

**PREDICTORS OF BACTERIAL MENINGITIS AMONG  
PAEDIATRIC PATIENTS AGED 0-5 YEARS HOSPITALIZED  
AT KENYATTA NATIONAL HOSPITAL**

**JUNE JELIMO SEREM**

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**OCTOBER, 2017**

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**DECLARATION**

I, June Jelimo Serem declare that this thesis is my own original work and has not been presented in any University or academic institution of higher learning for an academic award.

Sign.....

Date.....

**CERTIFICATE OF APPROVAL**

We certify that this thesis has been submitted with our approval as University Supervisors.

Dr. Margaret Chege, PhD, MPHE, RN/M

Senior Lecturer, School of Nursing Sciences

University of Nairobi

Sign.....Date.....

Dorcas Maina, MScN

Lecturer, School of Nursing Sciences

University of Nairobi

Sign.....Date.....

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## **DEDICATION**

This work is dedicated to mothers and their children who have suffered from bacterial meningitis.

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## **LIST OF ABBREVIATIONS**

ANC - Antenatal Clinic

ABM - Acute Bacterial Meningitis

BSc.N - Bachelor of Science in Nursing

CDC - Centre for Disease Control and Prevention

CSF - Cerebral Spinal Fluid

DIAM - Drug Induced Meningitis

Hib - *Haemophilus Influenza* Type B

HIV - Human Immunodeficiency Virus

I.e. - that is

IFAS - Iron and Folic Acid Supplementation

K.N.H. - Kenyatta National Hospital

LP - Lumbar Puncture

PCV - Pneumococcal Conjugated Vaccine

PEU - Paediatric Emergency Unit

SNO - Senior Nurse Officer

SPSS - Statistical Package for Social Sciences

UON - University of Nairobi

WHO - World Health Organization

## **OPERATIONAL DEFINITIONS**

**Child** - a baby aged 0-5 years of age.

**Co-morbid** - any chronic disease occurring prior to or together with the current meningitis infection as confirmed by the present diagnosis.

**Father** - the biological paternal parent to the child admitted with meningitis.

**Guardian** - the person who looks after and is responsible for the child admitted with meningitis.

**Informant** - the mother/father/guardian of the child admitted with meningitis.

**Meningitis** - in this study, it is a child with inflammation of the membranes that cover the brain and spinal cord (meninges) due to bacterial infections confirmed by positive symptoms and lumbar puncture test results.

**Mother** - the biological maternal parent to the child admitted with meningitis.

**Patient** - child admitted with meningitis.

**Predictors** - causative agent(s), environmental factors (social, economic & hospital) and comorbidities that contribute to the development of meningitis.

**Previous childhood illnesses** - any health condition that existed before the development of the current meningitis infection and predisposes the child to meningitis.

**Risk factor** - is any attribute, characteristic or exposure of an individual that increases the likelihood of developing a disease or injury.

**Study participant** - child suffering from meningitis and admitted in paediatric ward in K.N.H.

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## **ABSTRACT**

**Background:** Meningitis remains a common and serious problem in children worldwide. One million instances of meningitis are assessed to happen in children worldwide each year. In Africa, where outbreaks are common 70% of meningitis cases are diagnosed in children under the age of five (5) years. Though in most cases, doctors diagnose early and adequate treatment started, 5% to 10% of patients still succumb during the 24-48 hours after onset of clinical features. In 2009, the mortality rate in Africa was four thousand deaths.

**Study Objective:** This study describes the predictors of bacterial meningitis among children aged 0-5years admitted at Kenyatta National Hospital (K.N.H) paediatric wards.

**Methodology:** The study adopted a descriptive cross-sectional design. It was carried out in K.N.H paediatric wards. Data was obtained from consenting parent or guardian and healthcare workers (nurses and registrars). Study participants were selected by convenient sampling method. A total of 104 study participants were included in the study sample. In-depth interviews of key informants were conducted on 7 health workers; 5 nurses from the paediatric wards and paediatric emergency unit and 2 paediatric registrars. Ethical consideration included full disclosure to participants, confidentiality, security of health records and informed consent.

Data was collected by use of researcher administered semi-structured questionnaire and desk reviews of patients files were also used. Qualitative data from the interviews was audio-taped.

Logistic regression analysis was used for data analysis. Quantitative data was cleaned, entered and analysed using Statistical Package for Social Sciences (SPSS) version 23. Results were displayed by utilization of tables, pie charts. Qualitative data was transcribed, grouped in themes and analysed manually.

### **Study Results:**

The majority of the children (55.8%) were female. The highest percentage of the children (53.8%) were aged less than one year. The highest proportion of the parents (39.4%) were within the age group of 26-30 years. Neonatal sepsis (37.5%), neonatal jaundice (25.0%) and for observation (25.0%) were the common reasons for admission to NBU. Children admitted and managed in the nursery unit were significantly 2.7 times more likely to have bacterial

meningitis compared to those children never admitted to the nursery [OR=2.75; 95%CI=1.08-7.00; P=0.031].

*Streptococcus pneumoniae* was the main (51.2%) causative agent of bacterial meningitis among the children. Children who were taken to hospital in delay after illness were 1.740 times more likely to exhibit meningitis than those taken to hospital immediately. Children whose parents had higher levels of income were two times less likely to exhibit meningitis than those with lower. Majority (62.5%) resided in mid urban and slum areas. Most lived in a one (1) bed-roomed house and most houses (60.6%) had more than five people living in it. The main co-existing illnesses among the children were pneumonia (53.8%) and heart disease (22.9%).

### **Conclusions:**

*Streptococcus pneumoniae* was the common causative agent of meningitis among the study population.

The environmental factors such as living in overcrowded areas, inadequate exposure to health education contributed to contracting and developing meningitis. Financial constraints among caregivers posed a hindrance to the participants in seeking medical attention early.

A previous upper respiratory tract infection more often led to contracting meningitis.

The study duration was four (4) months at an estimated cost of Kshs.102,580.00.

## **CHAPTER ONE: INTRODUCTION**

### **1.1 Background**

Meningitis, pneumonia and sepsis in neonates and young ones (0-5years) are among primary reasons for children demise in developing nations. These conditions have more often than not been contemplated all in all as 'serious bacterial contaminations'(UNICEF, 2013). Meningitis is hard to recognize clinically in this age assemble on the grounds that its components might be non-particular. In Bangladesh, more than a fourth of neonates with suspected sepsis; yet without clinical indications of meningitis, had cerebrospinal liquid (CSF) discoveries suggestive of meningitis. The acknowledgment of meningitis is essential given the high death rate and neuro-formative sequelae of the ailment. The last mentioned, might be higher if there should be an occurrence of a missed diagnosis or incomplete/lacking span of treatment when a new born child is observed for the less particular condition 'neonatal sepsis' (Zahn, 2008).

Bacterial meningitis occurs in about 3 children per 100,000 annually in Western countries. Population-wide studies have shown that viral meningitis is more common, at 10.9 per 100,000, and occurs more often in the summer. In Brazil, the rate of bacterial meningitis is higher, at 45.8 per 100,000 annually. Sub-Saharan Africa has been plagued by large epidemics of meningococcal meningitis for over a century, leading to it being labelled the "meningitis belt". Epidemics typically occur in the dry season; attack rates of 100–800 cases for every 100,000 are experienced in Sub-Saharan Africa, which has less efficiency in medical care. (Saez Lloren, 2009).

In Kenya, the West Pokot region, there was an outbreak of meningitis in 2007 that recorded a case-fatality rate of 21%, this was a higher record than in other African meningococcal outbreaks. Extreme remoteness of the area and the lack of clinical experience in handling meningococcal outbreaks and under detection of milder cases might be the reason for recording the high mortality. (Mutonga, 2008)



The World Health Organization(WHO) guidelines list specific and general signs for meningitis. The specific signs include: convulsions, swelling fontanel for neonates and the general signs: laziness, trance like state, diminished feeding, fractiousness, anomalous cry, apnoeic scenes as signs for children aged 2 years of age and older; advising lumbar puncture (LP) if any of the above signs are present. These rules depend on confirmation from the WHO multicentre investigation of the aetiology of serious bacterial contaminations in the very young children (under five years) in low-income settings, and expert opinion (WHO, 2012). The following, according to various studies are signs for predicting severity of disease among infants; feeding trouble, absence of unconstrained development, fever, unsettling, lower chest wall in drawing, tachypnea, snorting, cyanosis, shakings, protruding fontanel and moderately slow capillary refill. (Mwaniki, 2011).

Meningitis epidemics occurs in areas where many people live together for the first time, such as army barracks, during mobilization and college campuses. The pattern of epidemic cycles in Africa is not well understood, several factors have been associated with the development of epidemics in the meningitis belt. They include: medical conditions (immunological susceptibility of the population), demographic conditions (travel and large population displacements), socioeconomic conditions (overcrowding and poor living conditions), climatic conditions (drought and dust storms), and concurrent infections (acute respiratory infections) (Bishai, 2011).

Be that as it may, in every one of these investigations, meningitis has been gathered with bacteraemia, radiological analysed pneumonia and hypoxemia as 'serious disease'. Current rules for Lumbar Puncture (LP) and/or possible treatment for meningitis among neonates and young children in developing nations depend on restricted information. Besides, LP is an under-utilized examination among young children in Kenyan health facilities. This is halfway

a direct result of the instability of elucidation without full biochemical and microbiological investigation of CSF, which is inadequate in many health facilities in the area (Berkley, 2011)

## **1.2 Problem Statement**

In Africa; the ‘meningitis belt’ large outbreaks of meningitis are common, approximately 70% of meningitis cases are diagnosed in children under the age of five (5) years. In most occurrence, the disease is diagnosed early and adequate treatment started. However, 5% to 10% of patients die typically within 24-48 hours after onset of symptoms. Left untreated up to 50% of cases may die; 4000 deaths were recorded in 2009 alone (WHO 2010).

In Kenya, the infant mortality rate is 52 per 1,000 live births and the under-five mortality is 74 deaths per 1,000 live births. This implies that one in every 19 children born in Kenya dies before its first birthday, while one in every 14 does not survive to age five. (KNBS,2009). In Kenyatta National Hospital, in the period of January to December 2015, the paediatric wards admitted a total of six hundred and seventy-two (672) children aged 0-12 years with meningitis. Four hundred and ninety-four (494) of the patients had a positive treatment outcome and they recovered, one hundred and seventy-eight (178) i.e. 26% died of the total cases admitted in that period during the course of management (KNH 2015). In July to September 2016, one hundred and sixty-three (163) children aged between 0-5years were admitted with meningitis. One hundred and sixteen (116) of the admitted children responded to treatment and were discharged. However, 28% of the children admitted in that period; died. Kenyatta National Hospital is a leading referral hospital in Kenya; many patients with varied conditions are seen and managed at the facility and so it offers a clear picture of the gravity of the situation in the region.

The case-fatality rates for meningitis vary by location, country, causative organism and age group. The case-fatality rate can be as high as 70% if the disease is not treated and one in five

survivors of meningitis may suffer with permanent damage including auditory loss, neurologic disability, or physical deformity. (WHO 2010). The complications that arise after the disease process are major and life threatening and affect the quality of life of infants and young children.

Several research has been conducted on meningitis in paediatrics however there is inadequate information to characterize meningitis among these children. The factors that contribute to developing the disease are issues that are preventable and can be avoided if identified, addressed and managed early to prevent progress of the disease. Meningitis is a burden. There is need to reduce the mortality and morbidity rate that arises from this disease. This review plans to determine the indicators and hazard components for mortality among children aged 0-5 years admitted with meningitis and help to develop plans and strategies to alleviate the predisposing factors to contracting meningitis.

### **1.3 Justification**

Meningitis in children is correlated with excess risk of mental, cognitive, hearing impairment as well as continued cognitive developmental problems of higher order language, planning, critical thinking and central acoustic function that increases learning and behavioural difficulties. The risk of developing these adverse outcomes is greatest in but not limited to those patients that experience acute neurological complications at the time of their illness

Meningitis in paediatrics continues to pose a challenge in reducing paediatric mortality rates. Efforts towards curbing the development of the disease are present but not very forthcoming. The disease is preventable if the factors associated with its occurrence and development are identified and managed early. The number of children admitted at KNH with meningitis is alarming. It is very prudent to establish the factors associated with development of meningitis

such as comorbidities, socio- economic, and environmental factors that contribute largely in the development and subsequent management of the disease.

This study aims at characterization of meningitis in children aged 0-5 years admitted at Kenyatta National Hospital paediatric wards. Characterization of meningitis will provide a holistic view to generating measures and strategies that will lead to prevention and early detection and management of the disease in an aim to reduce mortality and morbidity caused by meningitis.

#### **1.4 Research Questions**

1. What is the common documented causative agent of bacterial meningitis among paediatric patients admitted in KNH?
2. What are the environmental factors (social, economic& hospital) that favour development of bacterial meningitis among paediatric patients admitted in KNH?
3. What comorbidities (medical, surgical and congenital) are present during the disease (meningitis) process among paediatric patients admitted in KNH?

#### **1.5 Study Objectives**

##### **1.5.1 Broad Objectives**

To determine the predictors of bacterial meningitis among paediatric patients aged 0-5 years hospitalized at Kenyatta National Hospital.

##### **1.5.2 Specific Objectives**

1. To determine the common documented causative agents of bacterial meningitis among paediatric patients admitted in KNH
2. To establish environmental factors associated with contracting bacterial meningitis among paediatric patients admitted in KNH

3. To establish comorbidities, present during the disease (meningitis) process among paediatric patients admitted in KNH

## **1.6 Study Hypothesis**

Maternal factors play no role in contracting meningitis among children admitted in KNH paediatric wards.

There is no relationship between pre-existing illness/comorbidity and contracting meningitis among children admitted in KNH paediatric wards

Environmental factors do not determine contracting meningitis among children admitted in KNH paediatric wards

### **Study Variables**

Dependent Variable: Meningitis among children aged 0-5 years.

Independent Variable:

1. Demographic data of mother and child
2. Comorbidities
3. Environmental factors

Intervening Variable:

1. Mode of delivery
2. Immunization
3. Nutrition

Outcome Variables:

1. Healthy child

2. Child disability

3. Mortality

### **1.7 Study Benefits**

The study results will help the key players in the health sector gain a deeper understanding of the magnitude of the problem of bacterial meningitis among children as the study was conducted in a major referral hospital in Kenya. The information acquired will provide a basic guide to development of strategies for improvement of pediatrics care and help in development of guidelines for maternal health education with an aim of preventing bacterial meningitis in children which probably occurs as a result of modifiable environmental factors and other factors that are avoidable since the disease is a preventable illness.

## **CHAPTER TWO: LITERATURE REVIEW**

### **2.1 Introduction**

Meningitis is an intense irritation of the meninges; the layers that cover the cerebrum and spinal cord. Most cases are brought on by microscopic organisms or infections; bacteria, viruses or fungi, however some can be because of specific solutions or ailments (Mosby,2010). Meningitis; particularly bacterial meningitis, is a virtually life-threatening disease that can quickly progress to irreversible brain damage, neurologic problems, and even death. In infants, the signs and symptoms of meningitis are not always obvious. This is probably due to the infant's inability to communicate the symptoms (Mack,2014). Therefore, parents, relatives, guardians must pay very close attention to the infant's general condition.

The most genuine events of meningitis are created by bacteria. Viral-related meningitis occurs however; as a rule, is less serious and, with the exception of the extremely uncommon occasion of rabies contamination, never deadly (Theilen, 2008).

Meningitis typically happens as a complexity from a disease in the blood. The blood-cerebrum hindrance regularly shields the brain from tainting by the blood. Once in a while, diseases straightforwardly diminish the defensive capacity of the blood-brain hindrance. Different circumstances, causative microorganisms discharge substances that reduce this defensive ability. Once the blood-brain obstruction winds up plainly defective, a chain of responses can happen. microorganisms can attack the liquid-cerebrospinal fluid encompassing the brain. The body tries to battle the disease by expanding the quantity of white blood cells (ordinarily a supportive safe framework reaction), however this can prompt expanded irritation. (Emedicine, 2016). As the aggravation expands, cerebrum tissue can begin swelling and blood flow to essential parts of the brain can diminish because of additional pressure on the arteries and veins.

Meningitis can likewise be brought on by the immediate spread of a close-by extreme disease, for example, an ear contamination (otitis media) or a nasal sinus disease (sinusitis). A contamination can likewise happen whenever taking after direct injury to the head or after a head surgery. Commonly, the contaminations that cause the most issues are because of bacterial infections. Other more uncommon reasons for meningitis that are non-bacterial are tumors, head injury, brain surgery, lupus, and a few medications. (Patrick, 2016). There is no individual to-individual transmission from these generally uncommon causes.

Meningitis can have a number of symptoms, including a high temperature (fever) over 37.5°C (99.5°F), feeling and being sick, irritability and a lack of energy, a headache, aching muscles and joints, breathing quickly, cold hands and feet, pale, mottled skin, a stiff neck, confusion, a dislike of bright lights, drowsiness and fits (seizures) (Eaton, 2015).

Classic or common symptoms of meningitis in infants younger than three (3) months of age may include some of the following: decreased liquid intake/poor feeding, vomiting, rash, stiff neck, increased irritability, increased lethargy, fever, bulging fontanelle (soft spot on the top of the head), seizure activity, hypothermia (low temperature), shock, hypotonia (floppiness), hypoglycaemia (low blood sugar), jaundice (yellowing of skin) (Medscape, 2016).

Classic symptoms in children older than one (1) year of age are as follows: nausea and vomiting, headache, increased sensitivity to light, fever, altered mental status (seems confused or odd), lethargy, seizure activity, coma, neck stiffness or neck pain, knees automatically brought up toward the body when the neck is bent forward or pain in the legs when bent i.e. brudzinski's sign, inability to straighten the lower legs after the hips have already been flexed 90 degrees i.e. kernig's sign and rash. Symptoms of viral meningitis most commonly resemble those of the flu; fever, muscle aches, cough, headache but some may



have one or more of the symptoms listed above for bacterial meningitis, but the symptoms are usually considerably milder. (Medscape, 2016)

## **2.2 The Most Common Causative Agent of Meningitis among Paediatric Patients**

Infants and young children are susceptible to most diseases with high incidence being observed in healthy older children and adolescents. Despite the continuing development of new antibacterial medications, bacterial meningitis casualty rates stay high, with detailed rates in the vicinity of 2% and 30% (Feigin, 2009).

Viral microorganisms are the most common cause of meningitis in children, followed by bacterial microorganisms and, rarely, fungal microorganisms. Viral meningitis is caused by viruses, most often enteroviruses. Meningitis that occurs as a result of enteroviruses occurs most often in neonates (0-28days) and young children (Fleming, 2009).

Viral meningitis is less severe than bacterial meningitis and often stays undiscovered on the grounds that its clinical manifestations are like the normal influenza. The recurrence of viral meningitis increments somewhat in the hot and dry weather months in light of more noteworthy presentation to the most well-known viral agents; enteroviruses, for example, coxsackievirus and poliovirus and the herpesvirus. (Noah, 2010)

In a study done in Greece on the patterns of occurrence of bacterial meningitis among children, most cases recorded were due to *Neisseria meningitidis* which occurred in infants and young children: 26.3% occurred in infants < 1 year and 71.1% in children < 5 years of age. Infants < 1 year of age had the highest age specific IR (32.8) recorded in the period of the study. The mean age of *Neisseria meningitidis* cases is approximately the of 2.7 years ((Johnson *et al*, 2010).

Intense bacterial meningitis is among a standout amongst the most serious ailments in children. The bacterial infection not only results in physical and neurologic sequelae, but also continues to be an important cause of mortality (Li Y, 2014). 10–20% of survivors suffer permanent sequel, including epilepsy, mental retardation, or sensorineural deafness (Khowaja, 2013).

Before the introduction of modern vaccines, 90% of reported cases of acute bacterial meningitis were caused by *Hemophilus influenzae* type b (Hib), *Streptococcus pneumoniae* (*S. pneumoniae*), or *Neisseria meningitidis* (*N. meningitidis*) (Agrawal, 2011). Hib meningitis primarily affects very young children; from the age of one (1) month to three (3) years (Kim, 2010). The introduction of highly effective Hib polysaccharide-protein conjugate vaccines has virtually eradicated invasive Hib disease in most developed countries where routine Hib vaccination has been implemented (Khowaja, 2013).

*S. pneumoniae* real reason for childhood bacterial meningitis in many nations especially in those where Hib illness has been killed by immunization (Robinson, 2010). In some European and sub-Saharan African nations, *S. pneumoniae* is the second most much of the time archived reason for septic meningitis after meningococcal cases (Saez,2009).

The ongoing improvement and presentation into routine vaccination timetables of glycoconjugate pneumococcal immunizations has incredibly diminished the occurrence of illness created by antibody serotypes. The success of these vaccines means *N. meningitidis* is now considered to be the leading cause of bacterial meningitis in many regions of the world, causing an estimated 1.2 million cases of meningitis and sepsis worldwide each year (Pathan, 2006). There are 12 recognized serogroups of *N.meningitidis*, but the greater part of intrusive ailment is identified with six meningococcal serogroups: (Men) A, B, C, W-135, X and Y (Rosentein,2009).

The study of the disease transmission and appropriation of these illness causing about different serogroups broadly by geographic location: so while Men A is the most prevalent infection creating serogroup in sub-Saharan Africa and remains an imperative consideration in parts of Asia, it now seldom if ever occurs in Western Europe or North America, where cases of Men A used to occur. In contrast, Men B and Men C dominate in the industrialized nations of North and South America (Stephens,2009). The introduction of routine childhood vaccination with monovalent meningococcal serogroup C conjugate vaccines into Europe and Australia has markedly decreased incidence in these countries. Serogroup W-135 has emerged recently in some parts of the world, primarily in the Middle East and Africa, causing large epidemics, and has been associated with small outbreaks in Europe due to pilgrims returning from the Hajj (Taha, 2010).

Men Y has been increasing in relative incidence over recent years in North America, South America and South Africa. Cases of Men X disease have emerged in sub-Saharan Africa (Harrison,2009). Men ACWY conjugate vaccines have been available for years but are not widely used. Men C conjugate vaccine has been widely used in Europe and Men A conjugate vaccine in sub-Saharan Africa through mass vaccination campaign and that their impact (Men A and Men C) has been dramatic in reducing meningitis due to the respective serotypes (Tan,2010).

### **2.3 Environmental Factors Associated with being Infected with Meningitis**

The reasons why a few people do get intrusive meningitis sickness while most do not are ineffectively caught on. It is likely that other than the elements identified with the irresistible pathogen or the host, natural qualities additionally assume a part (Kriz 2009). Various hazard components for the improvement of meningitis infection have been distinguished. The epidemiological writing, in spite of the fact that it is not broad, is reliable. These hazard

components can be extensively assembled into clinical versus ecological and social dangers (Bobak, 2009).

As far as sexual orientation is involved, males contract meningococcal illness more regularly than females (Robinson 2010). As to age, there has been a bimodal dissemination of the majority of informed cases with the most noteworthy rate in the 0-4 age gathering and a moment top in the 15-24-year age gathering, albeit all age gatherings can be influenced by meningitis.

Parental smoking has all the earmarks of being an especially solid hazard calculate for obtrusive meningitis malady in childred (Yung, 2009). The recurrence of the malady is higher in low financial regions, and most reviews have found that the danger of illness was lower in young ones living in more good financial conditions (Albrecht, 2010).

The central point for expanded hazard are: smoking, financial hindrance, abiding swarming and destitution, and geographic hazard. Smoking; Several natural systems can give the connection between tobacco smoke and meningitis illness. Introduction to smoke directly causes harm to the nasopharyngeal mucosa, and detached smoking is related with an expanded danger of respiratory sickness in the minors (Kriz, 2009). As kids have sensitive mucous films, they might probably obtain meningococcal sickness on the off chance that they are incessantly presented to passive smoking.

It is likewise realized that smoking rates are higher in lower financial gatherings. In a situation control contemplate examining natural calculates affirmed instances of meningitis illness, latent cigarette smoking in the house was related with a chances proportion of 7.5 for ailment hazard in young ones under five. The chances proportions expanded both with the quantities of cigarettes smoked and with the quantity of smokers in the family unit (Baker, 2011).

Existing information reliably proposes that financial detriment builds the danger of meningitis. In Brazil, the frequency of the illness was around two times higher in low financial zones than in more prosperous zones (Kriz, 2009). In the UK, swarming and a few other unfavourable social pointers were identified with meningitis malady chance (Rosentein, 2011). US studies have reliably found that individuals of African-American origin, individuals of low financial status, low maternal education and other antagonistic social attributes were related with expanded danger of the infection. (Grimwood, 2010).

The danger of obtrusive meningococcal sickness in little ones is firmly impacted by negative financial conditions; abiding in swarmed regions and neediness. (Kriz, 2009) Across the worldwide writing, abiding swarming has been observed to be related with abundance hazard for the development of meningococcal ailment. The creators of a longitudinal investigation of Belgian schoolchildren reasoned that "populaces of low financial status and living in thickly populated regions constitute an objective populace for meningitis illness aversion" (Cooke, 2011).

Contemplates in Denmark found that the danger of obtrusive meningococcal ailment expanded with expanding family unit thickness, even in the wake of altering for confounders, for example, presentation to smoking, age and financial variables. The creators proposed that the system behind this affiliation is "expanded danger of introduction from carriers and more compelling transmission" (Cooke, 2011). Thus, another Australian review found that intrusive meningococcal ailment was related with sharing bedrooms to at least two individuals or more. Living in swarmed spots is firmly contrarily corresponded with all financial pointers. All things considered it is an incredible marker of both detriment and malady hazard (McCall, 2011).

“..... discoveries recommend that in spite of the fact that the principle determinant of contrasts in ailment mortality by zone hardship is danger of malady occurrence, there might be an extra part due to socio-cultural contrasts in illness introduction or potentially early administration. Minimisation of neediness will have the best effect on disease avoidance, in the short to medium term, enhancements in access to health services and prior treatment will probably diminish the rate of mortality from meningitis for every social gathering" (Namani,2013).

Several studies point to the importance of weather-related influences on disease transmission. Research by Letson *et al* in 2012, noted the occurrence of epidemics of meningitis during the dry, dusty season, and it is hypothesized that high temperatures coupled with low humidity may favor the conversion of benign meningitis that is bacteria in the nose and throat to pathogenic bacteria by damaging the mucosa and lowering immune defense and resulting in completion of the disease process.

Unemployment and extreme poverty is observed in most of developing world and Kenya is no exception to this scenario. The situation predisposes people to live in overcrowded areas, slums and areas with poor sanitation putting them and their children at great risk of contracting meningitis and other illnesses. Meningitis, as a major disease, may be one such illness that can drive a household into severe poverty and is also a disease which can occur as a result of poverty. In the developing world in the meningitis belt, meningitis epidemics are devastating and contribute to the cycle of poverty through cost of illness. (Colombini *et al*, 2009).

In the East Africa region, Kenya for example, the cost of treating a case of meningitis often equates to two times a farm or slum family's annual income. The level of education of the parent(s)/guardian and the occupation of the head of the household also contribute to the

sequel of events towards developing meningitis. Not only is the disease financially disruptive, but long-lasting sequelae also present a burden to the family by disrupting social structure.

Meningitis cases ought to be nursed in very much ventilated rooms and the quantity of individuals occupying a space at a given time kept at the very least. Healthcare provider efforts should be geared towards prevention, prompt treatment and proper management of meningitis. The most effective strategies for prevention of meningitis is if possible isolate those infected, manage the infected patients in well ventilated rooms, reduce overcrowding and advocate for proper hygiene (Polin *et al.*2012). The role of immunization to promote immunity to be done to children above two (2) years of age and the need to adhere to follow-up visits emphasized. The healthcare provider offers a bridge between the community and the incidence of meningitis and should be prompt to provide appropriate health education to parents and care givers of the children infected with meningitis (Watt, 2009).

#### **2.4 Comorbidities Present during the Disease (Meningitis) Process**

Meningitis may occur after either an acute or subacute/chronic infection. Acute otitis media is the most common cause of meningitis. Extradural granulation tissue or frank pus may be found and such may spread to compromise the blood brain barrier. In children, meningitis in the setting of chronic suppurative otitis media may be secondary to the direct extension of infection through the dura, through a previous stapedectomy site, or through a cholesteatoma-induced labyrinthine fistula. (Eaton, 2015)

Intracranial complications of sinusitis are potentially life threatening and these complications include meningitis. In children under 1 year of age, the contamination can spread through the delicate developing arachnoid and cause meningitis, which happened in 75% of cases in one arrangement of subdural empyema study that was conducted. (Brook,2007). The

complication, despite the fact that uncommon, ought to dependably be looked for in patients being managed and treated for sinusitis.

Meningitis is the most genuine entanglement of meddling pneumococcal affliction. Of kids under five (5) years old who contract meningitis (pneumococcal meningitis) in the wake of agony from pneumonia, about 1 out of 15 dies of the contamination and others may have long haul issues, for example, hearing misfortune or formative deferral. (Hussain *et al*, 2010)

Mumps was a typical reason for aseptic meningitis in the United States until mumps vaccination came into use. In a couple of countries, mumps contamination remains a run of the mill pathogen in aseptic meningitis. It is spread by respiratory secretions, with extended recurrence in the spring (Bhatt, 2012).

Human immunodeficiency virus (HIV) can cause meningitis during the early stages (seroconversion) of HIV infection. Meningitis in patients with HIV infection is almost always infectious in origin. Two opportunistic pathogens stand out as important problems in patients with AIDS - *Cryptococcus neoformans* and *Mycobacterium tuberculosis*, and together they account for about  $\frac{3}{4}$  of the cases of meningitis. Infection with *C. neoformans* is the most common systemic fungal infection in patients infected with HIV and the most common cause of meningitis (Hakim *et al*, 2010). About 5% of HIV-infected patients in the Western World develop disseminated cryptococcosis; the disease occurs in 20-30% of patients in other parts of the world such as in sub-Saharan Africa. Cryptococcal meningitis has been described as an opportunistic infection in immunocompromised patients, but is also known to affect apparently healthy individuals (Graybill, 2010)

The rate of medication instigated meningitis (DIAM) is obscure. Many antimicrobials can cause the disorder e.g., trimethoprim-sulfamethoxazole, ciprofloxacin, cephalixin, metronidazole, amoxicillin, penicillin, isoniazid. Other drugs that have been associated with



DIAM include NSAIDs, ranitidine, carbamazepine, vaccines against hepatitis B and mumps, immunoglobulins, radiographic agents, and muromonab-CD3. (Martinez, 2012)

The pathogenic mechanism of DIAM are assorted and probably vary from medication to tranquilizer. There are two proposed instruments: coordinate meningeal disturbance by the intrathecal medication and hypersensitivity responses to the medication (type III and IV). In type III hypersensitivity responses, the medication or its metabolite shapes a complex with antibodies in the serum, thus enacting the complement cascade. In type IV responses, T helper cells, after past sensitization, are selected to the site of aggravation. (Jairus et al, 2009). Why such responses are limited specifically to the CSF compartment is vague.

## **2.5 Theoretical Framework**

Theoretical framework to be used in this study is adopted from Betty Neumann's` systems model (1998-2008). This model views the individual as an open system consisting of subsystems. The open system has internal structures (lines of defense) and the external structure (environment); an individual is in interaction with a bigger system; the environment (Pearson A; 2005). The Neumann's Systems Model depends on the patient's relationship to stress, response to it, and reconstitution considers that are dynamic.

The hypothesis comprises of vitality assets that are encompassed by three things: a few lines of resistance, which speak to the inner variables (internal factors) helping the patient battle against a stressor; the ordinary line (normal line) of barrier, which speaks to the patient's balance; and the adaptable (flexible) line of safeguard, which speaks to the dynamic nature that can quickly change over a brief span.

In the model, three levels of aversion are available. The first is essential/ primary aversion (before illness occurs) which protects the normal line and strengthens the flexible line of defense. The secondary prevention (during illness) is used to strengthen the internal lines of

resistance, which reduces the reaction and increases resistance factors. Finally, tertiary prevention (after illness or when complications occur) readapts, balances out, and secures the patient's arrival to health after treatment.

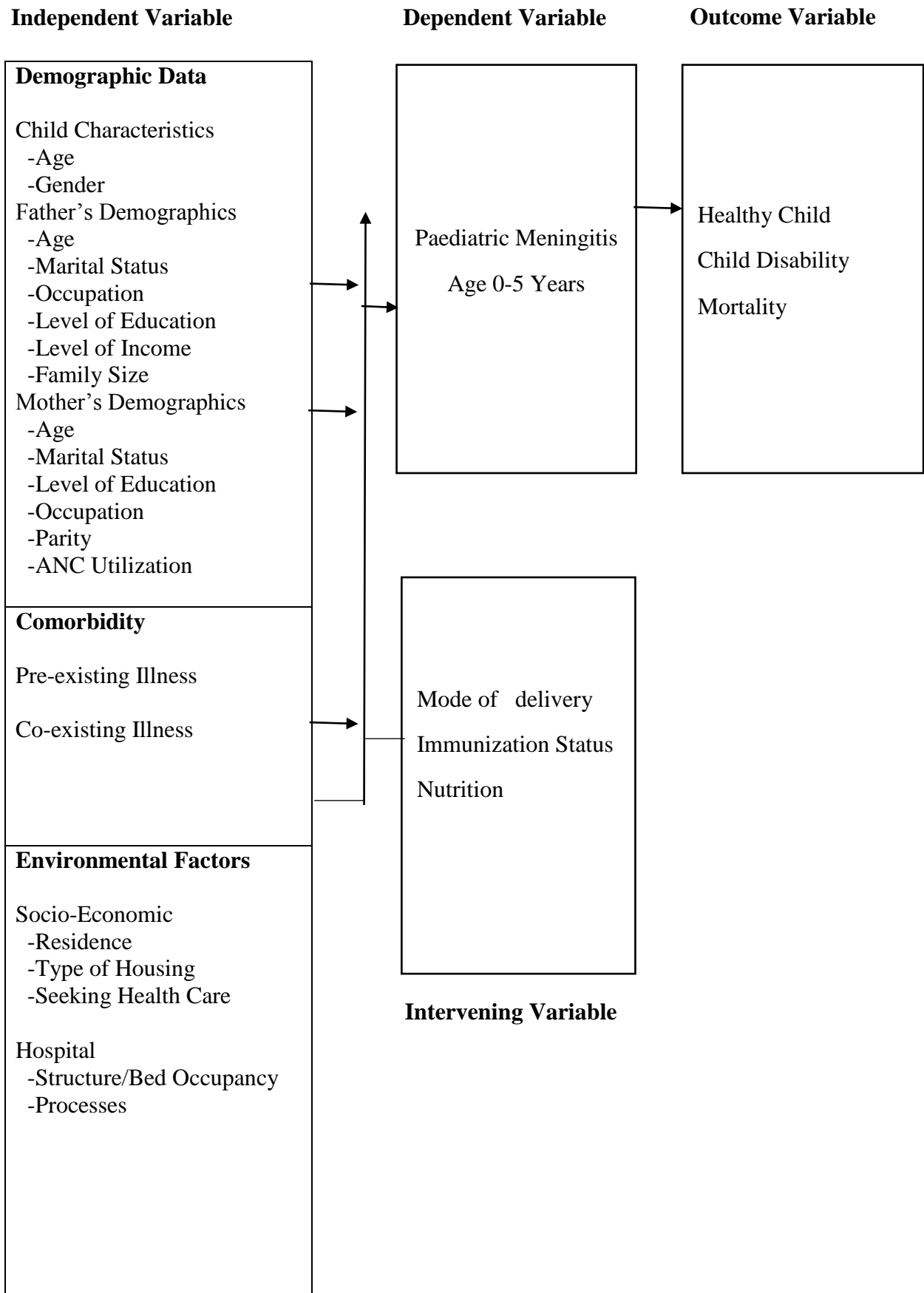
Neumann explains environment as the totality of the internal and external forces which surround a person, and with which they interact at any given time. These forces include the intrapersonal, interpersonal, and extra-personal stressors, which can affect the person's normal line of defense and so can affect the stability of the system. The environment has three components: the internal, which exists within the client system; the external, which exists outside the client system; and the created, which is an environment that is created and developed unconsciously by the client, and is symbolic of system wholeness. Failure of individual's subsystems (spiritual, physical, emotional, intellectual and social) to maintain stability leads to disease. The human being is described as having concentric circles of lines of resistance. Lines of resistance are protection factors activated when stressors penetrate the normal line of defense such as the mucous membranes, blood brain barrier. The child faces both internal and external stressors.

In the case of meningitis in children aged 0-5 years old, the child is the individual, an open system interacting with the external environment; the air they breathe, the home they live in, the exposure to people infected with meningitis, the care-givers who handles the child and the community at large. The stressors invade the normal line of defense which is the usual state of wellness. Having a weak defense system, the intrusion from the environment attacks the flexible line of defense (a protective accordion invaded by stressors) resulting into entropy (process of energy depletion) thereby actualizing causing meningitis. Entropy results in disease (meningitis), cognitive or neurological impairment or death as a result of lack of reconstitution, which Betty Neumann's describes as maintenance of balance towards recovery. In meningitis, we aim at primary prevention. Should the infection occur, then

prompt treatment is the target. Should the unfortunate complication such as neurological impairment occur, then tertiary prevention is the alternative applied to rehabilitate and stabilize the individual. Primary prevention is by the client and community, secondary prevention by the healthcare provider and tertiary prevention is by the collaborative effort of the client, healthcare provider, social leaders and spiritual leaders i.e. community at large

The Systems Model of health is equated with wellness, and defined as "the condition in which all parts and subparts, or variables, are in harmony with the whole of the client." The client system moves toward illness and death when more energy is needed than what's available. The client system moves toward wellness when more energy is available than is needed.

## 2.6 Conceptual Framework



## **CHAPTER THREE: METHODOLOGY**

### **3.1 Study Design**

A descriptive cross-sectional study design was used in the study. Participants were identified on admission at the pediatric wards and their progress was followed up until discharge from the hospital. The researcher did not give any additional intervention and the participants received the standard care as per the KNH protocols. Mixed research methods was used whereby qualitative and quantitative data was collected.

### **3.2 Study Area**

The study was conducted in Kenyatta National Hospital (K.N.H) paediatric wards. This is a major national referral hospital located in Kenya's Capital city 1.5 kilometers from the central business district, in upper-hill area. It is located along hospital road, off-Ngong' road. The hospital occupies about 5 hectares of land. It has 50 inpatient wards and a total bed capacity of 2000. The paediatric department has eight inpatient wards where general medical patients, orthopedic, oncology and surgical paediatric patients are admitted. The paediatric bed capacity is 256 and the bed occupancy is almost always above the available bed number. Patients suffering from meningitis are admitted in the medical paediatric wards through the paediatric emergency unit.

### **3.3 Study Population**

The study targeted children who are aged 0-5years and their parents or guardians. The children who presented with meningitis and were admitted in K.N.H paediatric wards. Data was collected from nurses and registrars who work in the paediatric emergency unit (entry point for sick children) and paediatric wards.

### 3.4 Inclusion Criteria

The inclusion criteria to be eligible to participate in the study was as follows:

- Children aged 0-5 years admitted with meningitis at KNH paediatric wards during the study period whose parent(s) gave consent to participate in the study
- Parent(s)/Guardian of children admitted with meningitis who gave consent
- Children with a diagnosis of meningitis whose files had documented lumbar puncture test results
- Nurses and registrars working in paediatric wards and paediatric emergency unit who consented to participate in the interviews.

### 3.5 Exclusion Criteria

- Children whose parent/guardian declined to consent to participate in the study.
- Children who were admitted with caregivers other than their parent/guardian.
- Children above five (5) years old admitted with meningitis.

### 3.6 Sample Size Calculation

The sample size was determined using the formula by Fisher's *et al* (1998)

$$n = \frac{Z^2 p (1 - p)}{e^2}$$

#### Where

n= the desired samples size (if the target population is greater than 10,000)

z = is the value for corresponding confidence level (i.e. 1.96 for a 95% confidence interval)

p= is the estimated value for the proportion of the target population that have the condition of interest (p=, the most conservative estimate, there being no documented incidence of meningitis in children, 50% is used).

e=the level of statistical significance set which is 5% with a confidence interval of 95%

$$n = \frac{1.96^2 \times 0.5 (1 - 0.5)}{0.05^2} = \frac{(1.96 \times 1.96) \times (0.5)(0.5)}{0.05^2} = \frac{3.8416 \times 0.25}{0.0025} = \frac{0.9604}{0.0025} \quad n = 384.16$$

The sample size was 385 study participants.

Since the study population was less than 10,000 the Fisher`s formula (1998) was used to calculate the finite study sample size as follows:

$$nf = \frac{n}{1+(n/N)}$$

Where

nf = the desired sample size (when the population is less than 10,000)

n = the desired sample size (when population is greater than 10 000)

N = the estimate of the population size in the study area (number of children admitted to K.N.H paediatric wards per month suffering from meningitis is about 55)

$$nf = \frac{385}{1+(385/110)} = 385/4.5 = 85.5 = 86 \text{ study participants}$$

Sample size was 86 study respondents.

Considering non respondents 20% of the study participants was added to get enough sample size. The sample size was 104 respondents.

### **3.7 Sampling Procedure**

#### **3.7.1 Sampling of Study Participants**

Purposeful sampling technique was used to select the study participants. All the children who were seen at paediatric emergency unit at KNH paediatric wards with clinical symptoms of meningitis and diagnosed with meningitis who met the inclusion criteria were included in the study. The children were followed up to outcome. Outcome was determined by discharge from the hospital or mortality. They were sampled as they were admitted until the sample size of participants was achieved.

### **3.7.2 Sampling of Interview (Nurses & Registrars) Study Participants**

Purposeful sampling technique was used to get the sample for the interviews. Interviews were conducted on nurses and doctors working in the paediatric wards and paediatric emergency unit. The researcher approached a nurse and requested him or her to participate in the interview. Preference was made to senior nurse officers (SNOs), those who agreed to consent were interviewed. The nurses interviewed comprised of 1 nurses from each of the paediatric wards (3A 3B 3C&3D) and 1 from the Paediatric Emergency Unit (PEU) and 2 doctors (paediatric registrars) to make a total of 7 interview participants.

### **3.8 Study Instruments**

The researcher used semi-structured researcher administered questionnaire (Appendix 4) to collect data from the parent/guardian. The questionnaire was researcher designed which was pretested to determine the content, construct and criterion validity.

Desk review procedure was used to obtain data by the researcher whereby; the file of any child with a diagnosis of meningitis was scrutinized for documented results of lumbar puncture test.

A key informant interview guide (Appendix 4b) was used to collect qualitative data from the nurses and doctors who participate in giving care to the study participants.

### **3.9 Training of Research Assistants**

One research assistant who was a registered BScN nurse was recruited and oriented on the purpose of the study and also trained on data collection process.

### **3.10 Pre-testing of the Study Instrument**

The study instrument was pretested in Mbagathi District hospital in Nairobi's Ngumo area. Mbagathi hospital is a public hospital just as K.N.H and serves a population with similar



characteristics to those in K.N.H. Mbagathi Hospital is a key hospital that refers patients suffering from meningitis to K.N.H. It has a paediatric wing where children are admitted. Reliability of the study tools was done by pretesting the tool by using 10% (11 respondents) of the study sample size. Ambiguous questions were rephrased and adjustments made where required.

### **3.11 Recruitment Process**

Eligible participants were the parent/guardian whose child met the inclusion criteria. They were recruited from the paediatric wards. Once recruited, the consenting procedure will follow.

The participants (nurses and registrars) for the interviews was recruited from among the nurses and doctors who work in the four paediatric wards and paediatric emergency unit selected purposively. The individuals were accessed prior to the date of the interview.

### **3.12 Consenting Procedure**

The researcher produced evidence of approval to undertake the research to the ward in-charge and introduced self. Upon contact with the child's parent/guardian, the researcher introduced self and issued the invitation to the study participant to participate in study. Study participants were given information that pertains to their participation in the study in-order to make an informed consent. The interview participants i.e. nurses and registrars were given information on the study title, objectives and benefits. Once they accepted to participate, they were requested to sign a consent form.

### **3.13 Data Collection Procedure**

Each prospective participant was approached and explained about the study. Once she/he consented to participate, she/he was taken to a room within the ward where face to face

interview were conducted. The researcher asked questions as per the questionnaire and then recorded responses on the respective sections of the questionnaire.

Desk review of patient's file were done to get information about lumbar puncture test results.

Semi-structured interviews conducted on the health workers were audio-taped.

### **3.14 Data Management and Analysis**

#### **3.14a Data Analysis**

At the end of each day of data collection, questionnaires were checked for completeness. Each questionnaire was entered against its unique identifier number into a Microsoft Excel program where data cleaning was done. Missing values, extreme values and inconsistency was identified and corrected. After cleaning, the data was then exported to software for analysis using statistical package for social sciences (SPSS) version 23. Logistic regression analysis was used. Odds ratios (OR) was used for analysis of data.

Multivariate analysis was used for descriptive analysis of maternal, child and environmental characteristics. Categorical data such as gender, marital status, level of education was analyzed by use of proportions. Distribution of categorical variables was compared using Pearson's chi-square test.

Transcribed qualitative data was categorized into themes and analyzed manually

The data was stored in computer hard drives and back-ups in flash-discs and personal email accounts. Filled questionnaires were kept in lockable drawers whose access was limited to the researcher.

#### **Data Analysis Dummy Tables**

**Objective: To Determine the Common Documented Causative Agents of Meningitis among Children Admitted in KNH**

**Table 1: Common Causative Agent**

<b>Causative Agent</b>	<b>Frequency (n)</b>	<b>Percentage (%)</b>
<i>Neisseria meningitidis</i>		
<i>Streptococcus pneumoniae</i>		
<i>Haemophilus influenzae</i>		

**Objective: To establish co-morbidity present during the disease process**

Table 2: Co-morbidity present

<b>Co-morbidity</b>	<b>Frequency (n)</b>	<b>Percentage (%)</b>
Otitis Media		
Sinusitis		
Pneumonia		

### **3.14b Data Presentation**

Analyzed data was presented in graphs, pie charts and tables.

### **3.15 Ethical Considerations**

Ethical approval to carry out the study was sought from the Kenyatta National Hospital and University of Nairobi Ethics and Research Committee (KNH/UON-ERC) and the Kenyatta National Hospital Administration. A written informed consent (appendix 1c) was obtained from the parent/guardian of the child admitted in KNH paediatric wards with meningitis.

Clear explanation about the study was given to the parent/guardian prior to consent to participate in study. Participation was purely on voluntary basis, there was no coercion and participants were free to leave at will. Questionnaires had code numbers to ensure anonymity of study respondents, there was no use of names on the questionnaires. The questionnaires were stored under lock and key and were accessed by the researcher and research assistant only. Health records (Patient file) was obtained with permission from the hospital and from the ward in-charge for data collection and after data collection is done, the health record was returned to the ward and the researcher or research assistant will countersign with the ward in-charge to confirm the patient file is intact and has been returned. Parent/guardian whose child was seriously ill was excluded from the study until the child is stable. The researcher explained the risks and benefits of the study. Information gathered will only to be shared to relevant parties for implementation. Accuracy, truthfulness and fairness was observed throughout the study.

### **3.16 Study Limitations**

The study was conducted in Kenyatta National Hospital a hospital set up; whose patient population come from Nairobi and the environs. It is also a referral hospital attending to referrals from various hospitals across the country.

The study findings may not give a picture of the actual community setup from where the patient was being referred from since the patients may have already been stabilized by the time they arrive in KNH thus may not be generalizable.

The laboratory findings could be interfered with since some parents could have medicated the child with over the counter antibiotics before coming to hospital or could have been medicated in another facility before coming to KNH thus the laboratory findings may not be generalizable. The hospital also receives severely ill patients who may require to be stabilized upon contact hence limiting their inclusion in the study.

### **3.17 Dissemination Plan**

Reports of the research findings was written and presented to the University of Nairobi College of Health Sciences Medical library and a copy was issued to the management of KNH. Attempts will be made to publish in relevant journals.

## CHAPTER FOUR

### 4.0 RESEARCH FINDINGS

#### 4.0 Introduction

The results and analysis of the study findings are presented in this chapter. It is organized as follows; univariate/descriptive information of the study variables then bivariate analysis.

#### 4.1 Demographic Characteristics of the Children

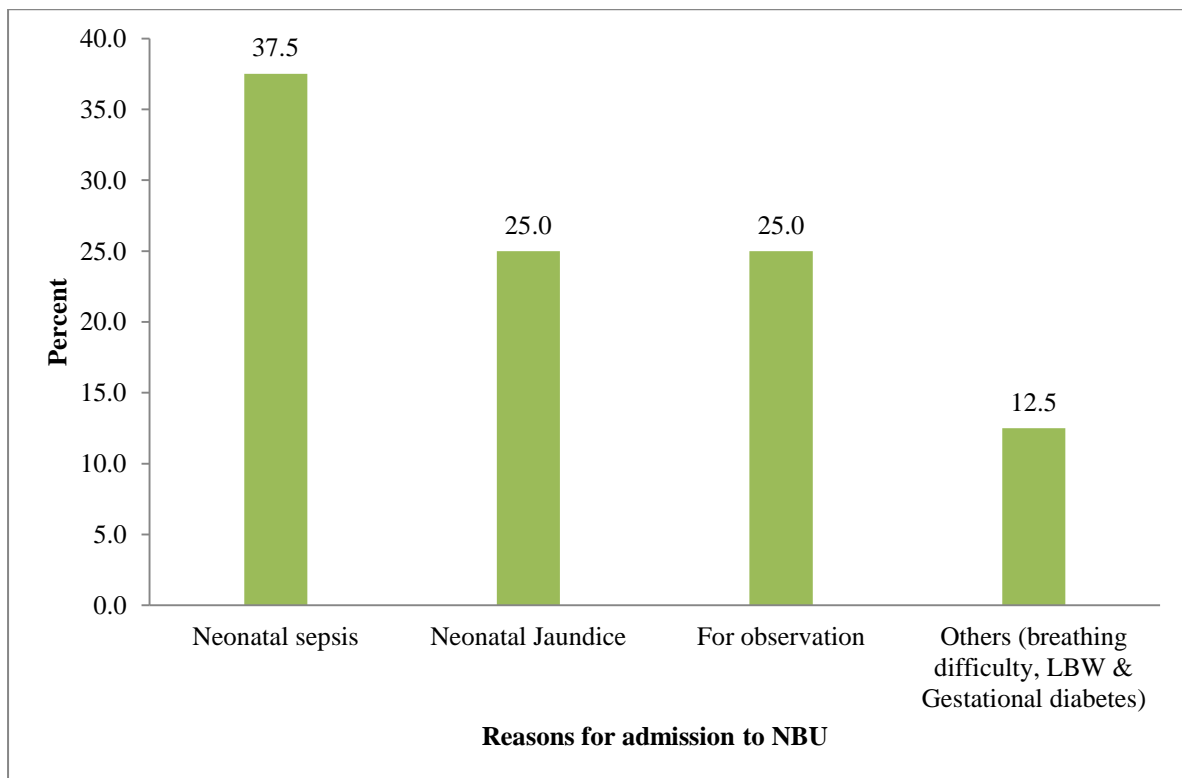
Table 1 shows the description of children by socio-demographic characteristics. The majority of the children 58 (55.8%) were female versus 46 (44.2%) who were male. The highest percentage of the children 56 (53.8%) were aged less than one year. Majority of the deliveries 83 (79.8%) were through spontaneous vaginal delivery. Most of the children 93 (89.4%) were fully immunized as per age

**Table 1: Socio-demographic Characteristics of the Children**

Variable	Category	N=104	%
<b>Gender</b>	Male	46	44.2
	Female	58	55.8
<b>Age</b>	< 1 year	56	53.8
	1 to 2 years	20	19.2
	3 to 5 years	28	26.9
<b>Mode of delivery</b>	Spontaneous Vaginal delivery	83	79.8
	Caesarean section	21	20.2
<b>Reasons for C/S (n=21)</b>	Prolonged labour	7	33.3
	Previous scar	3	14.3
	Breech presentation	4	19.0
	PROM	3	14.3
	Macrosomia	4	19.0
<b>Admission to the new born unit</b>	Yes	24	23.1
	No	80	76.9
<b>Duration of the new born in the nursery unit (n=24)</b>	< 24 hours	3	12.5
	1-2 days	8	33.3
	> 2 days	13	54.2
<b>Immunization history</b>	Fully immunized as per age	93	89.4
	Not fully immunized as per age	11	10.6

#### 4.1.1: Reasons for Admission to Newborn Unit (n=24)

Figure 1 shows the reasons for admission to the new born unit post-delivery. Neonatal sepsis 9 (37.5%), neonatal jaundice 6 (25.0%) and for observation 6 (25.0%) were the common reasons.



**Figure 1: Reasons for Admission to Newborn Unit (n=24)**

#### 4.2: Socio-demographic Characteristics of the Parents

The distribution of selected socio-demographic characteristics among parents who participated in this study is shown in Table 2. The findings show that the highest proportion of the parents 41 (39.4%) were within the age group of 26-30 years whereas there were only 2(1.9%) below 20 years. With respect to level of education, the highest percentage of the parents 43 (41.3%) had attended secondary school and about one third 34 (32.7%) attended college/university. Majority 88 (84.6%) of the parents of the children were married.

**Table 2: Socio-demographic Characteristics of the Parents**

Variable	Category	N =104	%
<b>Parent's Gender</b>	Fathers	10	9.6
	Mothers	94	90.3
<b>Parent's age in years</b>	Below 20	2	1.9
	20-25	33	31.7
	26-30	41	39.4
	30-49	28	26.9
<b>Parent's level of education</b>	Primary level	21	20.2
	Secondary level	43	41.3
	College/University level	34	32.7
	Have no formal education	6	5.8
<b>Parent's religion</b>	Protestant	48	46.2
	Catholic	53	51.0
	Muslim	3	2.9
<b>Parent's marital status</b>	Single	11	10.6
	Married	88	84.6
	Separated/widowed	5	4.8

#### **4.3: Maternal and Antenatal Characteristics**

The maternal and antenatal characteristics among mothers are summarized in Table 3. Majority of the mothers 58 (55.8%) had less than three children. Large percentage of the mothers 100 (96.2%) attended antenatal clinic while expecting the baby.

Most of the mothers 93 (89.4%) did investigations during ANC visits. Majority of the mothers (58.7%) had medically prescribed drugs during early pregnancy. Iron/folate supplement was the main type of drug among those who used prescribed drugs.

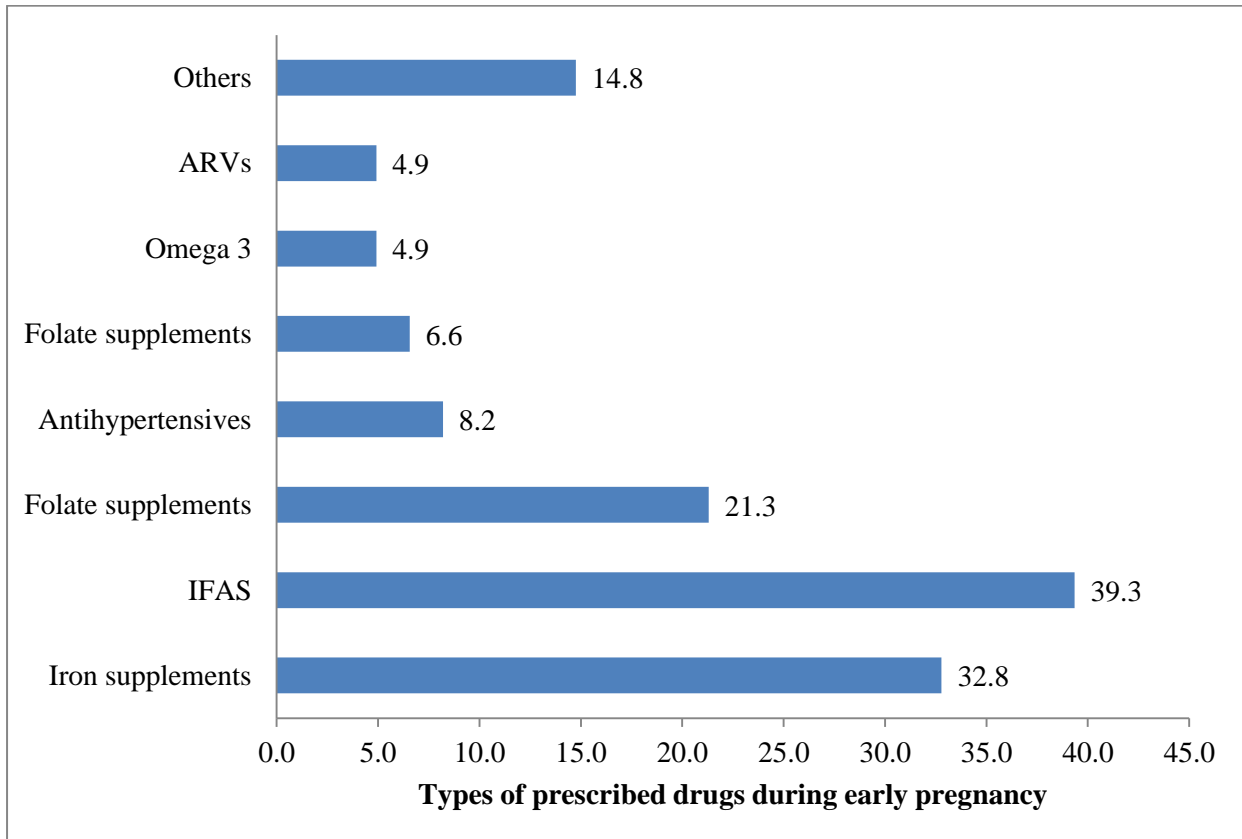


**Table 3: Factors Related to Maternal Antenatal History**

<b>Variable</b>	<b>Category</b>	<b>N =104</b>	<b>%</b>
<b>Number of children</b>	Less than three	58	55.8
	3 to 5	42	40.4
	More than five	4	3.8
<b>Attending any antenatal clinic while expecting this baby</b>	Yes	100	96.2
	No	4	3.8
<b>Frequency antenatal clinic (n=100)</b>	1-3 times	71	68.3
	4 times or more	29	27.9
<b>Gestational age during the first antenatal visit (n=100)</b>	Within the first 3 months	29	27.9
	Second 3 months	58	55.8
	Last 3 months	13	12.5
<b>Any medical illness during pregnancy</b>	Yes	11	10.6
	No	93	89.4
<b>Types of the medical illness during pregnancy</b>	Preeclampsia/Eclampsia	5	45.5
	Others	6	9.1
<b>Any investigations done during ANC visit</b>	Yes	93	89.4
	No	11	10.6
<b>Whether urinalysis was done (n=93)</b>	Done	92	98.9
	Not done	1	1.1
<b>Whether VDRL was done (n=93)</b>	Done	55	59.1
	Not done	38	40.9
<b>Whether Hemoglobin was done (n=93)</b>	Done	91	97.8
	Not done	2	2.2
<b>Any medically prescribed drugs during early pregnancy</b>	Yes	61	58.7
	No	43	41.3
<b>Did you use any non-prescribed drugs during pregnancy</b>	Yes	11	10.6
	No	93	89.4
<b>Types of non-prescribed drugs during pregnancy specify the drug(s) (n=11)</b>	Iron/folate supplements	8	72.7
	Pregncare	3	27.3
	Omega 3	2	18.2
	Others	3	27.3
<b>Ever been tested for H.I.V</b>	Yes	103	99.0
	No	1	1.0

### 4.3.1 Types of Prescribed Drugs during Early Pregnancy (n=61)

IFAS (39.3%), iron supplements (32.8%) and folate supplements (21.3%) were the main prescribed drugs during early pregnancy as indicated in Figure 2.



**Figure 2: Types of Prescribed Drugs during Early Pregnancy (n=61)**

### 4.4: Pre-existing and Co-Existing Conditions

Table 4 shows the pre-existing and co-existing conditions among the children. The highest percentage of the children 55 (52.9%) became ill after 28 days of birth. Considerable number of the children 43 (41.3%) had childhood illnesses and 42 (40.4%) of them were on treatment for the co-existing illness. More than half 56 (53.8%) were suffering from pneumonia.

Respondents were requested to indicate the time taken to bring the baby to hospital after illness began and the highest percentage 60 (57.7%) brought them immediately. The main

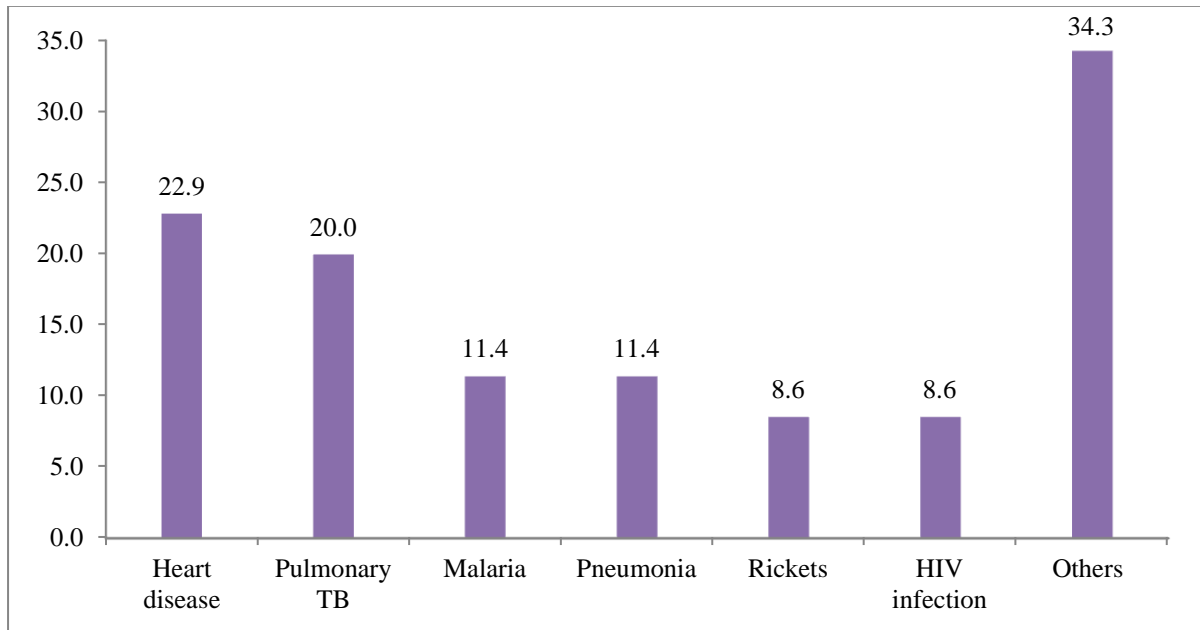
reason for not bringing the child immediately to the hospital was to observe and medicate at home (38.6%) followed by financial constraints (29.5%).

**Table 4: Pre-existing and Co-existing Conditions**

Variable	Category	N =104	%
<b>How long after birth did your child get ill</b>	0-7days	14	13.5
	8-28days	9	8.7
	>28days	55	52.9
	> 1year	26	25.0
<b>Whether the child was suffered from Otitis</b>	Yes	11	10.6
	No	93	89.4
<b>Whether the child was suffered from Sinusitis</b>	Yes	12	11.5
	No	92	88.5
<b>Whether the child was suffered from Mumps</b>	Yes	3	2.9
	No	101	97.1
<b>Whether the child was suffered from Pneumonia</b>	Yes	56	53.8
	No	48	46.2
<b>Whether the child have any co-existing childhood illness</b>	Yes	43	41.3
	No	61	58.7
<b>Whether the child is on treatment for the co-existing illness</b>	Yes	42	40.4
	No	62	59.6
<b>Refusal to feed</b>	Yes	85	81.7
	No	19	18.3
<b>Hotness of body (Fever)</b>	Yes	104	100.0
<b>Abnormal cry</b>	Yes	59	56.7
	No	45	43.3
<b>Convulsions</b>	Yes	98	94.2
	No	6	5.8
<b>Bulging Fontanel</b>	Yes	26	25.0
	No	78	75.0
<b>Irritability</b>	Yes	74	71.2
	No	30	28.8
<b>Stiff Neck</b>	Yes	41	39.4
	No	63	60.6
<b>Time taken to bring the baby to hospital after illness began</b>	Immediately	60	57.7
	1-2 days	34	32.7
	More than 2 days	10	9.6
<b>Reasons for not bringing the child immediately to the hospital</b>	Observed and medicated at home	17	38.6
	Finance	13	29.5
	Work	7	15.9
	Went to clinic first before the hospital	3	6.8
	Others	4	9.1

#### 4.4.1 The Types of Co-Existing Childhood Illnesses

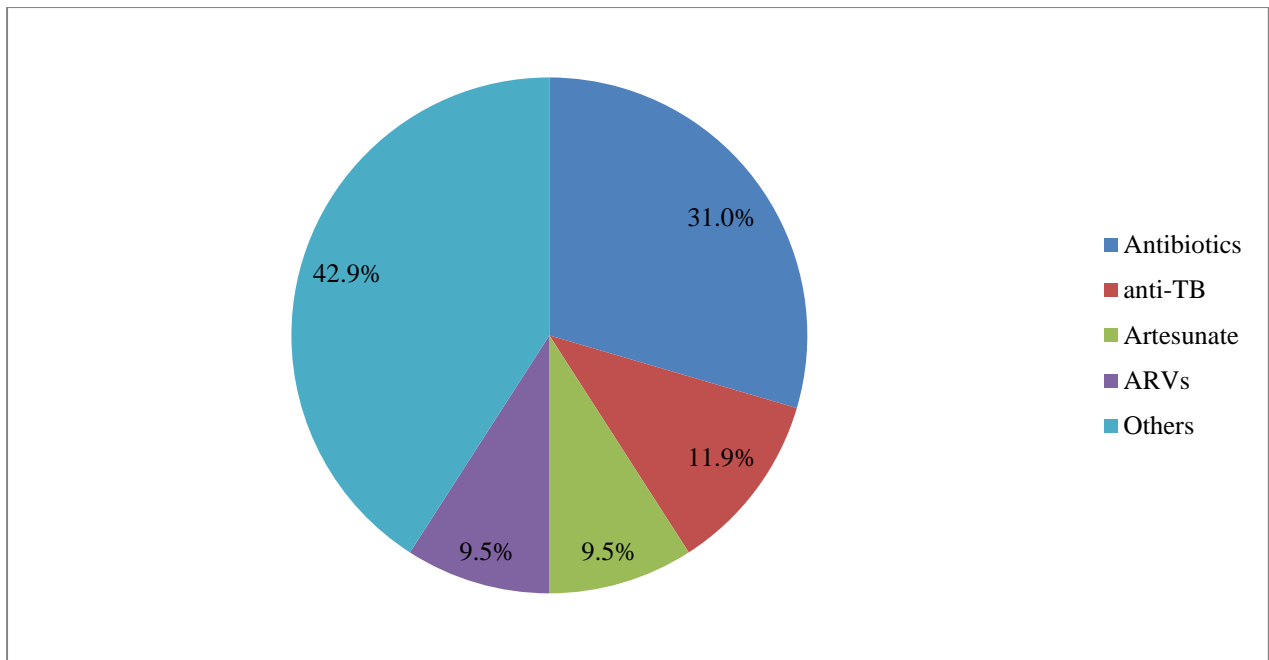
As indicated in Figure 3, the main co-existing illnesses among the children were heart disease (22.9%) and pulmonary TB (20.0%). N.B: The percentages are taken to a total responses and not respondents as some respondents had more than one option to respond to.



**Figure 3: The Types of Co-existing Childhood Illnesses**

#### 4.4.2 Types of Medication for Co-existing Illness

Figure 4 shows the types of medication for co-existing illness and antibiotics were the common types of drugs used (31.0%) followed by anti TB drugs (11.9%). N.B: The percentages are taken to a total responses and not respondents as some respondents had more than one option to respond.



**Figure 4: Types of Medication for Co-Existing Illness**

#### **4.5 Socio-economic Factors of the Parents**

Table 5 demonstrates the distribution of parents' socio-economic characteristics. More than half of the parents 56 (53.8%) had formal occupation. The highest percentage of the parents 41 (39.4%) had Kshs. 30,000 to Kshs. 40,000 Kenyan shillings per month as gross income followed by 10,000-20,000 Kenyan shillings 37 (35.6%). About half of the respondents 48 (46.1%) resided in mid-level urban settings whereby significant number of respondents lived in urban slum areas. Majority 65 (62.5%) had more than 1 bed-roomed plus sitting room and most houses 63 (60.6%) had more than five people. Large percentage of the respondents 86 (82.7%) were living more than five kilometres away from the nearest health facility.

**Table 5: Socio-economic Factors of the Parents**

Variable	Category	N =104	%
<b>Occupation</b>	Self-employed	19	18.3
	In formal employment	56	53.8
	Not-employed	29	27.9
<b>Gross income per month in Kshs</b>	<10,000	19	18.3
	10,000-20,000	37	35.6
	30,000-40,000	41	39.4
	>40,000	7	6.7
<b>Residence</b>	Mid-level urban setting	48	46.1
	Urban slum area	32	30.8
	Rural area	24	23.1
<b>Structure of the house currently living in</b>	Single room	10	9.6
	One bed-roomed plus sitting room	29	27.9
	More than 1 bed-roomed plus sitting room	65	62.5
<b>Number of people living in the house</b>	Less than three	5	4.8
	3 to 5	35	33.7
	More than five	63	60.6
<b>Distance from the nearest health facility to the house currently living in</b>	< a kilometers	12	11.5
	1 -5 kilometers	6	5.8
	More than 5 kilometers	86	82.7

#### 4.6 Characteristics Related to Hospital Environment

Majority of the respondents (88.5%) indicate that they were sharing the bed with another mother and child during hospital stay. Considerable percentage of the parents (46.2%) considered that the wards were crowded. More than three quarter of the parents (77.9%) indicate that they have never received any health education/ information about their child's illness. Twenty-three (22.1%) were those who were given health education, lumbar puncture process/procedure and management was the main type of health education provided (Table 6).

**Table 6: Characteristics Related to Hospital Environment**

Variable	Category	N =104	%
Sharing of bed during hospital stay	Yes	92	88.5
	No	12	11.5
Do you consider the ward you are in to be crowded	Yes	48	46.2
	No	56	53.8
Ever been given any health education/ information about your child's illness	Yes	23	22.1
	No	81	77.9
*Type of health education/ information given	On lumbar puncture process/procedure and management	21	91.3
	Education on breastfeeding and nutrition	3	13.0
	Others	5	21.7
*Multiple response			

#### 4.7: Result of Lumbar Puncture

##### 4.7.1 Statistics of CSF Biochemistry

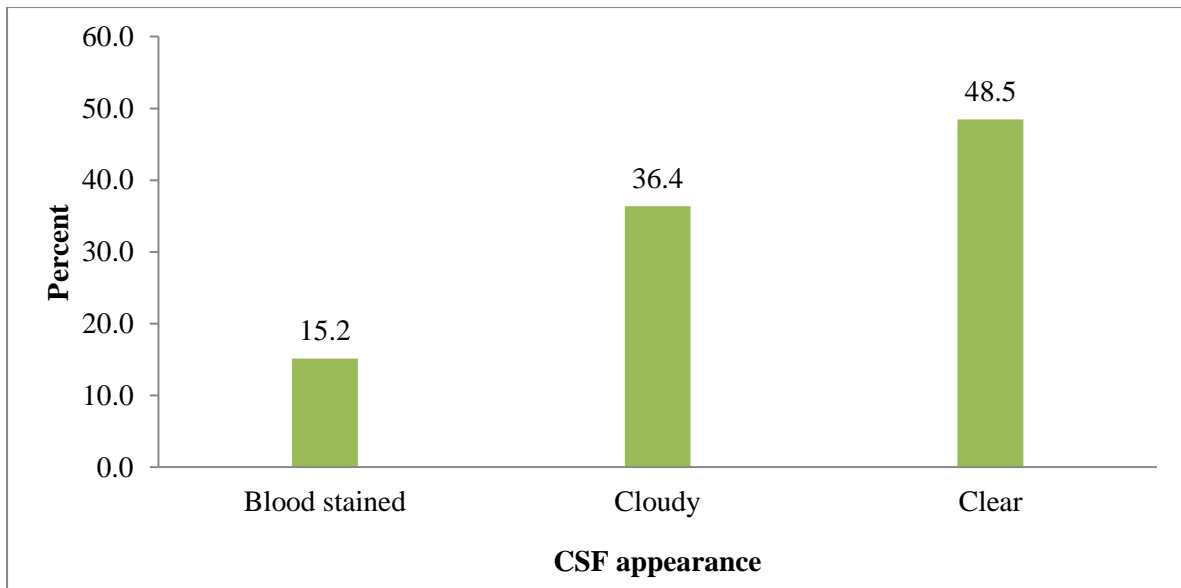
The distribution of CSF protein and CSF glucose among the children who participated in the study were as shown in Table 4.7.

**Table 7: Statistics of CSF Biochemistry**

CSF Biochemistry	Total (n)	Mean	Reference Range
CSF Total Protein	63	650.40	150 to 450
	32	121.28	66 to 83
	9	2.80	0.15 to 0.4
CSF Glucose	86	4.40	2.8 to 7
	3	2.93	2.5 to 5.5
	2	2.99	2.5 to 7
	11	4.67	3.9 to 4.4
	2	2.70	3.9 to 6.1

##### 4.7.2 CSF Appearance

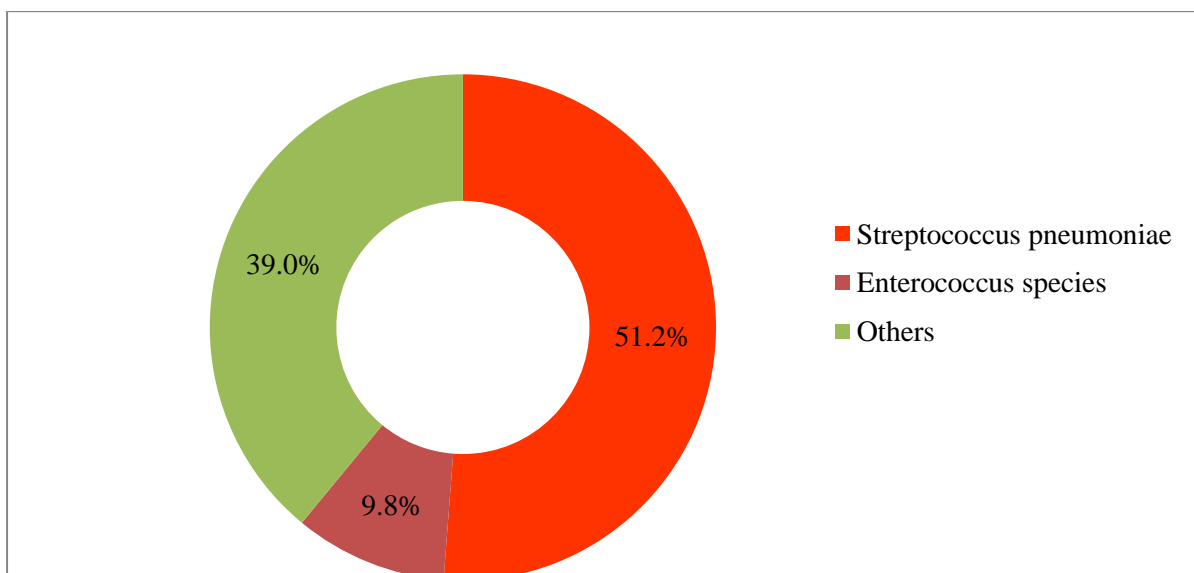
Figure 5 depicts result on the cerebral spinal fluid appearances and about half (48.5%) had clear appearance while 36.4% were cloudy and 15.2% were with stained blood.



**Figure 5: Result of CSF Appearance**

#### 4.7.3 Common Documented Causative Agents of Bacterial Meningitis

Streptococcus pneumonia was the main (51.2%) causative agent of bacterial meningitis among the children (Figure 6).

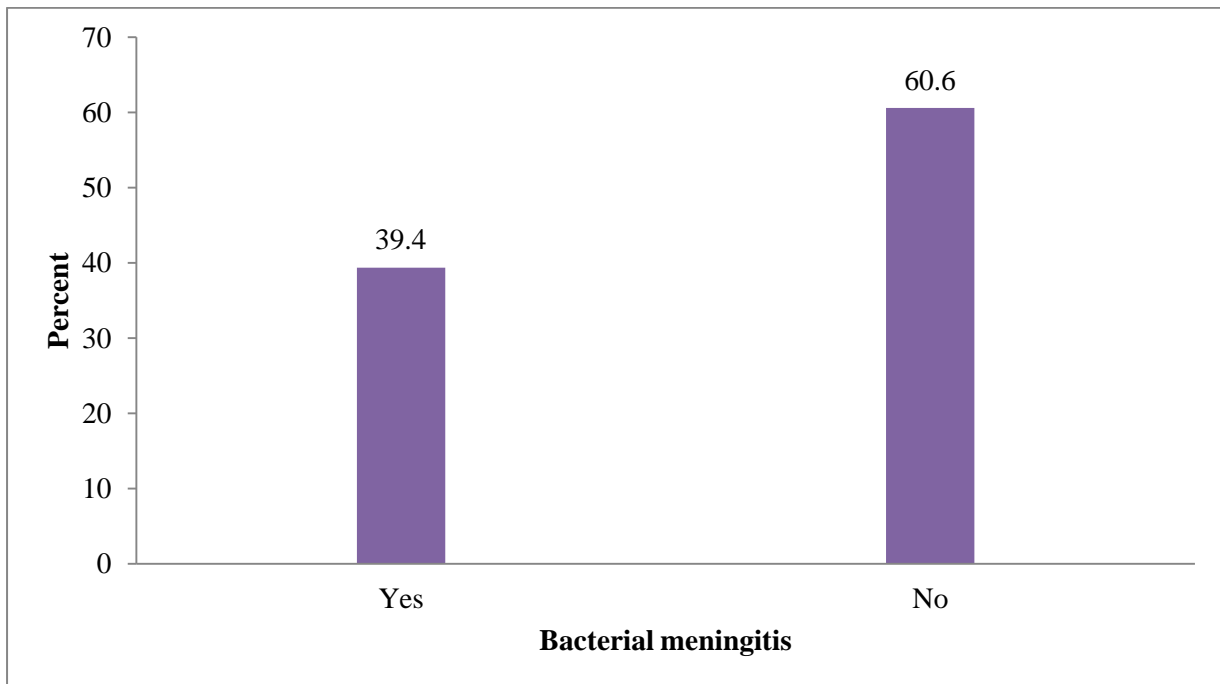


**Figure 6: Common Documented Causative Agents of Bacterial Meningitis**



#### 4.8: Prevalence of Bacterial Meningitis among the Children

According to the CSF profile and after considering the different results of the lumbar puncture test, the proportion of bacterial meningitis was 39.4% as indicated in Figure 7.



**Figure 7: Distribution of Bacterial Meningitis among the Children**

#### 4.9: Association between Child's Demographic Characteristics and Bacterial Meningitis

Table 8 shows the relationship of children's demographic characteristics and bacterial meningitis. Children admitted and managed in the nursery unit after delivery were significantly 2.7 times more likely to have bacterial meningitis compared to those children never admitted in nursery after delivery [OR=2.75; 95%CI=1.08-7.00; P=0.031].

Even though the odds of bacterial meningitis among children who were not fully immunized as per age (63.6%) than fully immunized (36.6%) was three times, it was not statistically significant [OR=3.04; 95%CI=0.83-11.13; P=0.094].

**Table 8: Association between Child’s Demographic Characteristics and Bacterial Meningitis**

Variables	Bacterial infection		Non bacterial infection		OR	95%CI		$\chi^2$ test P value
	n	%	n	%		Lower	Upper	
<b>Gender</b>								
Male	19	41.3%	27	58.7%	1.15	0.52	2.54	0.727
Female	22	37.9%	36	62.1%	Ref			
<b>Age</b>								
< 1 year	23	41.1%	33	58.9%	1.26	0.49	3.21	0.636
1 to 2 years	8	40.0%	12	60.0%	1.20	0.37	3.91	0.762
3 to 5 years	10	35.7%	18	64.3%	Ref			
<b>Mode of deliver</b>								
Spontaneous Vaginal delivery	31	37.3%	52	62.7%	Ref			
Caesarean section	10	47.6%	11	52.4%	1.53	0.58	4.00	0.391
<b>Was the baby admitted to new born unit</b>								
Yes	14	58.3%	10	41.7%	2.75	1.08	7.00	<b>0.031</b>
No	27	33.8%	53	66.3%	Ref			
<b>Immunization history</b>								
Fully immunized as per age	34	36.6%	59	63.4%	Ref			
Not fully immunized as per age	7	63.6%	4	36.4%	3.04	0.83	11.13	0.094

OR= Odds Ratio, CI= Confidence Interval,  $\chi^2$ = Chi-square, Ref = Reference

#### **4.10: Relationship between Parents’ Demographic Characteristics and Bacterial Meningitis**

Analysis of association between parents’ demographic characteristics and bacterial meningitis among the children is shown in Table 9. However, there was no statistically significant association observed between the variables.

**Table 9: Relationship between Parents' Demographic Characteristics and Bacterial Meningitis**

Variables	Bacterial infection		Non bacterial infection		OR	95%CI		$\chi^2$ test
	n	%	n	%		Lower	Upper	P value
<b>Parent's age in years</b>								
Below 26	12	34.3%	23	65.7%	Ref			
26-30	16	39.0%	25	61.0%	1.23	0.48	3.14	0.670
30-49	13	46.4%	15	53.6%	1.66	0.60	4.60	0.329
<b>Parent's level of education</b>								
Have no formal education	3	50.0%	3	50.0%	1.83	0.32	10.53	0.497
Primary level	10	47.6%	11	52.4%	1.67	0.55	5.05	0.366
Secondary level	16	37.2%	27	62.8%	1.09	0.43	2.77	0.862
College/University level	12	35.3%	22	64.7%	Ref			
<b>Parent's religion</b>								
Protestant	19	39.6%	29	60.4%	1.31	0.11	15.48	0.830
Catholic	21	39.6%	32	60.4%	1.31	0.11	15.41	0.829
Muslim	1	33.3%	2	66.7%	Ref			
<b>Parent's marital status</b>								
Single	4	36.4%	7	63.6%	0.86	0.10	7.51	0.889
Married	35	39.8%	53	60.2%	0.99	0.16	6.23	0.992
Separated/widowed	2	40.0%	3	60.0%	Ref			

OR= Odds Ratio, CI= Confidence Interval,  $\chi^2$ = Chi-square, Ref = Reference

#### 4.11: Association between Maternal History and Bacterial Meningitis among Children

Table 10 presents bivariate analysis of association between maternal history and bacterial meningitis among children. However, there was no statistically significant association observed between the variables.

**Table 10: Association between maternal history and bacterial meningitis among children**

Variables	Bacterial infection		Non bacterial infection		OR	95%CI		$\chi^2$ test P value
	n	%	n	%		Lower	Upper	
<b>Number of children</b>								
Less than three	25	43.1%	33	56.9%	Ref			
3 to 5	13	31.0%	29	69.0%	0.59	0.26	1.36	0.218
More than five	3	75.0%	1	25.0%	3.96	0.39	40.38	0.245
<b>Attending any antenatal clinic while expecting this baby</b>								
Yes	40	40.0%	60	60.0%	2.00	0.20	19.91	0.547
No	1	25.0%	3	75.0%	Ref			
<b>Any medical illness during pregnancy</b>								
Yes	5	45.5%	6	54.5%	1.32	0.38	4.64	0.665
No	36	38.7%	57	61.3%	Ref			
<b>Any medically prescribed drugs during early pregnancy</b>								
Yes	26	42.6%	35	57.4%	1.39	0.62	3.11	0.426
No	15	34.9%	28	65.1%	Ref			
<b>Did you use any non-prescribed drugs during pregnancy</b>								
Yes	3	27.3%	8	72.7%	0.54	0.14	2.18	0.383
No	38	40.9%	55	59.1%	Ref			

OR= Odds Ratio, CI= Confidence Interval,  $\chi^2$ = Chi-square, Ref = Reference

#### 4.12: Association between Pre-existing/Co-existing Conditions and Bacterial Meningitis

Table 11 below shows association between pre-existing/co-existing conditions and bacterial meningitis among children. The proportion of bacterial meningitis was more among children with stiff neck, among those who refused to feed and those with abnormal cry, however they were not significant. Moreover, there was no statistically significant association observed between the other variables.

**Table 11: Association between Pre-existing/Co-existing Conditions and Bacterial**

Variables	Bacterial infection		Non bacterial infection		OR	95%CI		$\chi^2$ test
	n	%	n	%		Lower	Upper	P value
<b>How long after birth did your child get ill</b>								
0-7days	6	42.9%	8	57.1%	1.42	0.37	5.37	0.608
8-28days	4	44.4%	5	55.6%	1.51	0.32	7.07	0.600
>28days	22	40.0%	33	60.0%	1.26	0.48	3.33	0.642
> 1year	9	34.6%	17	65.4%	Ref			
<b>Whether the child suffered from Otitis</b>								
Yes	4	36.4%	7	63.6%	0.87	0.24	3.16	0.826
No	37	39.8%	56	60.2%	Ref			
<b>Whether the child suffered from Sinusitis</b>								
Yes	5	41.7%	7	58.3%	1.11	0.33	3.77	0.866
No	36	39.1%	56	60.9%	Ref			
<b>Whether the child suffered from Pneumonia</b>								
Yes	20	35.7%	36	64.3%	0.71	0.32	1.57	0.403
No	21	43.8%	27	56.3%	Ref			
<b>Whether the child had any co-existing childhood illness</b>								
Yes	17	39.5%	26	60.5%	1.01	0.45	2.24	0.984
No	24	39.3%	37	60.7%	Ref			
<b>Whether the child is on treatment for the co-existing illness</b>								
Yes	17	40.5%	25	59.5%	1.08	0.48	2.40	0.856
No	24	38.7%	38	61.3%	Ref			
<b>Refusal to feed</b>								
Yes	35	41.2%	50	58.8%	1.52	0.53	4.38	0.439
No	6	31.6%	13	68.4%	Ref			
<b>Abnormal cry</b>								
Yes	27	45.8%	32	54.2%	1.87	0.83	4.21	0.130
No	14	31.1%	31	68.9%	Ref			
<b>Convulsions</b>								
Yes	38	38.8%	60	61.2%	0.63	0.12	3.30	0.585
No	3	50.0%	3	50.0%	Ref			
<b>Bulging Fontanel</b>								
Yes	9	34.6%	17	65.4%	0.76	0.30	1.92	0.562
No	32	41.0%	46	59.0%	Ref			
<b>Irritability</b>								
Yes	29	39.2%	45	60.8%	0.97	0.41	2.30	0.939
No	12	40.0%	18	60.0%	Ref			
<b>Stiff neck</b>								
Yes	18	43.9%	23	56.1%	1.36	0.61	3.04	0.451
No	23	36.5%	40	63.5%	Ref			

OR= Odds Ratio, CI= Confidence Interval,  $\chi^2$ = Chi-square, Ref = Reference

A logistic regression was performed to ascertain the effects of comorbidities; after how long after birth did your child get ill, whether the child had any co-existing childhood illness, whether the child is on treatment for the co-existing illness, problem presented and period you took to bring the baby back to hospital after illness begun on the likelihood that

participants contracting/ having meningitis. The logistic regression was statistically significant,  $\chi^2 (8) = 32.732$ ,  $p < .0005$ . The model explained 35.9% (Nagelkerke  $R^2$ ) of the variance in contracting meningitis and correctly classified 81.6% of cases. Children who were taken to hospital in delay after birth were 1.740 times more likely to exhibit meningitis than those taken immediately. Increase in number of illness and problems presented was associated with an increased likelihood of exhibiting meningitis, but children taken to hospital immediately after getting ill was associated with a reduction in the likelihood of exhibiting meningitis. Whether the child has any co-existing childhood illness and whether the child is on treatment for the co-existing illness does not influence contracting of meningitis are not significant hence they do not influence contracting of meningitis

#### **4.13: Relationship of Socio-economic and Hospital Environment with Bacterial Meningitis**

Table 12 demonstrates socio-economic and hospital environment factors stratified by bacterial meningitis. Children who shared a bed in the hospital had more proportion of bacterial meningitis (41.3%) than those who were not sharing beds (25.0%). But this was not statistically significant [OR=2.11; 95%CI=0.54-8.32; P=0.277]. Moreover, there was no significant association between socio-economic characteristics and bacterial meningitis.

**Table 12: Relationship of Socio-economic and Hospital Environment with Bacterial Meningitis among Children**

Variables	Bacterial infection		Non bacterial infection		OR	95%CI		$\chi^2$ test
	n	%	n	%		Lower	Upper	P value
<b>Occupation</b>								
Self-employed	6	31.6%	13	68.4%	Ref			
In formal employment	20	35.7%	36	64.3%	1.20	0.40	3.66	0.744
Not-employed	15	51.7%	14	48.3%	2.32	0.69	7.79	0.173
<b>Grossincome per month in Kshs</b>								
<10,000	7	36.8%	12	63.2%	0.78	0.13	4.54	0.780
10,000-20,000	10	27.0%	27	73.0%	0.49	0.09	2.61	0.406
30,000-40,000	21	51.2%	20	48.8%	1.40	0.28	7.06	0.683
>40,000	3	42.9%	4	57.1%	Ref			
<b>Residence</b>								
Mid-level urban setting	18	37.5%	30	62.5%	Ref			
Urban slum area	10	31.3%	22	68.8%	0.76	0.29	1.96	0.566
Rural area	13	54.2%	11	45.8%	1.97	0.73	5.32	0.181
<b>Structure of the house currently living in</b>								
Single room	4	40.0%	6	60.0%	0.88	0.23	3.42	0.855
One bed-roomed plus sitting room	9	31.0%	20	69.0%	0.60	0.24	1.50	0.272
More than 1 bed-roomed plus sitting room	28	43.1%	37	56.9%	Ref			
<b>Number of people living in the house</b>								
Less than three	1	20.0%	4	80.0%	Ref			
3 to 5	11	31.4%	24	68.6%	1.83	0.18	18.37	0.606
More than five	29	45.3%	35	54.7%	3.31	0.35	31.32	0.296
<b>Whether shared the bed with another mother&amp; child during your hospital stay</b>								
Yes	38	41.3%	54	58.7%	2.11	0.54	8.32	0.277
No	3	25.0%	9	75.0%	Ref			

A logistic regression was performed to ascertain the effects of environmental factors on the likelihood that participants contracting/ having meningitis. The logistic regression was statistically significant,  $\chi^2 (11) = 24.293$ ,  $p = .012$ . The model explained 26.6% (Nagelkerke  $R^2$ ) of the variance in contracting meningitis and correctly classified 72.6% of cases. Children whose parents had higher levels of income were 1.894 times less likely to exhibit meningitis than those with lower. Increasing number of people living in the household was associated with an increased likelihood of contracting meningitis, but increase in number of child health education sessions given was associated with a reduction in the likelihood of positive result

for meningitis. Occupation of the parent(s), residence, structure of the house currently living in, parent's / guardian's highest level of education, distance from the health facility to where you live, if lumbar puncture test was done to your child, have you shared the bed with another mother and child during your hospital stay and if you consider the ward you are in to be crowded are not significant hence they do not influence contracting of meningitis.



## **CHAPTER FIVE**

### **5.0 DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS**

This chapter includes discussion of the study findings, conclusions and recommendations.

#### **5.1 Discussion**

##### **5.1.1 Introduction**

The aim of the study was to determine the predictors of bacterial meningitis among children aged 0-5years admitted in Kenyatta National Hospital paediatric wards. Cross sectional study was conducted on 104 patients who presented with clinical symptoms of bacterial meningitis. The child's, parental and environmental characteristics which were analysed descriptively in the study have been elaborated and the diverse characteristics discussed. Analysis was done using Pearson's chi-square test and logistic regression.

##### **5.1.2 Child Demographic Characteristics**

Majority (54%) of the children were aged one (1) year old  $\pm 1$  month with 41% of them having positive lumbar puncture results for bacterial meningitis. Children in this age group are more susceptible to infection due to their underdeveloped immune system and therefore disease is likely to occur when exposed to bacteria or pathogens. This is in agreement with a study done in Australia on meningococcal disease that reported the average age of infection is between 0-4years of age (Robinson, 2008). A recent Kenyan study reported that 3–6% of all children admissions <59 days old were due to meningitis, with case fatality ratios of 26% in the first week of life and 18% between 7 and 59 days of age (Mwaniki, 2011).

The current study findings reported female children (56%) were more at risk of being affected with clinical symptoms of meningitis compared to their male counterparts (44%). About 38% of the children diagnosed with bacterial meningitis were female and this contradicts a study in Australia that reported that males contract meningitis more regularly than their female counterparts (Robinson, 2008).

The 37% of children who had bacterial meningitis were delivered via spontaneous vaginal delivery. However, no difference was observed regarding mode of delivery and likelihood of contracting meningitis. Normal flora present in the birth canal can cause life threatening CNS infections in the neonates either after intra-uterine infection or through vertical transmission during birth. The normal vagina has organisms such as group B *streptococci*, *alpha streptococci*, *E. coli* which multiply in number during pregnancy (Brooks, 2007); this may predispose a neonate to infection such as meningitis caused by streptococcus species either in the neonatal period or infancy period. Assisted delivery can also predispose a new born to infections if the sterility of equipment that was used during the caesarean section was broken or if the procedure was not entirely aseptic.

Children admitted and managed in the nursery unit after delivery were significantly three times more likely to have bacterial meningitis compared to those children never admitted in nursery after delivery. Admission to the new born unit has a significant risk in the eventual health of the child. The neonate can acquire iatrogenic infections and/or sepsis (Kleigman, 2016) which can cascade to developing life threatening illness such as meningitis. The new born unit can be overcrowded which can predispose the neonates to get infected with air borne infections. Caretakers/ mothers of the neonates may be carriers of bacteria as they go to the new born unit and back to the wards, they may predispose their children to infection unknowingly. The health workers who manage children in the NBU can also pose a risk to the new born as they handle one patient to the next; cross contamination can occur if proper sanitation and asepsis is not followed to the later. The fragile immune system of the new born can easily get compromised especially with lengthy admission such as more than 48hours of stay in the new born unit can also predispose to air borne infections.

Even though the odds of contracting bacterial meningitis was three times more (64%) among children who were not fully immunized as per age than fully immunized (37%), this was not

statistically significant. The aim of immunization is to provide protection against certain diseases and to boost the immune system and to prevent diseases such as meningitis and pneumonia. Immunization does not however entirely guarantee safety from disease. Hence for the children not fully immunized as per age; their immunity levels can be compromised because they have not attained the desired immunity against preventable diseases. This agrees with a study done in Malawi on acute bacterial meningitis (ABM) that reported that the decline in childhood cases of *S. pneumonia* ABM in children aged 3 months to <5 years preceding the introduction of PCV13 has not been observed in other sub-Saharan African facility-based studies (Feikin, 2010)

### **5.1.3 Parental Demographic Characteristics**

The mean age of the parents whose children were admitted with bacterial meningitis was 28 years of age  $\pm 2$ . This is a relatively young age. The young mothers/parents face challenges as regards child care as they are still continuing in learning skills and techniques of parenthood. This could have contributed to their children contracting meningitis.

Majority of the children (94%) were admitted to hospital with their mothers, this is a common scenario in the study set up as most mothers take care of their children at home. They are therefore the first to capture any changes in the health of their babies requiring hospital attention.

Education is meant to empower people but it has not played a role in preventing meningitis. Forty-three (43%) of the parents of the participants had secondary education as the highest level of education. This was expected as the Kenyan government has made education cost subsidised hence more people are achieving secondary school as the minimum education level. This is also in agreement with a report from UNESCO that stated net enrolment in secondary education in developing nations such as Barbados, Bahamas and Chile increased by an average of 7.8% between 2000 and 2008. The average net enrolment rate in 2008 was

72.8% (UNESCO, 2010). It noteworthy since Kenya is also a developing nation. This means that most of the parents had formal education; they are able to read write express themselves and have knowledge of basic skills needed in day to day living. Health education at the ANC, community level and even at school level may not be sufficient enough in preventing illness from disease such as meningitis.

### **Socio-economic Characteristics**

Economic empowerment of guardians/parents is a key pillar towards attainment of optimum health. Lack of economic independence and poverty among the population that was unemployed (28%), may have contributed to delay in seeking healthcare upon realizing that the child was unwell. Financial detriment builds the danger of meningitis. US studies have reliably found that individuals of African-American origin, individuals of low financial status, low maternal education and other antagonistic social attributes were related with expanded danger of infection with meningitis. (Grimwood, 2010).

Majority of the parents (54%) had formal employment with a gross family income of between Kshs. 10,000 to Kshs. 40,000 per month. Only 6% of the parents had a gross family income of Kshs. 40,000 and above. This means that the parent(s) were economically dependent on some economic network system. Children whose parents had higher levels of income were twice less likely to exhibit meningitis than those with lower income levels. This is in accordance with a study done in Brazil that reported the frequency of the illness was around two times higher in low financial zones than in more prosperous zones (Kriz, 2009).

The parent(s) were also active in work and employment looking for money hence leaving their children with house helps to raise and take care of them. This may mean that the ability to seek healthcare promptly and from established facilities is thus dependent on the strength of the support system and availability of the parents and finances during the time of illness

for the child. Not only is the disease financially disruptive, but long-lasting sequel also present a burden to the family by disrupting social structure.

#### **5.1.4 Common Causative Agents**

*Streptococcus pneumoniae* was the common causative agent at 51% of bacterial meningitis among the study age group; this is a well-known fact. This also is in agreement with a study done in Malawi that reported *Streptococcus pneumoniae* is the predominant bacterial pathogen causing 65% of infections in the 2- to 15-year age group (Peltola, 2001). Exposure to streptococcus species from the birth canal may be the start of a cascade of events that eventually lead to contracting meningitis among children aged 0-5years. Recurrent upper respiratory tract infections can also be attributed to infection with *S. pneumoniae*. Another study reported that *S. Pneumonia* is the real reason for childhood bacterial meningitis in many nations especially in those where Hib illness has been killed by immunization (Robinson, 2010). In some European and sub-Saharan African nations, *S. pneumoniae* is the second most much of the time archived reason for septic meningitis after meningococcal cases (Saez,2009).

The lumbar puncture results showed 39% of the tests done were positive for bacterial meningitis. CSF glucose had a mean of 4.4 mmol/L which was within normal levels with reference ranges of 2.5-7.0 mmol/L. This is a different finding for studies of bacterial meningitis that have been conducted and reported that the CSF glucose for bacterial meningitis should be low (Ramers et.al,2000). Low CSF glucose (< 20 mg/dL; <40% of serum glucose) is strongly associated with increased risk of death or major morbidity with bacterial meningitis.

CSF protein concentration is one of the most sensitive indicators of pathology within the central nervous system. CSF protein had an average mean of 650 mmol/L which is elevated

for the reference range of 150-450mmol/L this is in accordance with documented data that the CSF protein is significantly higher in bacterial meningitis caused by all pathogens (Edmond, 2010). Although the results of the lumbar puncture test could have been affected in cases where the parent had pre-medicated the child prior to the test being done. CSF appearance of the samples taken; 49% were clear and 36% were cloudy; both appearances of which are positive indicators for bacterial meningitis caused by all pathogens.

The ongoing improvement and presentation into routine vaccination timetables of glycoconjugate pneumococcal immunizations among children under 5years has incredibly diminished the occurrence of illness created by antibody serotypes. However, this is different as per the study population. *S. pneumonia* still poses as the most common causative agent of bacterial meningitis and so the reason for the findings in the current study. *N. meningitidis* is considered to be the leading cause of bacterial meningitis in many regions of the world, causing an estimated 1.2 million cases of meningitis and sepsis worldwide each year (Pathan, 2006) contrary to the current study findings.

### **5.1.5 Environmental Factors**

Forty-six percent (46%) of the study population resided in urban areas. The environment of children who live in urban areas and the hazards they are exposed to in urban areas is not the same as that of children who reside in rural areas. In urban areas, children are exposed to fumes, smoke, poor hygiene, poor sanitation, changes in weather conditions. It can be hypothesized that; high temperatures coupled with environmental hazards may favor the conversion of benign meningitis that is bacteria in the nose and throat to pathogenic bacteria by damaging the mucosa and lowering immune defense and resulting in completion of the disease process and diagnosis of meningitis (Letson et.al, 2012).

Increasing number of people living in the household was associated with an increased likelihood of contracting meningitis; 61% of the participants lived more than 5 people in a bedroomed house. The number of children and people living in the family/ household did not show any association with contracting meningitis among children under 5 years of age. However, sharing of one toilet, bathroom, there were high chances of contamination and transmission of infection to the children whose immune system was still immature. There were thus high chances of contracting infection due to poor environmental sanitation and vector transfer of infection from the overcrowding. This finding agrees with a study that was done in Queensland that reported living in swarmed spots is firmly a pointer toward meningococcal malady. All things considered it is an incredible marker of both detriment and malady hazard (McCall, 2011).

Thirty-one percent (31%) of the respondents resided in urban slum areas. As explained earlier; living in crowded areas either during hospital stay or at home is a favourable set of condition that predisposes to contracting meningitis. These findings agree with a longitudinal study on investigation of Belgian school children that reasoned out that "populaces of low financial status and living in thickly populated regions constitute an objective populace for meningitis illness" (Cooke, 2011).

Children who shared a bed in the hospital had more proportion of bacterial meningitis; 41% than those who were not sharing beds 25%. Although there was no significant association between sharing of bed in the hospital and contracting bacterial meningitis in the current study; the above findings disagree with studies done in Australia that reported that intrusive meningococcal ailment was related with sharing bed and bedrooms to at least two individuals or more (McCall, 2011). Meningitis being an airborne disease cross infection can result from sharing hospital beds. To protect this fragile group from this disease; proper ventilation of

rooms should be observed and when bed sharing is inevitable, proper triage should be done in order to group children with similar symptoms and/or disease together.

In the East Africa region, Kenya for example, the cost of treating a case of meningitis often equates to two times a rural or slum family's annual income (Mwaniki, 2011). The situation predisposes people to live in overcrowded areas, slums and areas with poor sanitation putting them and their children at great risk of contracting meningitis and other illnesses.

#### **5.1.6 Co-morbidities**

Meningitis may occur after either an acute or subacute/chronic infection. Forty-one percent (41%) of the respondents had co-existing childhood illness. 54% of the study participants suffered from pneumonia. Therefore, it can be hypothesized that the odds for contracting meningitis after ailment from pneumonia was high among the study population.

Children who were taken to hospital in delay after falling ill with symptoms related to those of meningitis were twice times more likely to exhibit meningitis than those taken to hospital immediately. The effects of co-morbidities; how long after birth did the child get ill, whether the child was on treatment for co-existing and/or pre-existing illness and the period taken to bring the baby to hospital after illness begun showed (36%) there was a positive association and likelihood of participants contracting/ having meningitis. This agrees with a study done in children under 1 year of age, that reported any form of contamination/ infection can spread through the delicate developing arachnoid and cause meningitis (Brook, 2007).



## 5.2 CONCLUSIONS

The study provided evidence that admission to newborn unit, level of income of parents/caregiver and the living conditions of the family were associated with contracting meningitis. The study concludes that:

1. Bacterial meningitis was most common among female infants and the prevalence was higher if the infant was hospitalised during the first twenty-eight days of life either in the new born unit or in the paediatric ward.
2. *Streptococcus pneumoniae* was the common causative agent of meningitis among the study population and that vaccination with PCV has incredibly helped lower the incidence.
3. The environmental factors such as living in overcrowded areas, inadequate exposure to health education contributed to contracting and developing meningitis. Financial constraints among caregivers posed a hindrance to the participants in seeking medical attention early. The environmental factors collectively lead to sequel that ended in meningitis.
4. A previous upper respiratory tract infection with pneumonia and/or sinusitis more often led to contracting or presenting with meningitis among the children studied.

Bacterial meningitis continues to cause mortality and morbidity in infants and with an unknown disease burden it must be diagnosed and treatment started early, i.e. with first contact with the patient especially when the clinical symptoms are suggestive of meningitis.

### **5.3 RECOMMENDATIONS**

The researcher proposes that:

1. There should be increased awareness and tailored health education provided to caregivers of children aged 0-5 years on the clinical symptoms that are suggestive of meningitis so that the children can be diagnosed and treatment started early.
2. Parents/ caregivers should be encouraged to take up health insurance cover i.e. NHIF to reduce financial constraints associated with seeking medical attention early.
3. Proper sanitation should be fostered and emphasis made on good housing conditions which go hand in hand to stem out the sequel of events from factors that lead to contracting meningitis
4. Prevention remains the best cure. Introduction of meningococcal vaccine to the division for vaccine and immunization (DVI) schedule should be done by the ministry of health along with the routine vaccination of PCV to reduce the likelihood of contracting meningitis.

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## APPENDICES

### APPENDIX 1: STUDY TIME FRAME

Duration of study: Ten months (November 2016-August 2017)

Time frame

Month Activity	Nov 2016- December 2016	January 2017	February 2017	March- April 2017	May- June 2017	July 2017	August 2017
Research proposal writing and submission to supervisor							
Submission to E.R.C							
E.R.C recommendations acted upon							
Data collection, entry and data cleaning							
Data analysis							
Research report writing							
Discussion and presentation							

**APPENDIX 2: STUDY BUDGET**

<b>Serial no</b>	<b>Item</b>	<b>Unit cost</b>	<b>Quantity</b>	<b>Total cost</b>
<b>1</b>	<b>Personnel</b>			
	Research assistant	2000*1	20days	40,000
<b>2</b>	<b>Supplies and equipment</b>			
	Pens	20	10	200
	Flash-disk	1500	2	3,000
	Printing paper	500	4	2,000
	Printing charges	1000	4	4,000
<b>3</b>	<b>Consultancy</b>			
	Biostatician	30,000	1	30,000
<b>4</b>	<b>Operating costs</b>			
	Binding fee	1500	6	10,000
<b>Total</b>				<b>89,200</b>
<b>Contingency</b>	<b>15% of total cost</b>			<b>13,380</b>
<b>Grand total</b>	<b>Total + contingency cost</b>			<b>102,580</b>

## **APPENDIX 3a: PARTICIPANT/PARENT INFORMATION SHEET**

**Investigator:** June Jelimo Serem Tel.: 0710787075

School of Nursing Sciences,

University of Nairobi

P.O. Box 19676, Nairobi.

**Introduction:** Hello! My name is June, a nursing student from the University of Nairobi. I am conducting a study to establish the characteristics of infants and their mothers that predispose the infant to developing meningitis (preventable illness) in infants admitted in this hospital. **The study title is: `Predictors of bacterial meningitis among paediatric patients aged 0-5years hospitalized at Kenyatta National Hospital paediatric wards`,** A descriptive cross sectional study at Kenyatta national Hospital, Nairobi. This study was conducted at Kenyatta national hospital paediatric wards.

You are invited to participate in this study. The following information is important to help you make an informed decision.

**Background and objective:** The purpose of the study is to identify the maternal, infant and environmental factors which could lead to development of preventable illness in the infant.

It aims at establishing the identification of those factors from the home set up to the hospital stay thereby providing a guide to help identify risk factors, in the long-run reducing possibility of infants getting ill.

You are therefore considered suitable participant because you are one of the mothers with a child suffering from meningitis.

### **Benefits of the study:**

The information you give will help us easily identify factors that contribute to the development of bacterial meningitis hence prevent the occurrence of the infection.

The information you give was used in policy making and guide in decision making on early detection of high risk children in-order to reduce chances of children getting the illness.

Minimal risk is expected in the study on the area of you giving us your information. Health records (patient file) was used to collect information. Security of the patient's file was observed by handling the file with permission from the hospital and ward in-charge and upon completion of data collection the file was returned to the ward in-charge who will ensure the file is intact and not tampered with. There was no direct monetary benefits or compensation for participation in the study.

### **What participation means**

Participation is voluntary.

The study will involve interviews at the bedside where questions were asked and you give answers to the questions. The interview is expected to take 15-20 minutes.

The information you give was kept confidential and your name will not be identifiable with the information.

You have the freedom to:

Decide whether to participate or not.

Answer the questions you are comfortable with.

Withdraw from the study at any point and your information was confidential and destroyed.

For more information and clarification; you are free to contact;

**Supervisor's Name** Dr. M. Chege

School of Nursing Sciences (UON)

Email address.....margaretchege@gmail.com

Telephone Number: 0725555114

Or

Chairman KNH/UON-ERC,

Box 20723 Kenyatta N. Hospital.

Tel 2726300-9, Ext 44102

## **APPENDIX 3b: FOMU YA MAELEZO KUHUSU IDHINI**

**Mtafiti:** June Jelimo Serem Rununu: 0723431811

Shule ya Wauguzi

Chuo Kikuu cha Nairobi

Sanduku la posta 19676, Nairobi.

**Utangulizi:** Hujambo! Jina langu naitwa June, mwanafunzi katika Chuo Kikuu cha Nairobi. Ninafanya utafiti kuhusu vipengele husika vya ugonjwa katika watoto kutoka kuzaliwa hadi umri wa miaka tano (5) ambao wamelazwa katika Hospitali Hii kuu Ya Kenyatta.

Umekaribishwa kushiriki katika utafiti huu. Walakini, maelezo yafuatayo yatakusaidia kumakinika unapotoa idhini yako kushiriki katika utafiti.

Lengo la utafiti huu ni kutambua vipengee katika mama, mtoto na mazingara vinavyoweza kuchangia kuibuka kwa maradhi yanayoweza kuzuiwa katika mtoto mchanga.

Utafiti unalenga kutambua hivyo vipengee kutoka nyumbani vile mama na mtoto wanavyoishi na wakati wa kulazwa hospitali ndiposa kuweka mikakati ya kupunguza uwezekano wa watoto wachanga kuugua maradhi hayo.

Umehesabiwa kuwa mshirika ufaaye kwa sababu wewe ndiye mzazi wa mtoto anayeugua maradhi hayo.

### **Faida za utafiti**

Majibu utakayopeana yatasaidia kutambua yaliyochangia kuugua kwa mtoto ndiposa tuweze kuzuia.

Matokeo ya utafiti yataweza kutumika kuelekeza maamuzi kuhusu kutambulikana kwa mapema kwa uwezekano wa ugonjwa kutokelezea na kuzuia hayo maradhi kwa mapema katika mlengo wa juu serikalini.

Kutoa habari kujihusu na mtoto ndio madhara yanayotarajiwa.

### **Kuhusika kushiriki.**

Kushiriki ni kwa hiari yako.

Utaulizwa maswali ulipo kuhusu unapo ishi na maswali mengine.. Kujibu maswali kutachukua muda wa dakika 15 hadi 20.

Habari utakazopeana zitalindwa zisiweze kupatikana na watu wasiohusika kwa utafiti na habari yako haitaweza kutambulishwa nawe.

Unao uhuru wa:

1. Kushiriki au kutoshiriki.
2. Kujibu maswali uko sawa kwayo.
3. Kusitisha kushiriki wakati wowote na habari yako italindwa na kuharibiwa.

Kwa habari na maelezo zaidi, una uhuru wa kuulizia,

**Mwalimu wangu:** Daktari M. Chege

Shule ya wauguzi

Chuo Kikuu Cha Nairobi.

Barua Pepe.....Margaret.chege@gmail.com

Rununu: 0725555114

Ama

Mwenye-kiti KNH/UON-ERC,

Sanduku la Posta 20723, Kenyatta N. Hospital.

Simu 2726300-9, Ext 44102

**APPENDIX 3c: PARTICIPANT/PARENT INFORMED CONSENT FORM**

I (serial number) ..... do agree to participate in the study on characterization of meningitis, whose purpose, benefits and risks have been explained to me.

I am informed that my participation is voluntary and no financial benefits are provided.

I have also been informed that my information was confidentially and securely maintained and it will not be possible to identify the information with me. I am also informed that I can withdraw from the study at whichever level I find appropriate to do so.

I therefore willingly and voluntarily agree to participate in the study on the predictors of bacterial meningitis.

For more information and clarification; you are free to contact;

- a) Supervisor`s Name Dr. M. Chege, School of Nursing Sciences (UON) Email address: [margarethege@gmail.com](mailto:margarethege@gmail.com) Telephone Number: 0725555114

Or

- b) Chairman KNH/UON-ERC, Box 20723 Kenyatta N. Hospital. Tel 2726300-9, Ext 44102

**Participant`s Signature/Thumb Print.....**

**Date .....**

**Time .....**

**Interviewer`s Name..... Sign .....**

**Date .....Time.....**

**APPENDIX 3d: FOMU YA KUTOA IDHINI KUSHIRIKI**

Mimi (nambari ya siri) .....natoa idhini yangu kwa hiari kushiriki katika utafiti ambao nimeelezwa lengo, faida na madhara yake. Nimejulishwa kwamba kushiriki kwangu ni kwa hiari na hakuna faida zozote za kifedha nitapokea.

Nimejulishwa pia kwamba ujumbe nitakaotoa utawekwa kisiri na hautaweza kutambulishwa nami. Nafahamu naweza kusitisha kushiriki kama itafaa kwa wakati wowote.

Hivyo basi natoa idhini yangu kushiriki katika utafiti utakaosaidia kutambua vipengele husika katika kusababisha maradhi ya watoto, kwa hiari yangu.

Kwa habari na maelezo zaidi, una uhuru wa kuulizia,

- a) Mwalimu wangu: Daktari M. Chege, Shule ya wauguzi, Chuo Kikuu Cha Nairobi.,  
Barua Pepe.....Margaret.chege@gmail.com au Rununu: 0725555114

Ama

- b) Mwenye-kiti KNH/UON-ERC, Sanduku la Posta 20723, Kenyatta N. Hospital.  
Simu 2726300-9, Ext 44102

**Sahihi ya Mshirika.....**

**Tarehe.....**

**Saa .....**

**Jina la Mtafiti.....Sahihi.....**

**Tarehe..... Saa.....**



**APPENDIX 3e: KEY INFORMANT- NURSE IN DEPTH INTERVIEW  
CONSENT FORM**

My name is June Serem. I am a student at the University of Nairobi, school of Nursing Sciences, undertaking a master’s degree course in paediatric nursing. I am conducting a research study on **‘Predictors of bacterial meningitis among children aged 0-5years admitted in Kenyatta National Hospital paediatric wards.’** This study is for the award of the degree of Masters of Science in Nursing (Paediatrics). I encourage you to participate freely and contribute your views and ideas as much as possible. The interview was audio-taped. The information gathered was treated as a group contribution and was strictly confidential. The information was highly valuable to the research and will help in holistic proactive approach in the management of meningitis in children. The will to participate is absolutely voluntary without any coercion or inducement. All rights was guaranteed. In case you would like to know the results of this study or you have any complaints, please do not hesitate to contact the following:

1. June Serem on cell phone number: 0710787075.
2. Dr M. Chege on cell phone number: 0725555114
3. Chairman KNH/UON-ERC, Box 20723 Kenyatta N. Hospital. Tel 2726300-9, Ext 44102.

I do hereby provide informed consent to take part in this study. I have been explained the nature of the study and its purpose.

**Participant’s Signature..... Date.....**

**Principle Investigator/Research Assistant’s Name .....Signature .....**

**APPENDIX 3f: KEY INFORMANT- PAEDIATRIC REGISTRAR IN DEPTH INTERVIEW CONSENT FORM**

My name is June Serem. I am a student at the University of Nairobi, school of Nursing Sciences, undertaking a master’s degree course in paediatric nursing. I am conducting a research study on **‘Predictors of bacterial meningitis among children aged 0-5years admitted in Kenyatta National Hospital paediatric wards.’** This study is for the award of the degree of Masters of Science in Nursing (Paediatrics). I encourage you to participate freely and contribute your views and ideas as much as possible. The interview was audio-taped. The information gathered was treated as a group contribution and was strictly confidential. The information was highly valuable to the research and will help in holistic proactive approach in the management of meningitis in children. The will to participate is absolutely voluntary without any coercion or inducement. All rights was guaranteed. In case you would like to know the results of this study or you have any complaints, please do not hesitate to contact the following:

1. June Serem on cell phone number: 0710787075.
2. Lead Supervisor; Dr M. Chege on cell phone number: 0725555114
3. Chairman KNH/UON-ERC, Box 20723 Kenyatta N. Hospital. Tel 2726300-9, Ext 44102.

I do hereby provide informed consent to take part in this study. I have been explained the nature of the study and its purpose.

**Participant’s Signature.....**

**Date.....**

**Principle Investigator/Research Assistant’s Name .....**

**Signature .....**

**APPENDIX 4a: STUDY QUESTIONNAIRE**

Study topic: **Predictors of Bacterial Meningitis among Children aged 0-5 Years Hospitalized at Kenyatta National Hospital**

Serial Number..... Date of Interview.....

**Instructions:** Thank you for your willingness to respond to my questions. This session will take 15-20minutes. You will be interviewed as the questionnaire is filled. Your responses will be recorded just the way you put them. Thank you.

**Interviewee:** Mother [ ] Father [ ] Other: \_\_\_\_\_

(please respond to the following questions)

**Part A: Socio-demographic Data**

**1.0 Child's Demographic Data**

1.1. What gender is your child?

- a). Male [ ]                      b) Female [ ]

1.2. How old is your child?

- a) 0-11months [ ]      b) 1-2years [ ]      c) 3-5years

1.3. What was the mode of delivery of the child?

- a) Spontaneous Vaginal Delivery [ ]                      b) Caesarean Section [ ]

If not Spontaneous Vaginal Delivery, why? Please explain

.....

1.4. Was the baby managed in the nursery after delivery?

- a) Yes [ ]                      b) No [ ]

1.5 If yes in 1.4 above, why?

.....

1.6. If yes in 1.4 above for how long was the newborn in the nursery unit?

- a) <24hours [ ]      b) 1-2days [ ]      c) >2days [ ]      d) N/A [ ]

1.7 Immunization history (Verify with Immunization Card)

- 1. Fully immunized as per age [ ]
- 2. Not fully immunized as per age [ ]
- 3. Never immunized [ ]

If never immunized, why? Please explain: .....

**2.0 Parent's Demographic Data**

2.1 How old are you?

- a) Below 20yrs [ ]      b) 20-25years [ ]      c) 26-30years [ ]
- d) 30-49years [ ]      e) Over 49years [ ]

2.2. What is your highest level of education?

- a) Primary Level [ ]    b) Secondary level [ ]      c) College/University level [ ]
- d) Have no formal education [ ]

2.3 To which religion do you belong?

- a) Protestant [ ]    b) Catholic [ ]    c) Muslim [ ]
- d) Other (specify).....

2.4. What is your marital status?

- a) Single [ ]    b) Married [ ]    c) Separated [ ]
- d) Widowed [ ]    e) Divorced [ ]

**3.0 Maternal Antenatal History**

3.1 How many children do you have?

- a) Less than three [ ]    b) 3-5 [ ]    c) More than five [ ]

3.2 Did you attend any antenatal clinic while you were expecting this baby?

- a) Yes [ ]    b) No [ ]

- 3.3 If yes in 3.2 above, how many times did you visit the antenatal clinic?
- a) 1-3 times [ ]                      b) 4 times or more [ ]
- 3.4 If no in 3.2 above, why? Please explain.....
- 3.5 At what gestation was the pregnancy when you first made your antenatal visit?
- a) Within the first 3 months [ ]                      b) Second 3 months [ ]
- c) Last 3 months [ ]
- 3.5. Did you suffer any medical illness during pregnancy? (Verify with ANC Book)
- a) Yes [ ]                      b) No [ ]
- 3.6. If yes, which one? .....
- 3.7. Were any investigations done during ANC visit?
- a) Yes [ ]                      b) No [ ]
- 3.8. If yes to 3.7 above, which tests were done? (Verify with ANC Book)
- a) Urinalysis [ ]                      b) VDRL [ ]                      c) Hemoglobin [ ]
- 3.9. Were you on any medically prescribed drugs during early pregnancy?
- a) Yes [ ]                      b) No [ ]
- 3.10 If yes in 3.9 above, which ones? (Verify with ANC Book)
- a) Antibiotics [ ]                      b) Antiepileptic [ ]                      c) Antiemetic [ ]
- d) Others (specify).....
- 3.11 Did you use any non-prescribed drugs during pregnancy?
- a) Yes [ ]                      b) No [ ]
- 3.12 If yes in 3.11 above, specify the drug(s)
- .....
- .....
- 3.13. Have you ever been tested for H.I.V? (Desk Review was done)
- a) Yes [ ]                      b) No [ ]

3.14. If no in 3.13 above, why? (Please Explain)

.....  
.....

**Part B: Comorbidity**

**4.0 Pre-existing and Co-existing Conditions**

4.1. How long after birth did your child get ill?

- a) 0-7 days [ ]    b) 8-28 days [ ]    c) >28days [ ]  
d) 1year Specify.....

4.2. Has your child suffered any of the following illness?

Disease	Yes	No
Otitis Media		
Sinusitis		
Mumps		
Pneumonia		

4.3. Does your child have any co-existing childhood illness?

- a) Yes [ ]    b) No [ ]

4.4. If yes in 4.3 above, please specify.....

4.5. Is the child on treatment for the co-existing illness?

- a) Yes [ ]    b) No [ ]

4.6. If yes in 4.5 above, please specify which medication.....

4.7. If no in 4.5 above, why? Please explain.....

4.8. What was the problem of the child when you came to hospital? (Indicate that which applies)

Symptom	Yes	No
Refusal to feed		
Hotness of body (Fever)		
Abnormal cry		
Convulsions		
Bulging Fontanel		
Irritability		
Stiff Neck		

Others (specify).....

4.9. How long did you take to bring the baby to hospital after illness began?

- a) Immediately [ ]      b) 1-2 days [ ]      c) More than 2 days [ ]

4.10. If not immediately, why? (please explain) .....

.....

### Part C: Environmental Factors

#### 5.0 Socio-economic Factors

5.1. What is your occupation?

- a) Self-employed [ ]      b) In formal employment [ ]      c) Not-employed [ ]  
d) Student [ ]

5.2. What is your gross income per month in Kshs?

- a) <10,000 [ ]      b) 10,000-20,000 [ ]      c) 30,000-40,000 [ ]  
d) >40,000 [ ]

5.3. How would you classify your residence??

- a) Mid-level urban setting [ ]      b) High social economic urban setting [ ]  
c) Urban slum area [ ]      d) Rural area [ ]

5.4 Which one of the following best describes the house you are currently living in?

- a) Single room [ ]      b) One bed-roomed plus sitting room [ ]  
 c) More than 1 bed-roomed plus sitting room [ ]

5.5 How many people live in your house?

- a) Less than three [ ]      b) 3-5 [ ]      c) More than five [ ]

5.6. How far from the nearest health facility do you live?

- a) < a kilometre [ ]      b) 1-3 kilometres [ ]      c) 3 -5 kilometres [ ]  
 d) More than 5 kilometres [ ]

### 6.0. Hospital Environment

6.1. Was lumbar puncture test done to your child?

- a) Yes [ ]      b) No [ ]

6.2. If yes, what were the results? (Desk Review was done)

CSF PROFILE	LP Result	Reference Range
<b>1. CSF Biochemistry</b>		
CSF Total Protein		
CSF Glucose		
<b>2. CSF Cell Count</b>		
Polymorphs		
Lymphocytes		
Erythrocytes		
<b>3. Microscopy</b>		
Bacteria		
Fungal Elements		
<b>4. CSF Appearance</b>		

6.3. Have you shared the bed with another mother& child during your hospital stay?

- a) Yes [ ]      b) No [ ]

6.4. Do you consider the ward you are in to be crowded?

- a) Yes [ ]      b) No [ ]

6.5. Have you been given any health education/ information about your child's illness?



a) Yes [ ]      b) No [ ]

6.6. If yes in 6.5 above, specify the health education/ information given .....

## APPENDIX 4b: STUDY QUESTIONNAIRE

**Study Topic:** Tabia ya uti wa mgongo kati ya wagonjwa waliolazwa katika Hospitali ya Taifa ya Kenyatta kwa mahali ya watoto.

Serial Idadi: ..... Tarehe ya mahojiano: .....

**Maagizo:** Asante kwa nia yako ya kujibu maswali yangu. kikao hiki itachukua dakika 15-20. Utakuwa waliohojiwa kama dodoso ni kujazwa. Majibu yako itakuwa kumbukumbu tu njia kuziweka. Asante.

**Mhojiwa:** Mama [ ] Baba [ ] Nyingine .....

(Tafadhali jibu maswali yafuatayo)

### Sehemu A: Socio-Idadi ya Watu

#### 1.0. Idadi ya Watoto

- 1.1. Mtoto wako ni wa jinsia ipi? a) Wakiume [ ] b) Wakike [ ]
- 1.2. Mtoto wako ni wa umri gani? a) Miezi 0-11 [ ] b) Miaka 1-2 [ ]  
c) Miaka 3-5 [ ]
- 1.3. Hali ya kuzaliwa kwa mtoto ilikuwa ipi? a) Kizao cha kawaida [ ]  
b) Upasuaji sehemu [ ]  
Kama si kizao cha kawaida, kwa nini? Tafadhali eleza .....  
.....
- 1.4. Mtoto aliwekwa katika kitalu baada ya kujifungua? a) Ndiyo [ ] b) La [ ]
- 1.5. Kama ndiyo katika (1.4) hapo juu, kwa nini? .....
- 1.6. Kama ndiyo katika (1.4) hapo juu, kwa muda gani alikuwa wachanga katika kitengo kitalu?  
a) Masaa chini ya 24 [ ] b) Masiku 1-2 [ ]  
c) Zaidi ya masiku 2 [ ] d) N/A [ ]
- 1.7. Historia ya chanjo
  1. Amepata chanjo kamilifu kama kwa umri [ ]
  2. Hajapata chanjo kamilifu kama kwa umri [ ]
  3. Hajawai pata chanjo [ ]Kama kamwe hajawai pata chanjo, kwa nini? Tafadhali eleza .....  
.....

#### 2.0. Ujumbe kuhusu wazazi:

- 2.1. Una umri wa miaka ngapi?
- a) Chini ya miaka 20 [ ]      b) Miaka 20-25 [ ]
- c) Miaka 26-30 [ ]      d) Miaka 30-49 [ ]      e) Zaidi ya miaka 49 [ ]
- 2.2. Kiwango chako cha juu cha elimu ni?
- a) Shule ya msingi [ ]      b) Kiwango cha sekondari [ ]
- c) Kiwango cha chuo / chuo kikuu [ ]      d) Hakuna elimu rasmi [ ]
- 2.3. Wewe ni wa dini gani? a) Protestant [ ]      b) Katoki [ ]      c) Maislamu [ ]
- d) Nyingine (taja) .....
- 2.4. Hali yako ya ndoa ni ipi? a) Single [ ]      b) Ndoa [ ]      c) Mumetenganishwa [ ]
- d) Mjane [ ]      e) Talaka [ ]
- 3.0 Historia ya mama ya uzazi:**
- 3.1. Je una watoto wangapi? a) Chini ya tatu [ ]      b) 3-5 [ ]      c) Zaidi ya tano [ ]
- 3.2. Je ulihudhuria kliniki yoyote ya wajawazito wakati ulikuwa unatarajia mtoto huyu?
- a) Ndiyo [ ]      b) La [ ]
- 3.3. Kama ndiyo katika (3.2) hapo juu, ulitembelea kliniki ya wajawazito mara ngapi?
- a) Mara 1-3 [ ]      b) Mara 4 au zaidi [ ]
- 3.4. Kama la katika (3.2) hapo juu, kwa nini? Tafadhali eleza .....
- .....
- 3.5. Katika ujauzito na mimba ya kwanza, ulifanya lini ziara yako ya wajawazito?
- a) Ndani ya miezi 3 ya kwanza [ ]      b) Miezi 3 yaliyofuata [ ]
- c) Miezi 3 ya mwisho [ ]
- 3.5. Uliteseka ugonjwa wowote wakati wa ujauzito? a) Ndiyo [ ]      b) Hapana [ ]
- 3.6. Kama ndiyo, taja gani? .....
- 3.7. Uchunguzi wowote ulifanyika wakati ulitembelea kliniki ya ANC?
- a) Ndiyo [ ]      b) Hakuna [ ]
- 3.8. Kama ndiyo kwa (3.7) hapo juu, vipimo gani yalifanyika?
- a) Urinalysis [ ]      b) VDRL [ ]      c) Himoglobini [ ]
- 3.9. Ulitumia dawa yoyote mapema wakati wa ujauzito? a) Ndiyo [ ]      b) Hapana [ ]
- 3.10. Kama ndiyo katika (3.9) hapo juu, taja gani?
- a) Antibiotics [ ]      b) Antiepileptic
- c) Antiemetic      d) Nyingine, eleza .....
- .....
- 3.11. Uliwai tumia madawa ya kulevya yoyote yasiyo ya kuagizwa wakati wa ujauzito?
- a) Ndiyo [ ]      b) Hapana [ ]

- 3.12 Kama ndiyo katika (3.11) hapo juu, bayana madawa ya kulevya .....
- .....
- 3.13. Umewahi kupimwa virusi vya ukimwi (H.I.V)? (Tathmini itafanyika)
- a) Ndiyo [ ] b) Hapana [ ]
- 3.14. Kama hapana katika (3.13) hapo juu, kwa nini? (Tafadhali Eleza) .....
- .....
- .....

### Sehemu B: Magonjwa mengine

#### 4.0 Magonjwa yaliyotangulia na yanayoambatana

- 4.1. Mtoto alipata ugonjwa siku ngapi baada ya kuzaliwa?
- a) Kati ya siku saba za kwanza [ ] b) Siku nane hadi ishirini na nane [ ]
- c) Hadi siku ishirini na nane [ ] d) Hadi mwaka mmoja wakati mwingine (fafanua) .....
- .....
- 4.2. Mtoto wako amewahi kuwa na magonja yafuatayo?

Ugonjwa	Ndio	La
Ugonjwa wa Maskio		
Ugonjwa wa Ssinusitis		
Ugonjwa wa Mumps		
Ugonjwa wa mapafu		

- 4.3. Je mtoto wako ako na ugonjwa au magonjwa mengine yoyote kwa sasa?
- a) Ndio [ ] b) La [ ]
- 4.4. Kama Ndio kwa jibu la swali 4.3 lililotangulia, tafadhali taja hayo magonjwa .....
- .....
- 4.5. Je, mtoto anapokea matibabu ya magonjwa yoyote kwa sasa hivi?
- a) Ndio [ ] b) La [ ]
- 4.6. Kama Ndio kwa jibu la swali 4.5 lililotangulia, tafadhali taja hayo madawa .....
- .....
- 4.7. Kama La kwa jibu la swali 4.5 lililotangulia, tafadhali elezea sababu .....

4.8. Je, ni sababu gani lililokusababisha umlete mtoto wako kwenye hospitali? (sahihisha jibu linalofaa)

Dalili	Ndio	La
Mtoto kukataa kula		
Joto kwa mwili		
Kulia zaidi		
Kushikwa na kifafa		
Kufura kwa kichwa		
Mtoto kuwa na fujo isiyo ya kawaida		
Mtoto kukauka shingo		

Dalilizingine (fafanua) .....

4.9. Je, ulichukua muda gani kuleta mtoto kwenye hospitali baada ya ugonja kuanzia?

- a) Punde tu alipokuwa mgonjwa [ ]      b) Kati ya siku moja hadi ya pili [ ]  
 c) Baada ya siku mbili [ ]

4.10. Kama sio punde tu alipokuwa mgonjwa? (tafadhali elezea sababu) .....

.....

### Sehemu C: Mazingara

#### 5.0 Uhusiano na uchumi

5.1. Je, unafanya kazi gani ili kutimiza mahitaji yako?

- a) Nimejajiri [ ]      b) Nimeajiriwa [ ]      c) Jua kali [ ]  
 d) Sijaajiriwa [ ]      e) Mwanafunzi [ ]

5.2. Elezea kiwango cha mapato yako kwa mwezi (Shillingi)?

- a) <10,000 [ ]      b) 10,000-20,000 [ ]      c) 30,000-40,000 [ ]  
 d) >40,000 [ ]

5.3. Elezea mazingara unapoishi?

- a) Kiwango cha kati kwenye mji [ ]      b) Kiwango cha juu kwenye mji [ ]  
 c) Kiwango cha chini kwenye mji [ ]      d) Mashambani [ ]

- 5.4. Tafadhali elezea aina ya nyumba unayoishi?
- a) Nyumba ya chumba kimoja [ ]
  - b) Nyumba ya chumba kimoja cha kulala na sebule [ ]
  - c) Nyumba iliyo na zaidi ya chumba kimoja cha kulala na sebule [ ]
- 5.5. Je, mnaishi watu wangapi kwenye nyumba unayoishi?
- a) Chini ya watatu [ ]
  - b) Kati ya watatu hadi watano [ ]
  - c) Zaidi ya watano [ ]
- 5.6. Elezea umbali kati ya mahali unapoishi na hospitali iliyo karibu?
- a) Chini ya kilometre moja [ ]
  - b) Kati ya kilometre moja hadi tatu [ ]
  - c) Kati ya kilometre tatu hadi tano [ ]
  - d) Zaidi ya kilometre tano [ ]
- 6.0 Kwenye hospitali**
- 6.1. Je, mtoto wako alidungwa kwa mti wa ubongo ulipompeleka hospitalini?
- a) Ndio [ ]
  - b) La [ ]
- 6.2. Kama Ndio, majibu ya vipimo yalikuwa aje? (Majibu yatakaguliwa)  
Fafanua.....
- 6.3. Je, ukiwa katika hospitalini umewahi kutumia kitanda moja na mama mwingine au mtoto mwingine?
- a) Ndio [ ]
  - b) La [ ]
- 6.4. Kwa maoni yako, ungeonelea kama wadi ulipolazwa kama kulikuwa na msongamano wa watu?
- a) Ndio [ ]
  - b) La [ ]
- 6.5. Je, umewahi kupewa maelezo yoyote kuhusu ugonjwa wa mtoto wako na afya hospitalini?
- a) Ndio [ ]
  - b) La [ ]
- 6.6. Kama jibu ni ndio katika swali 6.5 lililotangulia, fafanua maelezo/mafunzo uliyopewa hospitalini .....

## **APPENDIX 4c: SEMI STRUCTURED INTERVIEW GUIDE**

**Introduction:** Hello! My name is June, a nursing student from the University of Nairobi. I am conducting a study to establish the characteristic of infants and their parents that predispose the infant to developing meningitis (preventable illness) in infants admitted in this hospital. The study title is: **'Predictors of bacterial meningitis among paediatric patients aged 0-5years hospitalized at Kenyatta National Hospital paediatric wards'**. Meningitis in children is not only a national but both regional and global problem. It accounts for high morbidity and mortality rates among children. You have been selected to participate because you have information that was important and relevant to the study. The interview was audio-taped.

1. Do you think the number of children admitted with meningitis is rising and if so what child/ individual factors do you think contribute to the condition?
2. In your perspective, what are some of the common co-existing conditions that contribute to contracting meningitis?
3. Among the children being admitted in the paediatric unit, what preexisting conditions did they have that predisposed to contracting meningitis?
4. What are your views on the parental and environmental factors that could be contributing to contracting meningitis in this age group?
5. Lumbar puncture is crucial for diagnosis of meningitis. What are your views on the timing of doing the procedure? How long does it take to get lumbar puncture test results? Does this affect the time of starting medication?

**Conclusion:** The researcher will thank the participants for their participation in the interview. The researcher will inform the participants that there is no monetary benefit or compensation for their contribution. The information provided by the participant was for research purposes and will not be shared out without the consent of the participant.

**APPENDIX 5:           REQUEST FOR APPROVAL TO CARRY OUT STUDY**

June J. Serem

University of Nairobi

School of Nursing Sciences

Telephone No: 0710787075

[junserem@gmail.com](mailto:junserem@gmail.com)

The Chairperson,

Ethics and Research Committee-University of Nairobi and Kenyatta national Hospital,

Dear Sir/ Madam,

**RE:   REQUEST FOR PERMISSION TO CARRY OUT RESEARCH STUDY**

I am a post-graduate student pursuing Master of Science in Nursing-Paediatrics at The University of Nairobi. I wish to undertake a study titled `characterization of meningitis among patients admitted in Kenyatta National Hospital paediatric wards`.

I am kindly requesting for your approval to undertake the said study. I am committed to observe and adhere to the ethical principles of respect for persons, justice and beneficence.

I look forward to your favorable response.

Yours faithfully,

June J Serem.



**APPENDIX 6:           REQUEST FOR PERMISSION TO CARRY OUT STUDY**

June J. Serem,

University of Nairobi,

School of Nursing Sciences.

Telephone No: 0710787075

Email: [junserem@gmail.com](mailto:junserem@gmail.com)

The Chairperson,

Ethics and Research Committee-Kenyatta national Hospital,

Dear Sir/ Madam,

**RE:   REQUEST FOR PERMISSION TO CARRY OUT RESEARCH STUDY**

I am a post-graduate student pursuing science nursing (pediatrics) in the University of Nairobi. I wish to undertake a study on `characterization of meningitis among patients admitted in Kenyatta national hospital pediatric wards`.

I am kindly requesting for your approval to undertake the said study in your institution. Attached is a copy of the letter of approval from the University of Nairobi and Kenyatta National Hospital Ethics and Research Committee.

I look forward to a positive response.

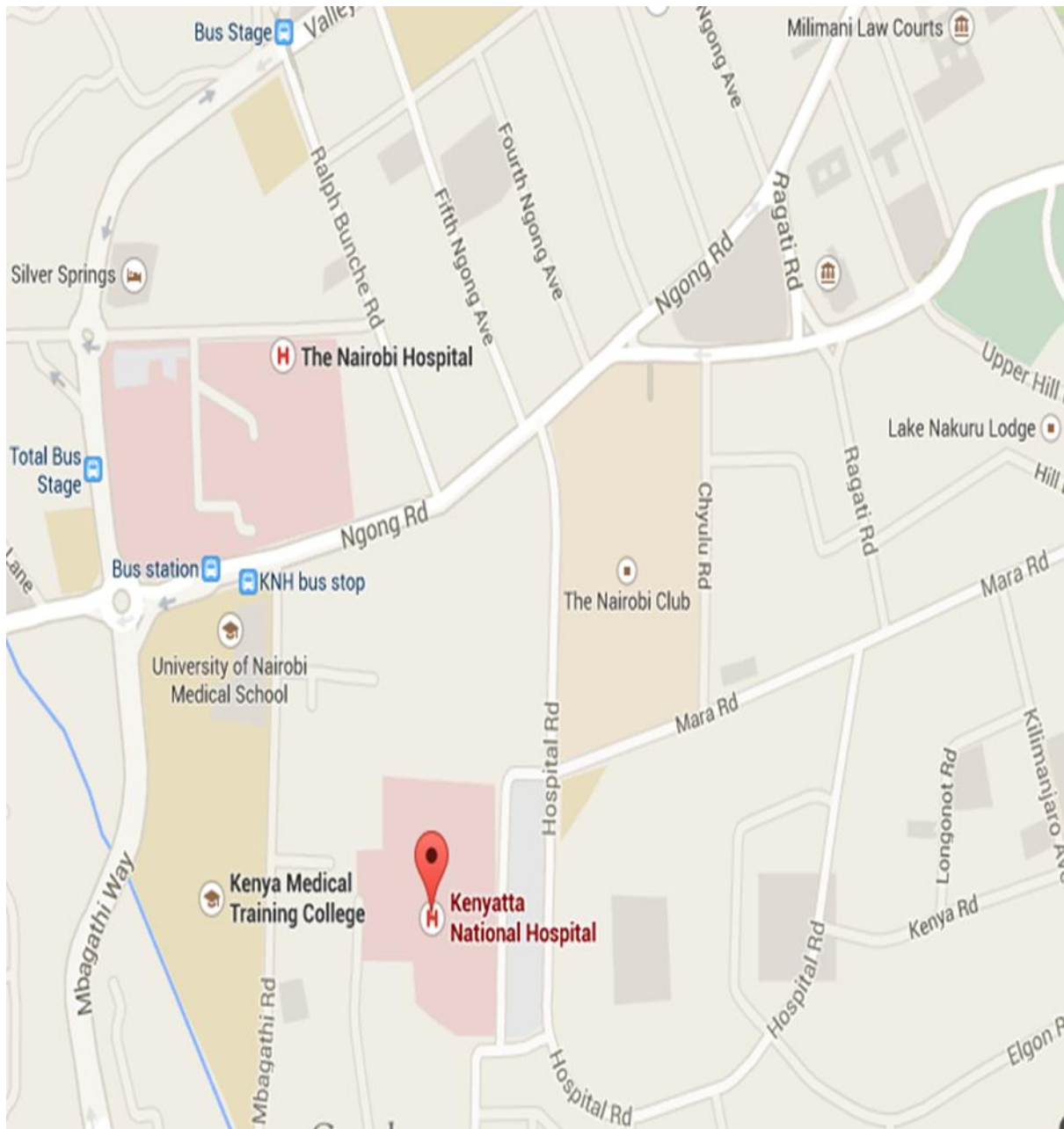
Yours faithfully,

June J. Serem

**APPENDIX 7: MAP OF NAIROBI COUNTY**



**APPENDIX 8: MAP OF KENYATTA NATIONAL HOSPITAL**



## ERC APPROVAL LETTER



UNIVERSITY OF NAIROBI  
COLLEGE OF HEALTH SCIENCES  
P O BOX 19676 Code 00202  
Telegrams: varsity  
Tel: (254-020) 2726300 Ext 44355



KNH-UoN ERC  
Email: [uonknh\\_erc@uonbi.ac.ke](mailto:uonknh_erc@uonbi.ac.ke)  
Website: <http://www.erc.uonbi.ac.ke>  
Facebook: [https://www.facebook.com/uonknh\\_erc](https://www.facebook.com/uonknh_erc)  
Twitter: @UONKNH\_ERC [https://twitter.com/UONKNH\\_ERC](https://twitter.com/UONKNH_ERC)



KENYATTA NATIONAL HOSPITAL  
P O BOX 20723 Code 00202  
Tel: 726300-9  
Fax: 725272  
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/104

23<sup>rd</sup> March 2017

June Jelimo Serem  
Reg. No. H56/82805/2015  
School of Nursing  
College of Health Sciences  
University of Nairobi

Dear June

**REVISED RESEARCH PROPOSAL: PREDICTORS OF BACTERIAL MENINGITIS AMONG PAEDIATRIC PATIENTS AGED 0-5 YEARS HOSPITALIZED AT KENYATTA NATIONAL HOSPITAL (P14/01/2017)**

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH- UoN ERC) has reviewed and **approved** your above revised proposal. The approval period is from 23<sup>rd</sup> March 2017 – 22<sup>nd</sup> March 2018.

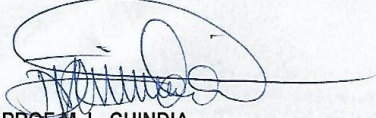
This approval is subject to compliance with the following requirements:

- Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
- All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH-UoN ERC before implementation.
- Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
- Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
- Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
- Clearance for export of biological specimens must be obtained from KNH- UoN ERC for each batch of shipment.
- Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

For more details consult the KNH- UoN ERC website <http://www.erc.uonbi.ac.ke>

"Protect to Discover"

Yours sincerely,



**PROF. M. L. CHINDIA**  
**SECRETARY, KNH-UoN ERC**

c.c.     The Principal, College of Health Sciences, UoN  
          The Director, CS, KNH  
          The Assistant Director, Health Information, KNH  
          The Chair, KNH-UoN ERC  
          The Director, School of Nursing Sciences, UoN  
          Supervisors: Dr. Margaret Chege, Dorcas Maina

## KNH DATA COLLECTION APPROVAL



KENYATTA NATIONAL HOSPITAL  
P.O. BOX 20723, 00202 Nairobi

Tel.: 2726300/2726450/2726550  
Fax: 2725272  
Email: [knhadmin@knh.or.ke](mailto:knhadmin@knh.or.ke)

Ref: KNH/PAEDS-AD/48 Vol.I

Date: 3<sup>RD</sup> April 2017

June Jelimo Serem  
School of Nursing Sciences  
College of Health Sciences  
University of Nairobi

Dear June

**RE: APPROVAL TO COLLECT DATA IN PAEDIATRICS DEPARTMENT**

Following approval by the KNH/UON-Ethics & Research Committee for your Research Proposal, this is to inform you that authority has been granted to collect data in Paediatrics Department, on your study titled "*Predictors of bacterial meningitis among paediatric patients aged 0-5 years hospitalized at Kenyatta National Hospital*".

Kindly liaise with the Senior Assistant Chief Nurse, Paediatrics Department for facilitation.

You will also be required to submit a report of your findings to this office after completion of your study.

**DR. IRENE INWANI**  
**HEAD OF DEPARTMENT, PAEDIATRICS**

Cc. Senior Assistant Chief Nurse, Paediatrics



## Turnitin Originality Report

PREDICTORS OF BACTERIAL MENINGITIS AMONG PAEDIATRIC PATIENTS AGED  
0-5YEARS HOSPITALIZED AT KENYATTA NATIONAL HOSPITAL by June Serem



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