contracting respiratory tract infection. This is due to the fact that children 0-11 months patronized the hospital during the study period. The finding of this study is in contrast to a study conducted in Philadelphia (Kronman et al, 2011) United State of America (Cilla et al, 2008) Europe and North America (McIntosh, 2002) and Kenya (Nokes et al, 2008).

### **5.2 Relationship between Sex and Respiratory Tract Infection.**

The results of the current study show that there were more male than female children during the study period with the disease. The finding of this study was in line with various studies conducted elsewhere. A study conducted in the United State of America reported that among the young children studied; there were more male patients than female patients (Grijalva et al, 2007). South Asian (Nair et al, 2003), England (Trotter, Stuart, George, & Miller, 2008).

### **5.3 Duration of Stay at the Hospital (Days)**

In the current study the duration of stay on admission at the hospital ranged from 0 to 49 days with most of the children staying on admission for 4 days (79.12%). This study was in contrast to other studies conducted in United State (Poehling et al, 2006; Grijalva et al, 2007). Also a study done in Spain (Cilla et al, 2008), England (Trotter, Stuart, George, & Miller, 2008). Their reasons for the rise in pneumonia cases who go on admissions was attributed to population factors, changes to health service organization, other biologic phenomenon, or a combination of these.

### **5.4 Trends of Acute Respiratory Tract Infections before and after the Introduction of the Pneumococcal Vaccine**

This study looked at pneumonia and other respiratory tract infections reported at the hospital from 2010 to 2014 and realized that before the introduction of the pneumococcal vaccine in 2012 those who reported at the hospital with respiratory tract infections were fewer than reported cases after the introduction of the vaccine. The respiratory tract infection increased from 7.09% before the introduction of the vaccine to 10.73% after the introduction of the vaccine. Both pneumonia outpatient and admissions cases also increased after the introduction of the pneumococcal vaccine. Reported cases of

pneumonia outpatient increased from 0.63% to 1.70% and the pneumonia admissions also increases from 4.17% to 6.28%. These increases though difficult to explain as that was not expected, may be as a result of increased awareness among caregivers at home after the introduction of the vaccine for which reason more episodes were being reported after the introduction of the vaccine which otherwise would have been managed at home with or without success. The introduction of the vaccines could also have prompted clinicians to pay more attention to the diseases than before and therefore resulting in more cases being diagnosed than before.

Changes in health policies in relation to service delivery such as operations of the national health insurance scheme also have the tendency to influence hospital attendance that might influence such trend analysis. These are all worth further investigation. The study is in contrast to various studies in the United State, (Kronman et al,2011, Griffin, Zhu, Moore, Whitney, & Grijalva, 2013, Haddy et al, 2005, Poehling et al, 2006)).

From the study it was found that admissions of bacterial pneumonia cases increased after the introduction of the pneumococcal vaccine. It also shows that, increased before and after the introduction of the vaccine was statistically significant. This might be due to the higher numbers of overall hospital admissions made during the period covered by the study. The highest number of attendance does not come as a surprise as most of the children visiting the Asante Akim District Hospital are residents of Agogo, where the hospital is located. This can be assumed to be fully or partially vaccinated that leads to the increase in the bacterial pneumonia admissions. It can also be due to the study site where the Agogo Presbyterian Hospital is the largest hospital and a national referral hospital where a lot of people came in after the introduction of the vaccine. It can also be due to changes in health service organization. The increased in the finding is in contrast with other studies conducted in United States of America (Pilishyili et al, 2010; Haddy et al,

2005; Kyaw et al,2006; and Atlanta Georgia ( Albrich, Baughman, Schmotzer, & Farley, 2007),Tennessee (Talbot et al, 2004) and England (Whitney et al 2003). In England their reason was that the vaccine provided some protection against disease caused by vaccine-related serotypes and preventing a substantial proportion of the disease caused by drug-resistant strains.

Also other studies were conducted in Poland (Patrzalek, Albrecht, & Sobczynski, 2010, Denmark (Ingels et al, 2012). In South Africa (Obaro & Madin, 2006); Argentina (Martin et al, 2004) and in the Gambia (Cutts et al, 2005).

However, the current study reported marked and consistently higher rates of outpatient and admissions of childhood respiratory tract infection. The reason for the increase after the introduction of the vaccine may be that the vaccine does not provide some protection against the children. This might be due to higher numbers of overall hospital admissions during the study period and also due to the overall higher disease rates observed in children during that period. The increase may also be due to an increase in the rate of disease caused by the pneumococcal conjugate vaccine serotypes. This increase is in contrast with other studies carried out in the United States of America (Nuorti, Whitney, & others, 2010; Grijalva et al 2006; Simonsen et al 2011; Zhou, Kyaw, Shefer, Winston, & Nuorti, 2007). In New York and Tennessee, study conducted indicated that there were only few visits with pneumonia cases, ( Poehling et al, 2004) and Province of Quebec, Canada admissions for all pneumonia cases decreased by 13% after implementation of the of the pneumococcal vaccine, ( De Wals et al , 2008).

Within England, they found that admission rates for bacterial pneumonia rates decrease (Koshy, Murray, Bottle, Sharland & Saxena, 2010b) in England and Wales; study

conducted concluded that the PCV7 introduction resulted in 83% reduction in PCV7 IPD (Ladhani et al, 2013) and (Fitzwater, Chandran, Santosham & Johson, 2012).

For the trends of both pneumonia and respiratory tract infections the outpatient cases increased before and after the introduction. Generally, October was found to be the month with the highest cases after the introduction of the pneumococcal vaccine during the study periods.

The current study was similar to study conducted in a rural area of Ghana which reported the seasonal trend seen for the infections, with a peak in October and a second, lower peak in the March (Krumkamp et al 2012). Another study conducted in Kumasi, Ghana on epidemiology of invasive pneumococcal disease established that the disease was most prevalent immediately following the peak of the harmattan wind (Holliman, Liddy, Johnson, & Adjei, 2007).

**Determine any short term change in the pattern of respiratory tract infection in children less than five years after the introduction of the pneumococcal vaccine**

Respiratory tract infections show remarkable changes and there was a change in the pattern of the disease after the introduction of the vaccine in May, 2012. The cases slightly reduced from January to February, 2014 after the introduction of the pneumococcal vaccine. This was in contrast to study conducted in the United State of America (Grijalva, 2007) and Italy (Esposito et al, 2007).

It is important to note that in all the studies conducted, PCV-7 was the vaccine of choice.

In Ghana, PCV-13 is the vaccine being used even though the efficacy of PCV-10 and PCV-13 has not yet been established as widely as PCV-7, it is thought that they will be efficacious against vaccine type disease due to demonstrated non-inferiority of serologic

studies compared with (Zangeneh et al, 2011). PCV-10 and PCV-13 are mostly found in Africa and Asia, where approximately 50% of invasive serotypes are not covered by PCV-7 but PCV-10 and PCV-13 cover more than 70% of serotypes. In the case of the study conducted at the Agogo Presbyterian Hospital, the pneumococcal vaccine did not protect the children and need to research into it to find out the increase.

By these findings, the objective of introducing the pneumococcal vaccine into the Expanded Programme on Immunization (EPI) is not on course. This also implies that the anticipated reduction in morbidities due to respiratory tract infections in children under five years of age by 92% is not being achieved. The finding of the study is not consistent with the earlier findings conducted by Klugman et al, 2003, Cutts et al, 2005).

### **5.5 Limitations**

Time did not make it possible for the research to cover a wider time range and greater complexity/size. Consequently, the study covered only respiratory tract infections and pneumonia cases that reported at the outpatient department and admissions at the Agogo Presbyterian Hospital between May, 2010 to April, 2014 with children under five years.

## CHAPTER SIX

### CONCLUSIONS AND RECOMENDATION

#### 6.1. Conclusions

The objective of the study was to assess the trends in acute respiratory tract infections in children less than five years before and after the introduction of the pneumococcal vaccine in the Agogo Presbyterian Hospital. There was a significant increase in acute respiratory tract infections after the introduction of the pneumococcal vaccine. The rate of respiratory tract infections and pneumonia outpatient was 17.82% and 2.33%. However, pneumonia admissions were 10.45%. The age range for acute respiratory tract infections was 0-59 months and more in children less than 11 months (39.75%). There was a short term change in the pattern of respiratory tract infection after the introduction of the pneumococcal vaccine.

The new PCV13 in Ghana, especially in the Agogo communities has not made any impact; therefore there is a need to provide important measures to reduce childhood respiratory tract infection.

#### 6.2. Recommendation

Acute respiratory tract infection is a painful disease that claims the lives of over a million children every year. The study has identified issue that can help to reduce the disease in the Agogo Township and the surrounding villages. In view of the findings of the study, it is recommended that;

1. Further research is required to understand the reasons for the increase in the childhood respiratory tract infection so that the most appropriate interventions can be determined.

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**SCHEDULE OF ACTIVITIES**

	Preparatory work and instrument development	Submission of Proposal to Ethical Committee of Ghana Health Service for Review	Pilot study	Instruments correction & redesigning	Data collection	Data entry	Data analysis	Review & submission of final write up To supervisor
January								
February								
March								
April								
May								
June								
July								

**BUDGET**

<b>Item</b>	<b>No. of units</b>	<b>Unit cost</b>	<b>Frequency</b>	<b>Cost GH¢</b>	<b>Purpose/Justification</b>
<b>PERSONNEL</b>					
Field Supervisor	1	40	14	560	Daily subsistence allowance/ per diem
Data entry Clerks	2	30	14	420	Payment for technical services
Data Analysts	1	30	14	420	Payment for professional services
Double entry clerks	1	30	14	420	Payment for technical services
Data collectors	4	30	14	420	Payment for technical services
<b>Sub-total</b>				2240	
<b>TRANSPORTATION</b>					
Vehicle rental	1	50	14	700	Cost of private rental for commuting
Fuel Cost	4	10	14	140	Cost for fuel for hired vehicle
Local travel insurance	6	10	14	140	Estimates are based on private insurance rates. Travel

<b>Item</b>	<b>No. of units</b>	<b>Unit cost</b>	<b>Frequency</b>	<b>Cost GH¢</b>	<b>Purpose/Justification</b>
					protection is a legally binding obligation
<b>Sub total</b>				980	
<b>COMMUNICATION</b>					
Phone calls	<b>20</b>	3	14	42	Cost of communication among personnel
Internet Cost	2	2	14	28	Internet connectivity for accessing information
<b>Sub- total</b>				70	
<b>STATIONARY, OFFICE SUPPLIES AND LOGISTICS</b>					
A4 paper	4	10	1	40	Needed for general operation of study
Pens	4	5	1	20	
Pencils and Erasers	3	4	1	12	
Markers	2	15	1	30	
<b>Subtotal</b>				102	

<b>Item</b>	<b>No. of units</b>	<b>Unit cost</b>	<b>Frequency</b>	<b>Cost GH¢</b>	<b>Purpose/Justification</b>
<b>TRAINING</b>					
Conference Hall	1	100	1	100	
Refreshment	2	100	1	100	For pre-requisite skills acquisition  as may be peculiar to the study
Facilitators Allowance	1	50	1	50	
Participant Allowance	6	25	1	25	
<b>Sub-total</b>				275	
<b>GRAND- TOTAL</b>				3667	

## APPENDICES

### Appendix A: Informed Consent Process

The consent form contains information about the research entitled: ‘‘Trends of Acute Respiratory Infections at the Agogo Presbyterian Hospital with the introduction of Pneumococcal vaccine in Ghana.

Before the commencement of the study permission will be sought from the Chief Executive Officer and the Director of Nursing Services of the Hospital for the study to be conducted in the Out Patients Department and the Peadiatric ward. Matrons in charge of the Outpatient Department and the Peadiatric ward and staffs will be briefed on the purpose of the study to gain their support.

Contact Information: Question(s) about the study could be directed Miss Eunice Tewiah, School of Public Health, College of Health Sciences University of Ghana, Legon

Mobile: 0208219327

Email: [uboafo@yahoo.com](mailto:uboafo@yahoo.com)

Or

Academic Supervisor: Dr. Samuel Sackey

Name of researcher.....

Signature.....

## DATA COLLECTION CHECKLIST

### CONSULTING ROOM REGISTERS

- Date of attendance..... ( )
- Age..... ( )
- Sex..... ( )
- Diagnosis..... ( )

### ADMISSION AND DISCHARGE BOOKS

- Date of admission..... ( )
- Age..... ( )
- Sex..... ( )
- Diagnosis..... ( )
- Duration of hospitalization..... ( )

**Appendix B: Data Collection Form**

**Data collection form**

**Title of study:** Trends of acute respiratory tract infections at the Agogo Presbyterian Hospital with the introduction of pneumococcal vaccine in Ghana   **Date**...../...../.....

**Name of researcher**.....

**Year for which data is being collected:**.....

<b>ID number</b>	<b>Age</b>	<b>Sex</b>	<b>Diagnosis 1</b>	<b>Diagnosis 2</b>	<b>Diagnosis 3</b>	<b>Date of attendance</b>	<b>Date of discharge</b>	<b>Duration of stay at hospital</b>	<b>Name of community of residence</b>
1.									
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									

**Eunice Tewiah**

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**PERSONAL INFORMATION**

Date of Birth : 10<sup>th</sup> July 1966

Place of Birth : Accra

Nationality : Ghanaian

Language Spoken : English, Fante, Twi, Ga

Gender : Female

**ACADEMIC BACKGROUND****University of Ghana, Legon**

2013 – Date

Msc. Clinical Trials

**School of Nursing, College of Health Sciences, University of Ghana**

2001 -2004

BA Nursing with Psychology

**Ebenezer Secondary School**

1981- 1986

**WORK EXPERIENCE****NATIONAL DIABETES MANAGEMENT AND RESEARCH CENTRE KORLE-BU, ACCRA, GHANA**

Principal Nursing Officer, Research Nurse

October, 2006 – date

- Responsible for the operation of Hypertension Clinic
- Patient's education about diabetes and hypertension
- Monitor patient's blood pressure and weight
- Responsible for effective day-to-day management of the department
- Participate in clinical audit and operational research

**DEPARTMENT OF MEDICINE AND THERAPEUTIC, KORLE-BU, ACCRA, GHANA**

Staff Nurse

May, 2008-August, 2001

- Monitor blood pressure and check vital signs
- Written of ward reports
- Handing and taking up

**KORLE-BU TEACHING HOSPITAL, MAMPROBI POLYCLINIC AND ACCRA  
PSYCHIATRIC HOSPITAL, ACCRA GHANA**

February, 1997-May, 1998

Orientation

**SKILLS AND ABILITIES**

- Proper measurement of blood pressure
- Patient's education about diabetes and hypertension

**RESEARCH EXPERIENCES**

**Point of care (POC) testing of glucose strips**

February, 2012

- Recruitment of study
- Registration of patient's
- Recording of values

**Kidney disease and anaemia in Diabetes**

January, 2011

- Recruitment of study
- Registration of patient's and obtained informed consent
- Administration of questionnaires
- Measurement of blood pressure, weight, body mass index, hip circumference and waist circumference

### **Clinical Efficacy of safety of Amaryl-M**

January, 2011

Recruitment of study

- Registration of patient's and obtained informed consent
- Administration of questionnaires
- Measurement of blood pressure, weight and body mass index

### **Audit of Glucose meter strips at the Korle-bu Teaching Hospital**

December, 2010

- Administration of questionnaires
- Data entries

### **Interstrokes**

June, 2002

- Recruitment of study
- Registration of patient's and obtained informed consent
- Administration of questionnaires
- Measurement of blood pressure, weight and body mass index ,hip circumference and waist circumference

## **CONFERENCES AND WORKSHOP**

November, 2013

CSIR-EDCTP Research Ethics Conference

May, 2013

Palliative Care (Korle-Bu Teaching Hospital)

December, 2012

Basic and Advanced Multidisciplinary course in Diabetes(Holy Trinity SPA , Sogakope

Sept, 2011

Epidemic Preparedness and Infection Control (Korle Bu Teaching Hospital)

May, 9- 2011

Strengthening Institutional Public Health

Sep, 2009

Quality Assurance, Customer Care, Postoperative Care and Infection Control (Korle –Bu Teaching Hospital)

## **HOBBIES**

Interested in indoor game such as Ludo Reading, singing and dancing

## **REFERENCES**

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