PERFORMANCE OF A MODIFIED RESPIRATORY INDEX OF SEVERITY IN CHILDREN (RISC) SCORE TO PREDICT POOR OUTCOMES IN CHILDREN ADMITTED WITH LOWER RESPIRATORY TRACT INFECTIONS AT KENYATTA NATIONAL HOSPITAL

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

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DEDICATION

I wish to dedicate this work to my wife and family for their constant support and encouragement.

You are truly inspirational.

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LIST OF ABBREVIATIONS

AIDS Acquired Immune Deficiency Syndrome

ART Antiretroviral Therapy

AVPU Alert Voice Pain Unresponsive

CD4 Human T helper cells expressing CD4 antigen (T helper cell)

CDC Centers for Disease Control and Prevention

DNA Deoxyribose nucleic Acid

HIV Human Immunodeficiency Virus

IMCI Integrated management of childhood illnesses

ICU Intensive care unit

KNH Kenyatta National Hospital

PCR Polymerase chain reaction

RISC Respiratory Index of Severity in Children

RNA Ribose nucleic Acid

WHO World Health Organization

UNAIDS Joint United Nations Programme on HIV/AIDS

DEFINITION OF TERMS

Acute lower respiratory tract infections: Patient presenting with complaints of cough or difficulty in breathing for a period of less than two weeks severe enough to warrant hospitalization.

Duration of hospital stay: Duration from hospitalization to time when discharge is given by attending clinicians.

Very severe Pneumonia: Cough or difficulty in breathing accompanied by central cyanosis, inability to feed, altered level of consciousness and grunting.

Severe Pneumonia: Cough or difficulty in breathing with associated lower chest wall indrawing.

Pneumonia: Cough or difficulty in breathing with associated respiratory rate of > 50 in children aged 2-11 months and a rate of >40 in children aged > 12 months.

Hypoxia: Oxygen saturation less than 90% measured by pulse oximetry when child is not on oxygen supplementation.

Poor outcomes:

- Death within seven days of hospital stay. Classified as early if within 48 hours of admission or late if death is within 2-5 of hospitalization.
- Hospital stay longer than seven days after hospitalization from an acute lower respiratory illness.
- Need for mechanical ventilation due to the severity of the lower respiratory tract infection.

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ABSTRACT

Background: Respiratory tract infections including pneumonia are a leading cause of mortality and morbidity in children under five years of age. A large burden of these cases is in Africa. Clinical prediction scores such as respiratory index of severity in children (RISC) score have been developed to predict outcomes in children with respiratory tract infections. RISC score is a composite score that uses the oxygen saturation, ability to feed, presence of chest indrawing and nutritional status. The score ranges from zero to six with six being the poorest score. Such a score would make it easier for clinicians to predict outcomes and prioritize care based on available resources to reduce morbidity and mortality

Objectives: To determine the RISC scores and evaluate its validity to predict poor outcomes in children aged 2-59 months who are hospitalized with acute lower respiratory tract infections at Kenyatta National Hospital.

Methods: This study recruited children aged 2-59 months presenting with symptoms of cough or difficulty in breathing for a duration of less than two weeks that was severe enough to require hospitalization. Demographic, clinical information and the child's RISC score was also captured in a pretested questionnaire on admission. Children were followed up in the ward for outcomes of interest that included death within seven days of admission, prolonged hospital stay of more than one week and mechanical ventilation. We analyzed the rates of poor outcomes and relationship between the observed and expected outcomes based on the modified score

Results: A total of 146 children were recruited. The male to female ratio was 1:0.8 with a median age of 10 months. The modified RISC scores ranged between zero and six with a median RISC score of two. Thirty nine percent of the study participants had a poor outcome with a mortality rate of 0.7%. The score predicted mortality perfectly for higher risk groups based on the modified score ($\geq$ 4) but performed poorly for values representing low risk (0 to 1) or moderate risk (2 to 3) of poor outcomes. The Hosmer-Lemeshow test for goodness-of-fit provided evidence of differences between the observed and estimated frequencies (chi square = 4.45; DF=2; p value = 0.35).

Conclusion: The score in our setting ranged from zero to six with a median RISC score of two. This score was associated with a 33 % prevalence of poor outcomes. We recorded a mortality rate of 0.7 % from children admitted with acute lower respiratory tract infection, 35% of children hospitalized with acute lower respiratory tract infections had a hospital stay of greater than a week and 4% of children required mechanical ventilation. However, the overall RISC score is a poor screening tool to predict poor outcomes as evidenced the poor calibration. Further modifications on the tool are recommended.

1 BACKGROUND AND LITERATURE REVIEW

1.1 INTRODUCTION

Globally, respiratory tract infections are a leading cause of morbidity and mortality in children under five years of age with an estimated 156 million cases per year (1). The largest burden of these cases is in south East Asia and Africa. Africa records 36 million new cases per year. In 2008, pneumonia accounted for the largest percentage of infectious disease deaths in children less than five years in the world (2).

In developing countries, especially in areas with high Human Immunodeficiency Virus (HIV) prevalence, HIV infection has led to the increase in the incidence and severity of pneumonia and other respiratory tract infections. Pneumonia in HIV infected patients is associated with longer hospital stay and a higher case mortality (3). In Kenyatta National Hospital, which is one of Kenya's teaching and referral hospitals, pneumonia-associated mortalities in previous studies have been estimated to be as high as 13% (4).

In effort to improve quality of pneumonia case management and other common childhood diseases the World Health Organization (WHO) developed the Integrated Management of Childhood Illness (IMCI) strategy to aid in management of common childhood illnesses, including pneumonia, in resource-constrained countries. Its main components were improvements in the case-management skills of health staff through the provision of locally adapted guidelines, improvements in the health systems required for effective management of childhood illness and improvements in family and community practices to ensure good health at the family level. These guidelines were mainly for the first level of care and outpatient settings to aid in early assessment, diagnosis, treatment and referral for definitive care of the children (5).

The WHO later developed the guidelines for management of common childhood illnesses in areas with limited resources; these focused more on inpatient management of major causes of childhood mortality including pneumonia. They were a buildup of the IMCI guidelines that were for outpatient management of sick children (6).

The WHO guidelines for management of pneumonia classify pneumonia cases into three. These are very severe pneumonia, severe pneumonia and pneumonia based on the clinical presentation. Very severe pneumonia is defined as cough or difficulty in breathing and any one of the following; central cyanosis, altered consciousness, convulsions, lethargy, inability to drink or breastfeed, vomiting everything or signs of severe respiratory distress like head nodding. Severe pneumonia is defined as cough or difficulty in breathing associated with either lower chest wall indrawing , nasal flaring or grunting in young infants without the above signs of very severe pneumonia. Finally pneumonia is defined as cough or difficulty in breathing and fast breathing defined by a respiratory rate of $\geq$ 60 breaths per minute in children aged < 2 months, $\geq$ 50 breaths per minute in children aged 2-11 months and a rate of $\geq$ 40 breaths per minute in patients one to five years of age without the above signs of severe or very severe pneumonia. These guidelines have been recently revised by the WHO to include three categories of severe pneumonia, pneumonia and no pneumonia but the Kenyan guidelines have retained the old classification as described above (6).

Other diseases present like pneumonia and should be considered in making pneumonia diagnosis. For example, brochiolitis, which is a lower respiratory tract infection, occurs in children aged less than 2 years and is characterized by airway obstruction and wheezing (6). It is mainly caused by the respiratory syncitial virus although other viruses have been implicated. The WHO case definition for brochiolitis includes children presenting with wheezing that is not relieved by up to three doses of rapid acting bronchodilator, hyperinflation of the chest wall with increased resonance to percussion, lower chest wall indrawing, fine crackles or rhonchi on chest auscultation. The children also have difficulty in feeding, breastfeeding or drinking due to the respiratory distress (6).

The IMCI guidelines aim to increase ability to identify as many children as possible who will need antibiotic treatment and referral (5). However, these are not without challenges as many countries especially the low-income countries still have low referral rates due to economic and geographic constraints. Having a system that discriminates children with lower respiratory tract infections based on risk of severe outcomes such as death or need of mechanical ventilation may help improve decision making for example need for early intensive care unit (ICU) care. IMCI is often used to determine who needs hospitalization but there remains a need for a complementary

system to help with the triage of the large number of respiratory illness cases involving a broad spectrum of severity within the hospitalized setting.

Clinical prediction scores are common in management of adult community acquired pneumonias (7). The scores assign points to various symptoms and signs; these are totaled to predict the risk of severe outcomes such as mortality and prolonged hospital stay. However, few scores exist in the paediatric age group that can be utilized in low resource areas. In South Africa the respiratory index of severity in children (RISC) score was developed from analysis of more than 4000 admissions of children with lower respiratory tract infections between 1998 and 2001 to predict mortality (8). Separate models were developed for HIV infected and uninfected patients. Risk factors build in the model included oxygen saturation, chest in drawing, wheezing, refusal to feed and age, Scores ranged from zero to seven points for HIV-infected, the poorest score was seven which was associated with a mortality rate of 47% and zero to six points for non-infected children, with six being the poorest score with a mortality rate of 14%. The score was developed for use in settings that have limited resources thus though certain laboratory and radiological parameters that may not be readily available were found to be significant in predicting mortality they were not included in the final score.

1.2 FACTORS ASSOCIATED WITH PNEUMONIA OUTCOMES

Several studies have been carried out both locally and abroad to characterize the factors that affect outcomes of children with pneumonia. Spooner *et al* examined the clinical signs and symptoms in 897 children less than five years of age presenting with pneumonia at a hospital in Papua New Guinea. The usefulness of clinical signs in predicting severity of disease was determined and risk factors for severe disease were identified. The strongest predictors of death were cyanosis as 54 out of 61 children with cyanosis died (OR 17.41; $P<0.001$) and poor feeding as 38 out of 60 children died (OR 7.58: $P<0.001$); bronchial breathing (OR 3.35: $P<0.001$), grunting (OR 3.05; $P<0.001$) and nasal flaring (OR 2.52; $P<0.01$)

Other factors that affected severity of disease and increased the risk of death were age under one year, first born children, females, malnourished children and children with who had clinical symptoms for more than seven days. Fever alone did not increase the risk of dying unless it was present for more than seven days (9). In a study by Shann et al who sampled 748 children with severe pneumonia there was high mortality in children with a prolonged illness (sensitivity 72%:

specificity 55%: P<0.001), severe roentgenogram changes (sensitivity 67%: specificity 64%: P< 0.001), cyanosis (sensitivity 66%: specificity 56%: P<0.00I), Leucocytosis (sensitivity 36%: specificity 85%: P<0.001), hepatomegaly (sensitivity 53%: specificity 61%: P< 0.01), inability to feed (sensitivity 32%: specificity 78%: P< 0.05). There was a trend toward a higher mortality in children with grunting (sensitivity 47%; specificity 63%: P<0.06) or severe chest indrawing (sensitivity 41 %: specificity 69%: P<0.06) (10).

Demers et al in a study of 395 children aged less than five years presenting with cough or difficulty in breathing, in the Central African Republic demonstrated that of the 49 (12.4%) children who died, 39 had indrawing of the chest which in univariate analysis, was the risk factor most strongly associated with death [odds ratio, 22.99; 95% confidence interval (CI), 3.81 to 935.2]. In a multivariate model the independent risk factors for death were indrawing of the chest [adjusted odds ratio (AOR) 8.35, CI 1.04 to 66.82], hepatomegaly (AOR 6.72, CI 2.35 to 19.21), age between 2 and 11 months (AOR 6.37, CI 2.18 to 18.59), grunting (AOR 4.53, CI 1.96 to 10.45), a moderate/severe alteration of general status (AOR 3.23, CI 1.17 to 8.94) and acute malnutrition (AOR 2.74, CI 0.96 to 7.78) (11). Locally, studies by Kosgei among children aged 2-59 months demonstrated that grunting, (AOR 2.2, CI 0.9 to 5.4) altered consciousness (AOR 2.5, CI 1.0 to 6.2) and inability to drink were the main factors for poor outcomes which were defined as death, clinical decision to change antibiotics and worsening clinical symptoms and signs within 48 hours of admission in children (12).

Hypoxemia, that is oxygen saturation of < 90%, has been associated with poor outcomes in pneumonia. Hypoxemic children in a Kenyan study were 4.3 times more likely to die within five days of admission than children without hypoxemia (95% confidence interval of relative risk 1.03 to 17.8 p=0.02). Hypoxemia on admission predicted short term hospital mortality with 90% (68% to 98%) sensitivity and 34% (26% to 41%) specificity (13). A rapid respiratory rate of ≥ 70 (OR 2.6 CI 1.02-6.6), grunting (OR 2.7 CI 1.2-6.7) and chest retractions (OR 7.9 CI 1.5-20.4) were found to be independent predictors of hypoxemia.

In India, Tiewosoh *et al* studied 200 children aged 2-60 months hospitalized with severe pneumonia. This study described several outcomes of children who were on follow up which

included need for mechanical ventilation, prolonged hospital stay, need for antibiotic change and death. The study demonstrated that children living in overcrowded homes were more likely to have a prolonged hospital stay and change of antibiotics during treatment when hospitalized with pneumonia. Several other features were associated with the severe outcomes; these included head nodding [Risk ratio (RR) (95%CI) 8.34 (2.71 to12.77)], altered sensorium [RR (95%CI) 5.44 (1.34 to17.56)], abnormal leukocyte counts [RR (95%CI) 5.85(1.36 to 17.14)] and pallor [RR (95%C) 10.88 (2.95 to20.40)] (14).

These and other studies in which a multivariate analysis of the factors was done are summarized in the table below

Table 1 PREDICTORS OF POOR OUTCOMES IN CHILDREN WITH LOWER RESPIRATORY TRACT INFECTIONS

Reference, Setting and year of study	Age in months	Severe outcomes	Factors associated
Demers A et al. 1996-1997(11) Central African Republic	2-59	Death	• Oxygen saturation lower than 85% • Chest in drawing • Altered consciousness • Grunting • Hepatomegaly
Spooner et al 1982-1985(9) Papua New Guinea	2-59	Death	• Cyanosis • Refusal to feed • Bronchial breathing • Nasal flaring
Shann et al 1985 (10) Papua New Guinea	2-59	Death	• Prolonged duration of respiratory symptoms • Cyanosis • Leucocytosis • Hepatomegaly
Tiewosh et al 2004-2006(14) India	2-60	Need to change antibiotics Hospital stay of more than 5 days Death	• Abnormal chest radiograph • Head nodding • Altered sensorium • Abnormal leucocyte counts • Pallor
Reed et al 1998-2001(8) South Africa	<24	Death	• Oxygen saturation lower than 90% • Chest in drawing • Refusal to feed , • Weight for age less than -2 Z-score
Onyango et al 1989 (13) Kenya	< 36	Death	• Oxygen saturation < 90% • Tachypnoea • Grunting and chest retractions.

1.3 RESPIRATORY INDEX OF SEVERITY IN CHILDREN (RISC) SCORE

Clinical prediction scores are common in management of various illnesses. These clinical scores are used to predict risk of severe outcomes where points are assigned to each risk factor/ predictor and a composite score used to predict the outcome. These predictions can assist clinicians in their initial management decisions such as determining the most appropriate site of treatment (ward vs. intensive care units) and the intensity of diagnostic testing and treatment. A clinical prediction tool assists in prioritizing care, in proper assigning of the level of care e.g. referral to a tertiary facility and also allows for the proper utilization of the available resources to reduce morbidity and mortality (15). An accurate prediction of possible outcomes also allows the clinicians to inform patients and family of the expected outcomes based on their signs, symptoms and laboratory data.

One such score is the RISC score. Developed in South Africa, the study sampled hospitalized children aged between 0 and 24 months who were hospitalized with lower respiratory tract infections. The main objective of the study was to develop two severity scores for respiratory tract infections in children with or without HIV and assess its ability to predict mortality by evaluating the performance of the scoring model. The children were enrolled under two arms based on their HIV status. The main outcome of interest was mortality. Several variables were analyzed to assess their association with mortality. They enrolled more than 2,600 HIV uninfected and 1,500 HIV infected children for the study (8). They thus developed two separate scores.

Among the HIV, uninfected children, oxygen saturations of < 90% (Adjusted Odds ratio 20.9; 95%CI 5.0-87), lower chest wall in drawing (Adjusted Odds Ratio 4.6; 95%CI 2.2-9.4), wheezing (Adjusted Odds Ratio 0.2; 95% CI 0.05-0.6), refusal to feed (Adjusted Odds Ratio 1.8; 95%CI 0.9-3.8) and weight for age of less than -2 Z score (Adjusted Odds Ratio 2.5: 95%CI 1.6-3.8) were found to be the main risk factors for mortality. From these factors, a score was developed and points assigned to the various predictors. The scores ranged from zero to six as shown in the table 2 below. Higher scores were associated with higher mortality rates.

Table 2 SIGNIFICANT FACTORS THAT FORMED THE RESPIRATORY INDEX OF SEVERITY IN CHILDREN (RISC) SCORE (8)

Clinical Risk Factor	Score
Severity of Respiratory Signs on Physical Examination	
Oxygen saturation ≤90%	3
Oxygen saturation >90% with chest wall indrawing	2
Presence of wheeze	-2
Refusal to feed	1
Growth Standard Weight for Age Z Score	
WAZ ≤ -3	2
-2 ≤WAZ <-3	1
WAZ≥ -2	0
TOTAL RISC SCORE	**6**

The table below summarizes the mortality rates associated with each of composite score.

Table 3 RISC SCORE AND CORRESPONDING MORTALITY RATES IN CHILDREN HOSPITALIZED WITH LOWER RESPIRATORY TRACT INFECTIONS

RISC SCORE	0	1	2	3	4	5	6
ASSOCIATED MORTALITY (%)	0	0	0.7	2.2	5.1	10.9	13.9

Since clinical evidence is dynamic, there are various aspects of the score that would need to be modified to reflect current clinical practice. The RISC score uses weight for age to assess nutritional status among the children. The WHO recently published child growth standards for attained weight and height to replace the previously recommended 1977 NCHS/WHO child growth reference. These new standards are based on breastfed infants and appropriately fed children of different ethnic origins raised in optimal conditions and measured in a standardized way (16). Wasting indicates in most cases a recent and severe process of weight loss, which is often associated with acute starvation and/or severe disease. These children are at a higher risk of death (17). However, stunting tends to reflect the long-term health and nutritional experience of the individual or population. It has a lower effect on mortality as compared to wasting as stunted children can be treated as outpatients unlike children with severe wasting. Therefore including weight for height as an assessment for growth and nutritional status based on the new growth standards would be in line with the current national and international guidelines.

1.4 PERFORMANCE OF PREDICTIVE SCORES

Measures used to test the performance of a predictive (prognostic) score include discrimination and calibration. Models with good discrimination are able to distinguish between patients with and without the outcome of interest and assess if patients with the outcome actually have higher risk predictions than those without (18). Various statistical or clinical factors may cause a prognostic model to perform poorly when applied to other patients. The model's predictions may not be reproducible because of deficiencies in the design or modeling methods used in the study to derive the model. Poor performance in new patients can arise from differences between the setting of patients in the new and derivation samples, including differences in healthcare systems, methods of measurement, and patient characteristics. However as part of external validation of predictive scores, one may evaluate other aspects not initially evaluated and make necessary modifications to make the score relevant (19).

This is different from evaluating a diagnostic test where one compares a new test with a gold standard. In this case measures like sensitivity, specificity and predictive values of the test may be obtained. The aim of this study was to evaluate the performance of a predictive test the modified RISC score to predict poor outcomes in children admitted with lower respiratory tract

infections in our population. Specifically we determined if the observed poor outcomes in our setting correlate with the expected outcomes based on the RISC score.

Calibration measures how well the predicted probability of the outcome of interest matches the actual outcomes observed (20). Calibration may be represented graphically with prediction on the Y-axis and the outcomes on the X-axis. Perfect predictions will fall on the 45-degree line. Other ways of assessing calibration are the Hosmer Lemeshow goodness of fit test. Although the test has limited statistical power to assess poor calibration and is oversensitive for very large samples (21).

2 JUSTIFICATION

Respiratory tract infections are a leading cause of death in children under five years of age. In order to effectively manage these cases and avert death, it is important to efficiently and rapidly identify those most at risk of dying in the hospital from among the many overall cases of respiratory illness. Classifying the cases not only optimizes the use of constrained resources but also helps to prevent deaths by intensifying care of severe cases.

The RISC score is a clinical prediction score that was developed to predict mortality in children with lower respiratory tract infections. Different points are assigned to various clinical signs and symptoms including oxygen saturation, chest wall indrawing and child's nutritional status and a composite score used to predict mortality in these children. A high score predicted increased mortality risk. The usefulness and applicability of the score which was developed in a southern Africa setting, needs to be assessed in different geographic locations due to the diversity in populations and health seeking behaviors. The score uses clinical signs and symptoms most of which are already in use locally under the current WHO classification of pneumonia (6). This score goes further than these guidelines which list high risk symptoms and signs of severe disease by assigning and numerical value to the group of signs and symptoms which is directly proportional to the mortality risk. In high volume patient care environment, the clinical team may easily identify from among those at risk children who are highest risk and therefore prioritize optimally and minimize mortality. Although the original score only assessed death as an outcome, we included other outcomes. This is to effectively capture most possible outcomes of ill children who do not necessarily die. This is because with the introduction of vaccines and improved case management mortality and morbidity of pneumonia is on the decline (22, 23). We thus included need for mechanical ventilation and a prolonged hospital stay as part of the outcome measures.

3 RESEARCH QUESTION

What is the validity of the modified respiratory index of severity in children (RISC) score to predict poor outcomes in children aged 2-59 months hospitalized with acute lower respiratory tract infections at Kenyatta National Hospital?

3.1 OVERALL OBJECTIVE

To evaluate validity of the Modified Respiratory Index of Severity in Children (RISC) score to predict poor outcomes in children aged 2-59 months hospitalized with acute lower respiratory tract infections at Kenyatta National Hospital.

SPECIFIC OBJECTIVES

1. Describe the RISC scores of children aged 2-59 months hospitalized with acute lower respiratory tract infections at Kenyatta National Hospital.
2 Describe short-term treatment outcomes of children aged 2-59 months hospitalized with acute lower respiratory tract infections at Kenyatta National Hospital.
3 Determine the relationship between the modified RISC score and poor outcomes among children aged 2-59 months hospitalized with acute lower respiratory tract infections at Kenyatta National Hospital.

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4 METHODOLOGY

4.1 STUDY DESIGN

This study was a short longitudinal study.

4.2 STUDY SITE

This study was conducted in Kenyatta National Hospital (KNH), which is the National Referral Hospital and Teaching hospital for the University Of Nairobi Medical School. It is located in the Kenyan capital city Nairobi. KNH serves as one of the two national (tertiary) referral hospitals in Kenya and receives patients from all other hospitals in the country and neighboring East African countries. It also serves non-referral patients mainly from the capital city and the surrounding counties. Children under the age of 12 years are reviewed in the specialist outpatient clinics, general paediatric outpatient clinics and the paediatric emergency unit. Care is offered by consultant paediatricians, trainee paediatricians, medical officers, clinical officers with training in paediatrics and qualified nurses. There are four paediatric wards with a capacity of 240 beds with the occupancy often over 100%. KNH records over 11000 paediatric admissions in a year. Critically ill children needing close monitoring are hospitalized in the acute rooms in the ward which act as the high dependency units. These acute rooms have no mechanical ventilators and thus children requiring mechanical ventilation are admitted into the critical care unit, which has 21 beds which accommodate both children and adults. Treatment and care is based on the Ministry of Health clinical practice guidelines and the Emergency Triage Assessment and Treatment Plus admission care (ETAT+) guidelines (23).

4.3. SOURCE POPULATION

KNH serves patients of middle to lower socioeconomic status from Nairobi and its environs as well as those referred from other hospitals in Kenya. The children recruited into the study were drawn from this population.

4.4. STUDY POPULATION

We included children who met the following inclusion criteria;

1. Aged between 2 and 59 months
2. Presenting with history of cough or difficulty in breathing for a duration of less than 14 days that is severe enough to require hospital admission.

3. Children whose parents or guardians or parents give informed consent for their inclusion in the study.

Exclusion criteria included the following Children excluded from the study were:

1. Readmission within 14 days of discharge to avoid recruiting those with possible nosocomial infections.
2. Children with underlying (confirmed previously or by the time of discharge) co-morbidities that impact outcome including congenital heart diseases, rickets, Down's syndrome, acute and chronic kidney disease, malignancy, sickle cell anaemia and chronic liver disease.
3. Children with thoracic anatomical abnormalities.
4. Children with confirmed pulmonary tuberculosis or on treatment for tuberculosis.
5. Children with confirmed HIV infection.

4.5 CLINICAL DEFINITIONS

1. Acute respiratory tract infections were defined as cough or difficulty in breathing for a duration of less than 14 days that is severe enough to require hospitalization.
2. Hypoxia defined as oxygen saturation less than 90% measured by pulse oximetry when child is not on oxygen supplementation.
3. Malnutrition as defined by a weight for height Z score classified as;
    - Mild & Normal $Z>-2$
    - Moderate $-2<Z<-3$
    - Severe $Z<-3$

4.6 OUTCOMES OF INTEREST

Outcomes on interest were death within seven days of hospital stay period, prolonged hospital stay of more than seven days and need for mechanical ventilation within the first 7 days of hospitalization.

4.7 SAMPLE SIZE

Based on the Bruderers formula for sample size calculation based on the sensitivity and the absolute precision level, (24) sample size n is equal to

$$= \frac{Z^2_{1-\alpha/2} \times S_N \times (1 - S_N)}{L^2 \times \text{Prevalence}}$$

S_N, = anticipated sensitivity set at 95% (corresponding to the mid score)

α = size of the critical region ($1 - \alpha$ is the confidence level),

$Z^2 1\text{-}\alpha/2$ = standard normal deviate corresponding to the specified size of the critical region (α), set at 1.96

L = absolute precision desired on either side (half-width of the confidence interval) of sensitivity or specificity. Set at 0.1

P= the prevalence of pneumonia mortality in was set at 13 % from previous studies (4).

N= $(1.96^2 \times 0.95 \times 0.05) \div (0.1^2 \times 0.13)$

Minimum Sample size = 140 children

4.8 SAMPLING CRITERIA

The study consecutively enrolled all eligible children identified by the principal investigator or research assistant in the paediatric emergency unit prior to transfer to the ward. The enrolment occurred daily on weekdays and weekends.

4.9 STUDY PROCEDURE

The study identified patients aged 2 to 59 months hospitalized through the paediatric emergency unit with complaints of cough or difficulty in breathing and fever for a period of less than two weeks a diagnosis of acute lower respiratory tract infection. Those whose parents or caregivers consented were enrolled into the study from the paediatric emergency unit and the wards. The recruitment was conducted by the principal investigator or research assistants. The research assistants were trained clinical officers who were part of a larger clinical study on childhood respiratory illness of which this current study was a subset. The assistants had received prior training on data collection before the study commenced. Once the child was reviewed by the attending trainee paediatrician on call at the Paediatric Emergency Unit (PEU) and had been scheduled for hospitalization, the investigators approached the parent or guardian, informed them of the study, and sought to obtain informed consent. Once consent was obtained, the investigator

collected the patient's demographic information. This included the child's age and sex. Clinical data collected included height, weight, axillary temperature, oxygen saturation and heart rate. History obtained included history of cough, difficulty in breathing, chest pain, wheeze and vomiting. The child was examined for signs of lower chest wall indrawing, cyanosis, nasal flaring, palmar pallor, cyanosis and level of consciousness. The RISC score was then documented. Data were entered into a pretested questionnaire. Once admitted into the ward, the children were followed up for outcomes of interest which were death, prolonged stay and need for mechanical ventilation. The length of stay was based on previous local studies that put the average length of stay for patient admitted with severe or very severe pneumonia at eight days (4).

The study procedure is summarized in the flow chart below;

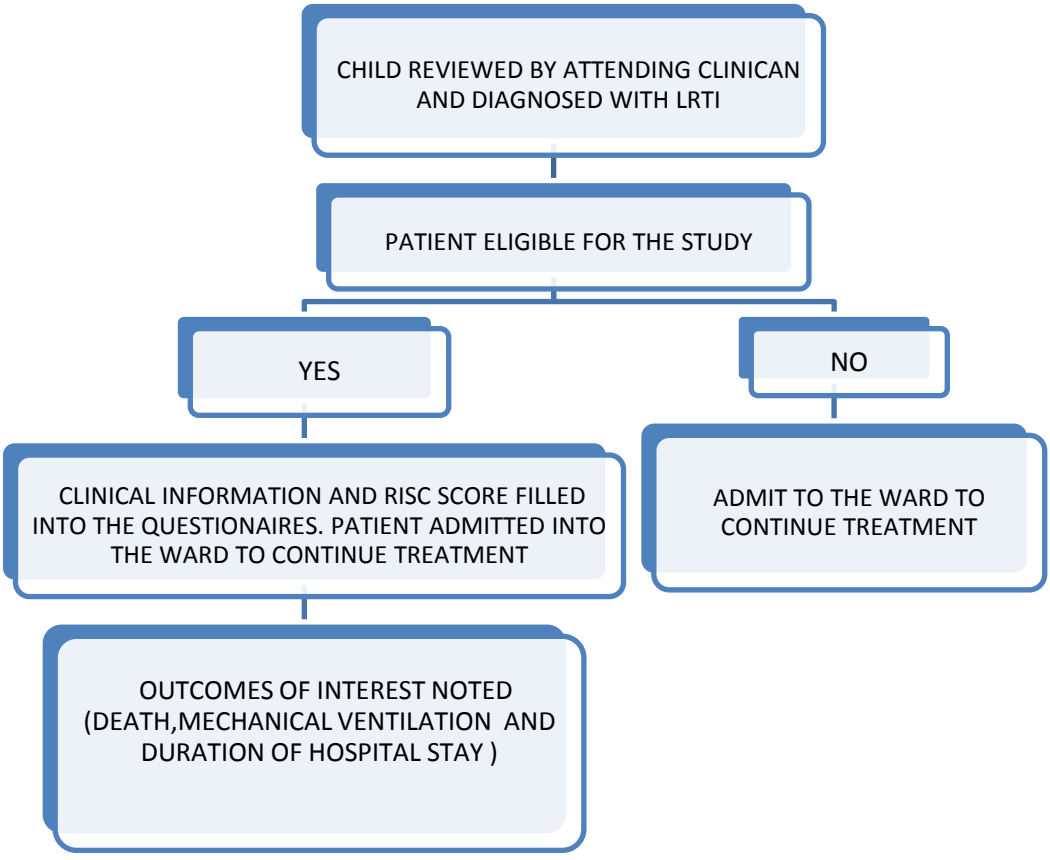

FIGURE 1 FLOW CHART OF STUDY PROCEDURE

4.9.1 Anthropometric Assessment

Each child was undressed prior to measurement of weight. The weighing scale was covered with a paper, and once turned on the child was be placed on his/her back or sitting on the tray ensuring that the infant or child was not touching anything off the scale. The weight appearing on the display panel was recorded in kilograms. For quality assurance, we used the same scales during the study and this scale was calibrated by the hospital biomedical department (25). Older children who were able to stand without support had their weight taken using a Salter scale which had also been calibrated by the biomedical team.

During measurement of the child's length, the stadiometer board was covered with table paper, children took off hats or shoes and the sliding foot piece was placed at the end of the measuring board and checked to ensure that it is sliding freely. Assistant lay the child down on his/her back on the measuring board and stood directly behind the child's head. Child was held securely by the parent or guardian at the waist while the assistant positioned the head. The assistant then placed the child's head against the headpiece with head in the correct position so that the shoulders, back and buttocks were flat along the center of the board. The movable foot piece was placed firmly against the child's heels. Ensuring the head is against the headpiece with eyes looking straight up, body and legs straight and flat in the center of the measuring board, heels and feet firmly against the foot piece, the measurement was read against the foot piece. Supine measurement was obtained for all children <24 months old and those who were too sick to stand. For children older than 24 months of age or those with a length of more than 87 centimetres a measurement of standing height was determined. They were placed against the wall without shoes or hats, ensuring that the heels, the buttocks, both shoulders and occiput were firmly against the wall. With the child looking straight ahead, the height from the floor to the top of the head was recorded in centimeters. Full details of the procedure are obtained in appendix 1.

4.9.2 Oxygen saturation by pulse oximetry

This was measured using a portable battery powered pulse oximeter. After explaining to the parent or caregiver on what will be done and the benefits, the probe was placed on the index finger or thumb after ensuring it has no nail polish. For those children on oxygen therapy the oxygen was switched off for maximum 30 seconds and the measure taken when child was not on oxygen. The probe was held in position until a reading was obtained; the reading was

documented as the first reading. The procedure was repeated after one minute and the second reading taken. The average of the two readings was recorded (25). Full details of the procedure are obtained in appendix 2.

4.9.3 Clinical Signs and Symptoms

Clinical signs and symptoms that were documented included presence and duration of cough, difficulty in breathing, wheeze, ability to feed, history of vomiting and diarrhea. Signs that were identified and documented were grunting, nasal flaring, lower chest wall in drawing, head nodding and central or peripheral cyanosis. Chest auscultation was performed for presence of crepitations or rhonchi. The child's respiratory rate was counted for a full minute and documented. Once this information was collected, it was counter checked with what was already recorded on the admission notes. In the case a clinical sign or symptom was omitted by the admitting clinician, they were informed to ensure that the patient has the correct diagnosis and treatment.

4.10 DATA MANAGEMENT

Data from the pretested questionnaires were entered into Microsoft excel spreadsheet and analyzed using SPSS windows version 17.0. Weight for age and weight for height Z score were determined using the WHO software- WHO Anthro version 3.2.2 (26). More information on the WHO Anthro software is found in appendix 3. The RISC was computed for each patient by assigning score points between -2 to 3 based on severity of respiratory signs on physical examination, oxygen saturation and growth standards as proposed by the modified RISC scoring system.

Descriptive analysis of continuous variables was done by calculating mean (standard deviation) or median (interquartile range) for normally distributed and skewed continuous variables respectively. We described the modified RISC score and the outcomes using frequency tables at 95 % confidence interval. In the assessment of the RISC score as a prognostic model we compared the observed poor outcomes against the predicted outcomes by calibration models. Calibration was assessed using the Hosmer-Lemeshow goodness of fit test. A low chi-square and high p-value indicates good calibration. Calibration was also assessed visually by graphing the observed frequencies of poor outcomes against the predicted probabilities of poor outcome at each score level. Data once analyzed were presented in tables and graphs.

4.11 ETHICAL CONSIDERATIONS

1. Permission was sought from the Kenyatta Hospital Ethics Research Committee and the Department of Paediatrics and Child Health University of Nairobi to collect and analyze data collected in the study. Reference number: KNH-ERC/A/157 (Appendix 7).
2. The purpose of the study was carefully explained to the children's parents or guardians with a view to obtaining written consent prior to enrolling any child in the study. The consent form was availed in English and Kiswahili.(Appendix 6)
3. Strict confidentiality was observed throughout the entire study period, held in trust by participating investigators, research staff and the study institutions. The study participants were given study identification numbers and no personal identification data was recorded. No information concerning the individual study findings was released to any unauthorized third party without prior written approval of the study institution or the Ethics Research Committee.
4. The overall study findings will be availed the specialists and staff running the paediatric units in hopes of disseminating the knowledge gained about pneumonia outcomes in children thereby contributing to the improvement of care delivered to these children. The study findings will also be presented to the University of Nairobi (UON) Department of Paediatrics and Child Health faculty and students in fulfillment of the requirements of the MMed Program.

5 RESULTS

5.1 Description of the Study Population

We enrolled 146 children during the period November 2013 through February 2014. There were 80 (54.8%) males and 66 (45.2%) females giving a male to female ratio of 1:0.8. The median age of the study participants was 10 months (range 2 months to 59 months). The figure 2 below describes the age distribution of the study participants. Majority of the study participants (83%) were aged below two years with 81 children (56%) under one year. The age group 12-13 months had 39 children accounting for 27% of the study population. The study recruited 15(10%) children aged 24-35 months. We noted that 6 children were in the age group 36-47 months and 4 children were aged between 48-59 months. The gender distribution in all the age categories had more male than female children being hospitalized.

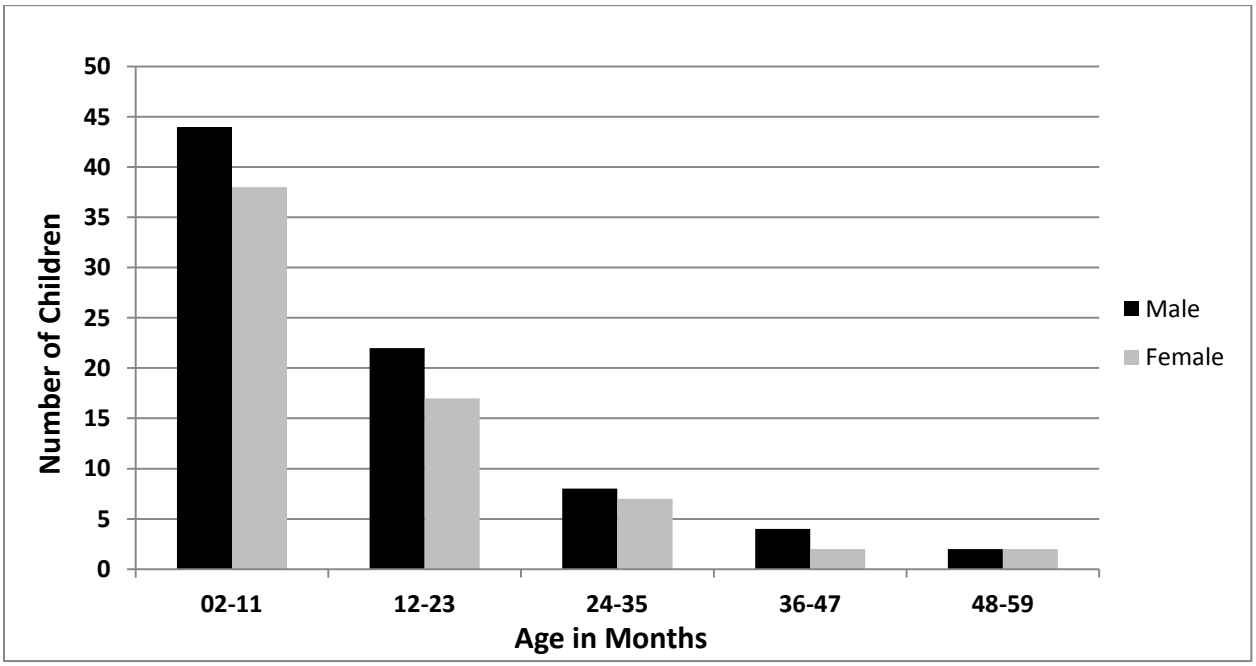

Figure 2: Distribution of Children Studied by Age and Gender

The duration of illness ranges from 1 to 40 days with a median of 5.5 days. On admission, 8.1 % of the children had hypoxia, defined as oxygen saturations lower than 90%. In terms of the nutritional status, 28.1% of the patients had severe malnutrition as evidenced by a weight for height Z score of $\leq$ -3. The study found 9.6% of the children were noted to have moderate

malnutrition. Of the clinical features assessed, grunting was noted in 29.5% of the children admitted and 11.6% of the children had inability to feed.

Table 4: Baseline Characteristics of Study Population

Group	Frequency N=146	Percentage
Oxygen Saturation		
Hypoxia	12	8.2
No Hypoxia	134	91.8
Nutritional status W/A Z score		
Mild & Normal ($Z \geq -2$)	81	55.5
Moderate $-3 < Z < -2$	45	30.8
Severe ($Z \leq -3$)	20	13.7
Nutritional Status W/H Z score		
Mild & Normal ($Z \geq -2$)	91	62.3
Moderate $-3 < Z < -2$	14	9.6
Severe ($Z \leq -3$)	41	28.1
Grunting		
Present	43	29.5
Absent	103	70.5
Inability to feed or drink		
Present	17	11.6
Absent	129	88.4

5.2 RISC Score

All of the 146 children admitted had a RISC score assigned to them based on the oxygen saturation, presence or absence of wheeze, ability to feed and their nutritional status. Thirty four (23.3%) children scored zero, with 23 (15.8%) children scoring one. Most of the children had a score of two (32.9%) and three (18.5%). The study found 13 children (8.9%) had a score of four with one child having a score of five and one with a score zero (figure 3). The RISC score distribution is as shown below;

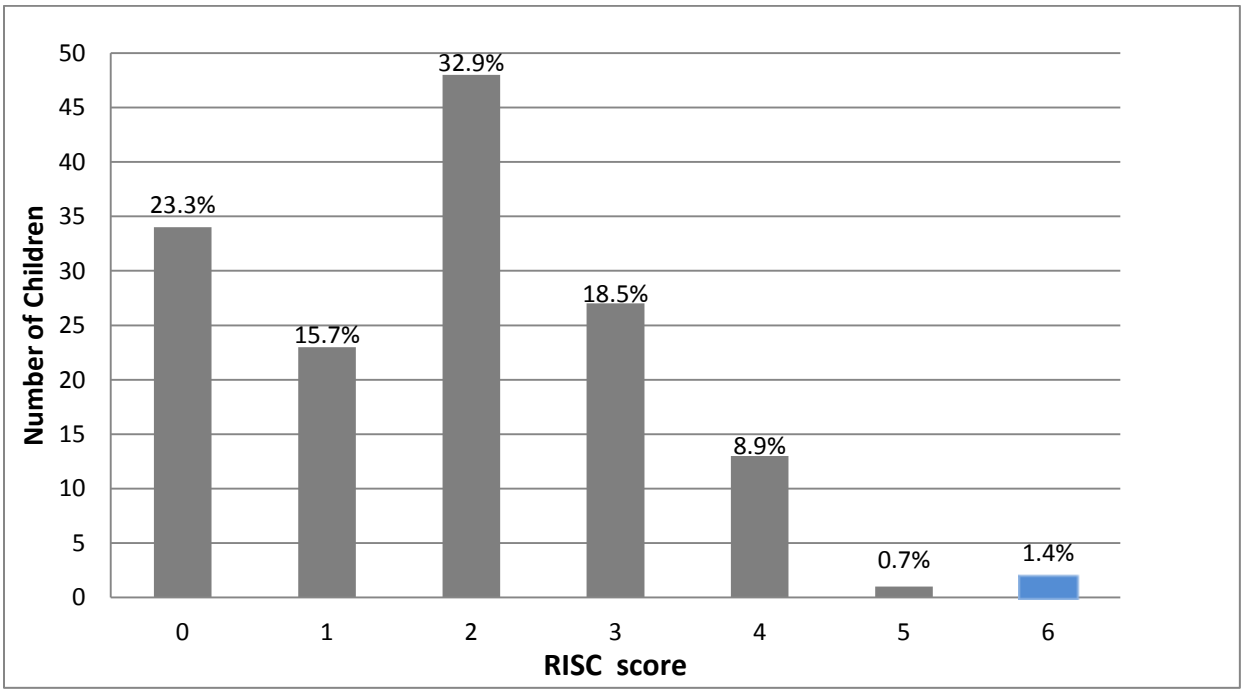

Figure 3: RISC score distribution and frequencies of the study population

5.3 Clinical Outcomes

The main measures of outcome in the study were recovery within seven days of admission, prolonged hospital (more than seven days), need for mechanical ventilation and death. Of the 146 participants, 89 (61%) were allowed home within seven days of admission, 50 (34.3%) had a length of hospital stay of greater than a week, 6 (4.1%) children required mechanical venitilation and 1 (0.7%) patient died within the first week of admission. The study found 57 (39 %) of the study participants were classified to have a poor outocomes which we defined as death, mechanical ventilation or prolonged hospital stay of more than seven days.

This is as shown in figure below;

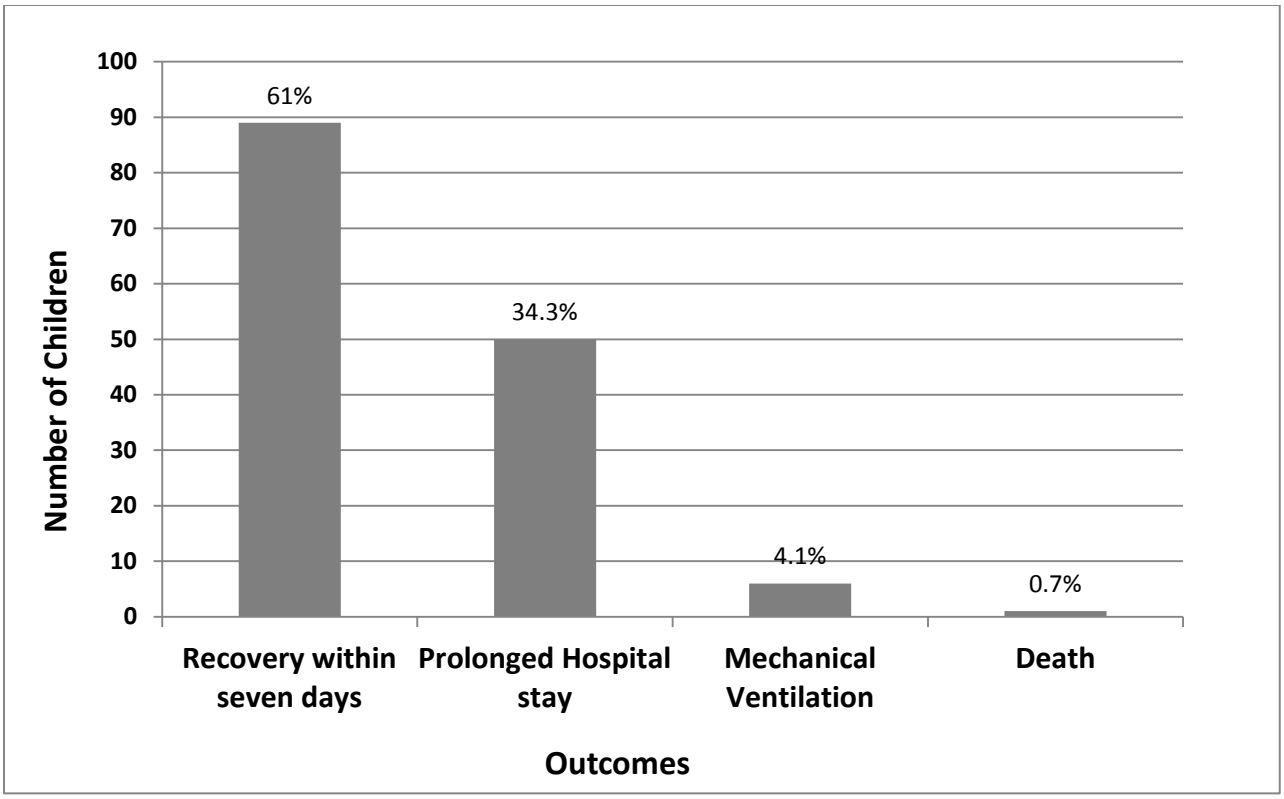

Figure 4: Clinical Outomes of study participants

5.4 Association between RISC Score and Poor Outcomes

The participants who had poor outcomes were grouped into three categories based on the RISC scores. 42% of the patients in the low risk category (0-1) had poor outcomes and 37% of patients in the moderate risk category had poor outcomes. This is as shown in the table below.

Table 5 Association between RISC score and clinical outcome

RISC SCORE	No. with Poor Outcome	No. children with score	Prevalence (95% CI) of Poor Outcome
0-1	24	57	42.1(30.1-55.0)
2-3	28	75	37.3(27.3-48.6)
>4	7	14	50(16.3-61.2)

The figure below is a graphical representation of the outcomes associated with each of the RISC scores.

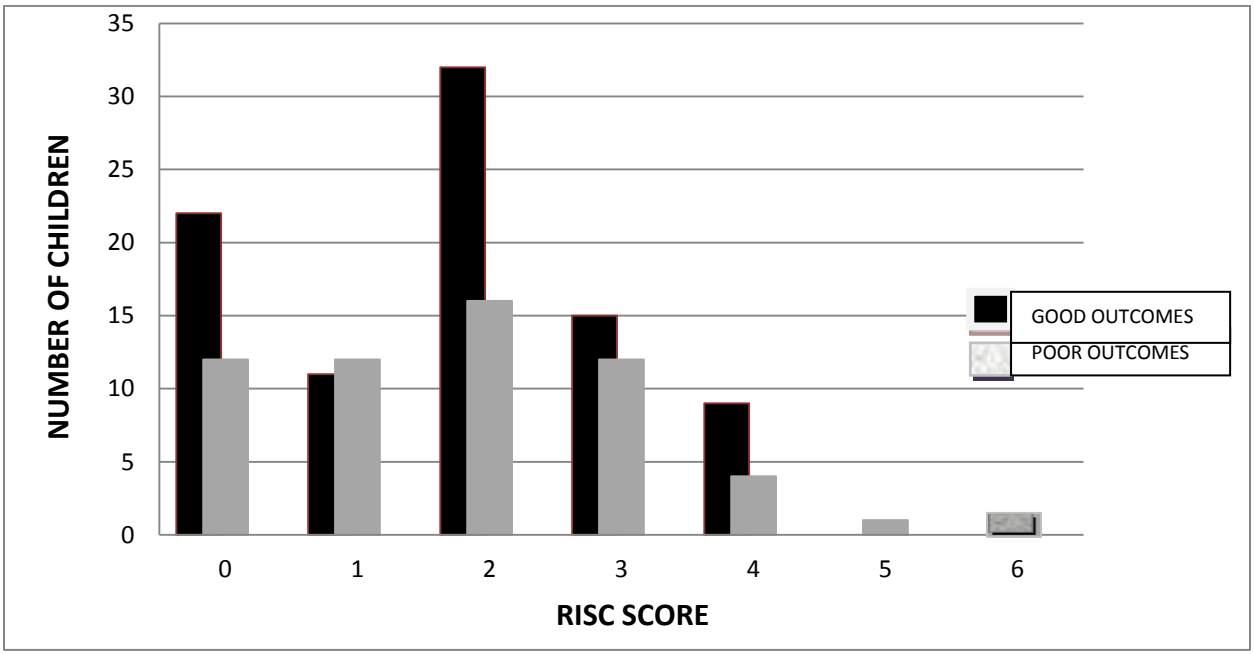

Figure 5 Outcome characteristics of the Modified RISC score

5.5 Validity of the RISC score

The study analyzed the RISC score to evaluate calibration. It was assessed using the Hosmer-Lemeshow goodness of fit test. The calibration was assessed by plotting the observed proportion of events and predicted probabilities of events against the range of values of the modified RISC score (0 to 6). The results showed that the modified RISC score model was poorly calibrated. The score predicted mortality perfectly for higher risk groups based on the modified score (≥ 4) but performed poorly for values representing low risk (0 to 1) or moderate risk (2 to 3) of poor outcomes.

Although the modified RISC score was poorly calibrated, the Hosmer-Lemeshow test for goodness-of-fit provided evidence of differences between the observed and estimated frequencies (chi square = 4.45; DF=2; p value = 0.35).

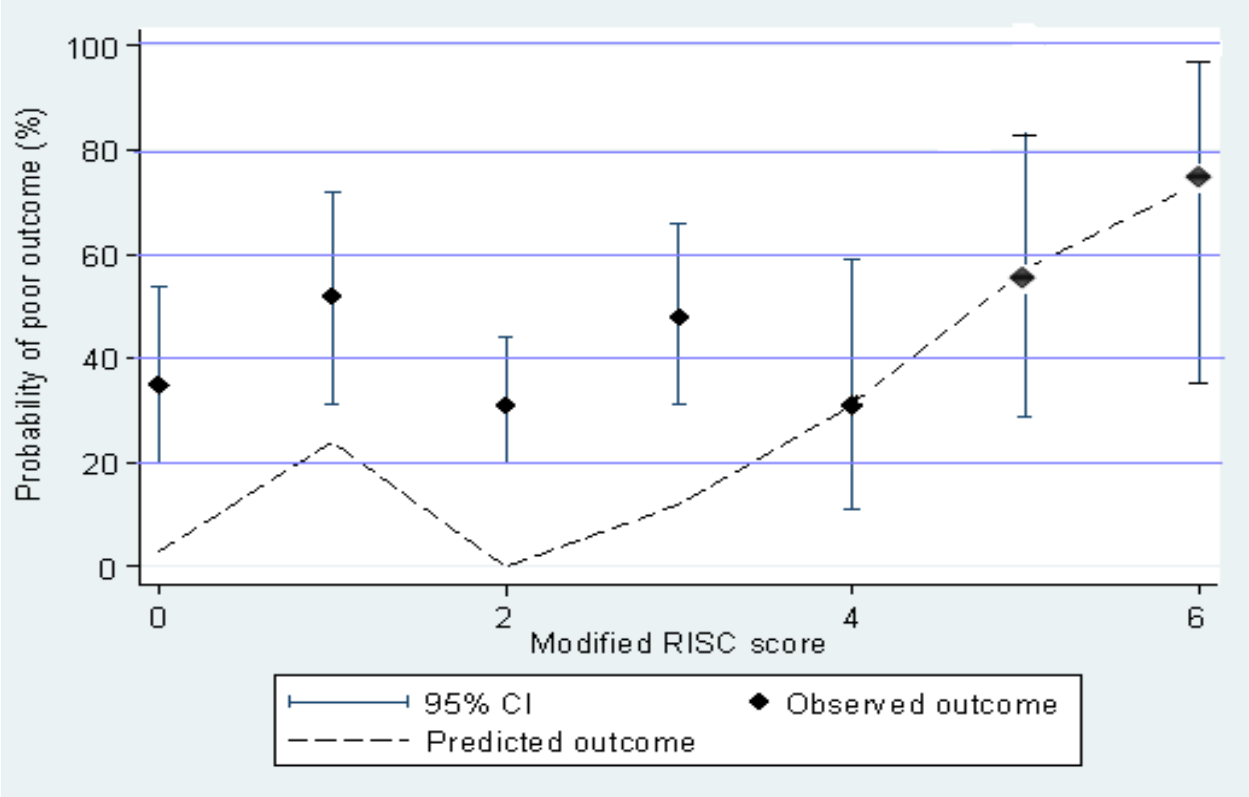

Figure 6 Observed poor outcomes (with 95% confidence intervals) and mean predicted outcomes by modified RISC score for children 12-59 months hospitalized with acute lower respiratory tract infections.

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6 DISCUSSION

This study focused on assessment of children admitted with lower respiratory tract infections age 2- 59 months. The patients were classified as low, moderate and high risk based on the assigned RISC score of 0-1, 2-3 and ≥ 4 respectively. The patients were followed up during the study duration and the observed outcomes (death, prolonged hospital stay and need for mechanical ventilation) were compared to the predicted outcomes based on the RISC score. Most of the study participants were in the low risk category. The study found 39% of the children to have poor outcomes with a mortality rate of 0.7 %. The score predicted poor outcomes well for patients in the moderate and the high risk category but not for the low risk group. Overall the score had significant differences in observed outcomes compared to what was predicted.

The children recruited in the study were found to have a median age of 10 months with 83% of the children aged less than 2 years. This is in keeping with other studies that severe forms of acute respiratory illness occur more commonly in younger children mainly below two years of age. (27). Locally, a research looking at short-term outcomes of pneumonia among children also found a median age of 8 months with similar male to female ratios(4). Nutritional status of the children was assessed using weight for height and found that 30% of the children had moderate or severe malnutrition. These rates resonated with local research that found a rate of 29 % (14). These rates are higher than those of the original RISC score study. The differences in nutritional status may be based on the fact that South Africa is a middle income economy with better socioeconomic status access to food.

Hypoxemia, which has been found in previous studies to be a significant cause of death in children with respiratory illnesses was found to be present in 5% of the study participants, these rates are lower in previous local data found that almost half of patients admitted with severe or very severe pneumonia had oxygen saturations of less than 90%. This may be due to the fact that we only switched off oxygen therapy for maximum of 30 seconds while measuring the saturations. The decision to keep patients on room air for maximum 30 seconds was made to prevent children's status from deterioration further thus in some patients a nadir oxygen saturation may not have been reached in 30 seconds. Prompt administration of oxygen prior to referral or after triage may also account for the lower rates in our study. This was noted as most sick patients were put on oxygen mainly via non-rebreather masks prior to referral and in the

emergency unit at triage even before review by the clinician and thus had improved saturations during recruitment.

Inability to feed which has been shown to be a predictor of mortality in children with respiratory tract infections was also assessed as part of the RISC score. It was found to be present in 11 % of the children. We noted that the rates were lower in our study than in previous local data. In a study by Maina *et al* which found an overall mortality of 13%, there was a strong association between inability to feed and mortality with 25 % of children admitted not being able to breast feed or drink. The low rates in our study of 11 % may account for the lower mortality rates recorded.

In terms of outcomes, the study assessed death, need for mechanical ventilation and prolonged hospital stay of greater than once week. The study found that 34 % of the children were hospitalized for greater than a week , this is different from studies by Tiewosh et al in India who had 20% of children hospitalized for more than five days in a similar study. The longer duration may be due to the fact that our setting was a national referral hospital and thus the children admitted may have been sicker and hence stayed longer. When this duration is compared to local data, Maina et al found 46 % of children admitted with lower respiratory tract infections took longer than a week in hospital. The reduction in our study may be explained by the prompt recognition of danger signs and early interventions following emergency treatment and improved admission care (23). We found 4% of children required mechanical ventilation. This group was much lower than in India where 20% of the children in a similar study received mechanical ventilation. The lower rates may be due to the fact that mechanical ventilation is not readily available in our setting. The case fatality rates from the respiratory tract infections were much lower than previously documented studies , we had a mortality rate of 0.7 % which is lower than studies by Maina et al who recorded a mortality rate of 13.7% (4) and Irimu et al who found a rate of 6.5% down (23). These rates were more comparable to that of the RISC score team that found a mortality rate of 1.3%. The median duration of stay for the children admitted with the respiratory tract infections in our study was 5.3 days. This was similar to what was found in other local studies which had a median duration of 5.2 days (4).

The RISC score was distributed between zero and five with a median RISC score of two. 38% of the patients had a score of 0-1 (low risk). This finding is lower to the original study in which

66% of the patients were in this category. We found that 9% of the children were in the high risk group score (≥ 4). The original South African study had 5 % of children in this category. In the South African study, this high risk group accounted for 25 % of the poor outcomes in the study. In our setting however the high risk group accounted for 9 % of the poor outcomes. For children with scores of ≥ 4 there was an increase in the trend of poor outcomes with worsening scores. This is in keeping with the original work in South Africa. The main difference between the modified score and the original score is between scores of 0-1, we observed higher rates of poor outcomes compared to the original scores. These differences may be to the fact that the RISC score does not capture other clinical signs like grunting and level of consciousness which may be present in the child and may be a predictor of poor outcomes as seen by studies by African countries which showed children with grunting were three times more likely to die (11). Local studies showed children with altered consciousness were twice more likely to die. (12).

To assess the performance of the modified score, we assessed the relationship between the observed and predicted outcomes to evaluate if there was a real difference. For scores of ≥ 4 the predicted and observed outcomes were similar. However for scores of less than 4 we observed much higher rates of poor outcomes than predicted by the model. Thus overall the model is shown to have a poor calibration. The modifications we made to the score to include a higher age cutoff of 59 months compared to 24 months in the original study and to include weight to height Z score in our model may also be contributing to the differences observed

6.5 Study Limitations

Despite an overall lower mortality rate among children in the study, this study was limited in capturing and excluding comorbid conditions and these may have had an effect on the overall outcomes. Children were referred while on oxygen supplementation or were put on oxygen supplementation at triage prior to recruitment. And thus the time lapses before review by the clinician and subsequent consent and recruitment may account for some of the high oxygen saturations recorded. The RISC score does not capture other factors that are associated with poor outcomes like grunting and altered consciousness which may significantly alter the outcomes.

6.6 Conclusions

1. The score in our setting ranged from zero to five with a median RISC score of two.
2. We recorded a mortality rate of 0.7 % from children admitted with acute lower respiratory tract infections, 35% of children hospitalized with acute lower respiratory tract infections had a hospital stay of greater than a week and 4% of children required mechanical ventilation.
3. The modified RISC score is a poor predictor of outcome in children hospitalized with acute lower respiratory tract infections. Overall it shows a difference between observed and predicted outcomes.

6.7 Recommendation

We recommend further studies with modifications on the RISC score incorporating other clinical signs and symptoms to make it a better screening tool to predict poor outcomes in children with acute lower respiratory infections in our setting.

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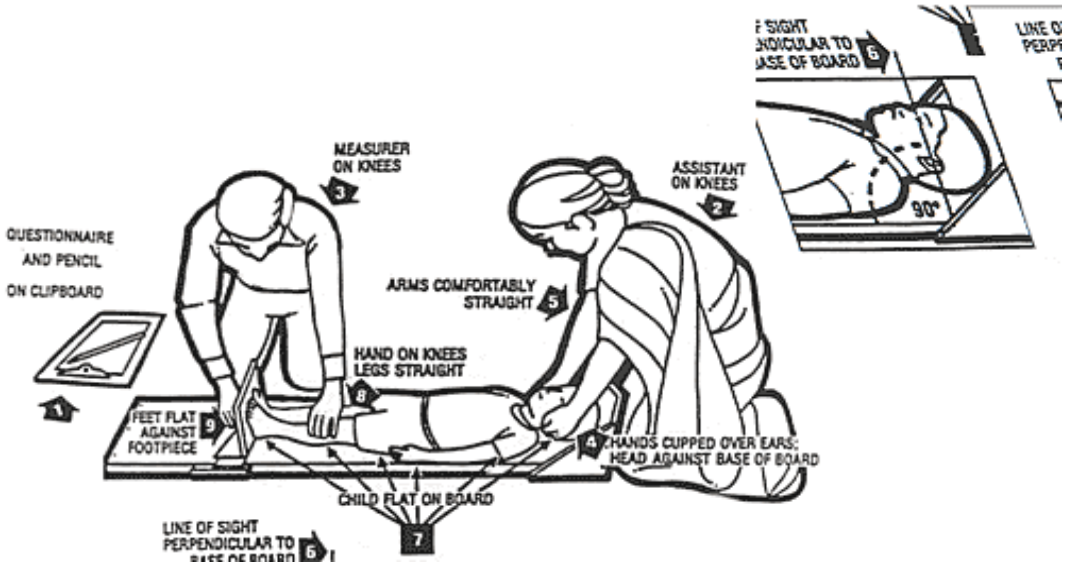
APPENDICES

Appendix 1: Procedure for measuring the recumbent length /height

EQUIPMENT

1. Cover the board with table paper.
2. Child should take off hats, shoes.
3. Place the sliding foot piece at the end of the measuring board and check to see that it is sliding freely.
4. Assistant lays the child down on his/her back on the measuring board and stands directly behind the child's head.
5. Child is held securely at the waist while the Assistant positions the he
6. Assistant places the child's head against the headpiece with head in the correct position. The line from the hole in the ear to the bottom of the eye socket (Frankfort Plane) should be perpendicular to the board or table.
7. Position the child's body so that the shoulders, back and buttocks are flat along the center of the board.
8. Firmly place the movable foot piece firmly against the child's heels
9. Ensure the head is against the headpiece with eyes looking straight up, body and legs straight and flat in the center of the measuring board, heels and feet firmly against the foot piece.
10. Read the measurement against the foot piece.
11. For children taller than 87 cm the board is placed upright and the child stands upright with the head, shoulders, buttocks, knees and heels held against the board by an assistant.
12. Length and height are measured to the nearest 0.1 cm



APPENDIX 2: PROCEDURE FOR PULSE OXIMETRY

Principle

Pulse oximetry by placing a pulsating arteriolar vascular bed between a dual light red and infrared source and a photo detector. The detector records the relative amount of each color absorbed by arterial blood and transmits this to the display. It is a non-invasive mode of monitoring for oxygen saturation (SaO2). For this model, the pulse oximeter SpO_2 readings compared to SaO_2 values of drawn blood samples measured by hemoximetry was within ± 2.5.

Equipment

Portable battery powered pulse oximeter (Nellcor N600).

Procedure

1. Explain to the parent or caregiver on what you want to do and the benefit.
2. Ensure child is clam.
3. Select finger to put the probe- without nail polish.
4. Hold probe in position until a reading is obtained.
5. Document the reading.
6. Repeat the procedure after one minute.
7. Record the average of the two readings.

Nellcor Oximax® N600 users guide.

Appendix 3: Using WHO Anthro Version 3.2.2

The software is available free of charge on the WHO website

Anthropometric data needed

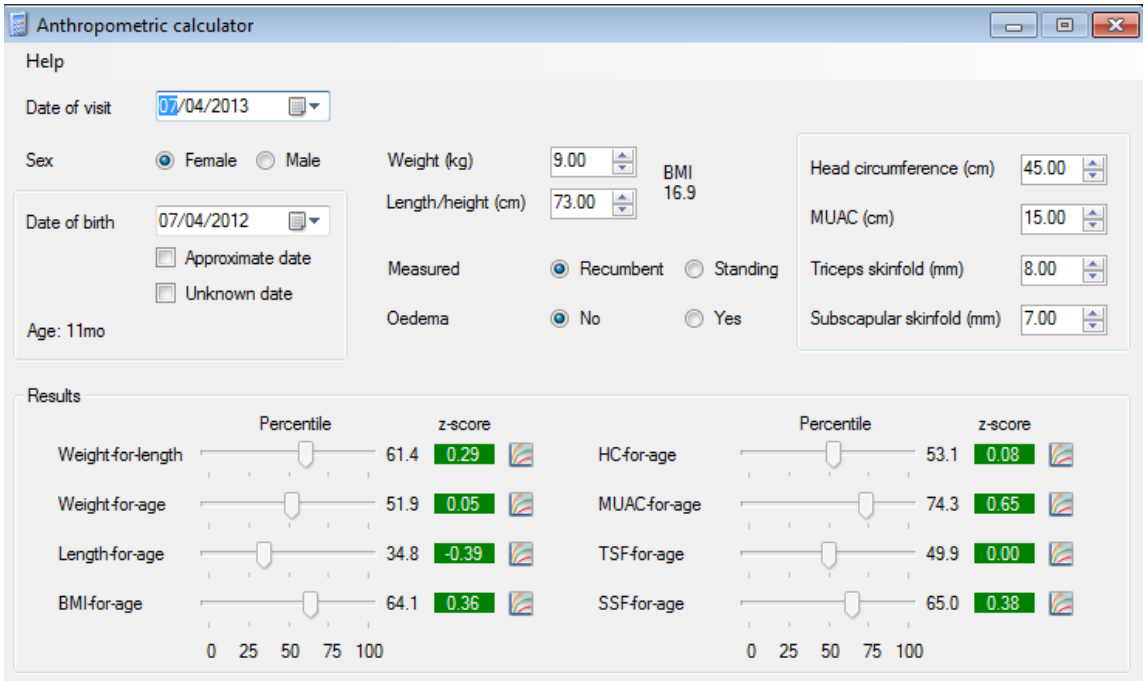
1. Weight
2. Height
3. Childs date of birth.

Procedure

1. Insert the child's demographic and anthropometric values on the tabs as marked on the software.

2. The data is automatically calculated to display the Weight for Age, Weight for height and the percentiles.

Below is a screen view of the software;



APPENDIX 4: ENROLMENT QUESTIONNAIRE

Patient ID number: __ __ __ - __ __ __ __ Date (dd/mm/yyyy): ____/____/____

Hospital's admission number_____

Interviewer's initials: _____

PART ONE: Socio-demographic Information

1 .Date of Birth (DOB) dd/mm/yyyy: _ _ / _ _ / _ _ _ _

2. Age in months

3. Gender: ❑ Male ❑ Female

4. Current Weight _____ kilograms (nearest one decimal place)

5. Height: ____cm

6. Weight for Age Z score $Z \geq -2$ ❑ $-2 \leq Z < -3$ ❑ $Z \leq -3$ ❑

7. Weight for Height Z score $Z \geq -2$ ❑ $-2 \leq Z < -3$ ❑ $Z \leq -3$ ❑

8. Mid Upper Arm circumference <11.5 cm ❑ 11.5-12.4 cm ❑ 12.5-13.4cm ❑ >13.5cm ❑

PART 2: Clinical Description

9. Date hospitalized with current illness dd/mm/yyyy _ _ / _ _ / _ _ _ _

10. How many days after the illness began did you first seek medical advice or treatment? _____

11 Tick if following diagnosis is made

a. Pneumonia Yes ❑ No ❑

If Yes, Classify ❑ Non Severe ❑Severe ❑Very severe ❑ Not classified

b. Brochiolitis Yes ❑ No ❑

c. Laryngotracheobronchitis (LTB) Yes ❑ No ❑

d. Other acute LRTI (specify)

13. Respiratory rate: _____ breaths per minute (count for full minute)

14. Oxygen saturation ___% 15. Heart Rate _____

16. Current axillary temperature ___^{0}C

Does the patient have the following symptoms or signs with this illness (caretaker's perception)?

17. Cough Yes ❑ No ❑ Don't Know ❑

18. Difficulty in breathing Yes ❑ No ❑ Don't Know ❑

19. Chest pain on breathing Yes ❑ No ❑ Don't Know ❑

20. Wheezing Yes ❑ No ❑ Don't Know ❑

Complete the following after examining the child: Is the child,

21. Unable to drink or breastfeed at all Yes ❑ No ❑ Don't Know ❑

22. Vomits everything Yes ❑ No ❑ Don't Know ❑

23. Grunting Yes ❑ No ❑ Don't Know ❑

24. Chest in-drawing (retractions under ribcage on inspiration) Yes ❑No❑Don't Know ❑

25. Nasal flaring Yes ❑ No ❑ Don't Know ❑

26. Cyanosis Yes ❑ No ❑ Don't Know ❑

28. Severe palmar pallor Yes ❑ No ❑ Don't Know ❑

29. AVPU Scale Alert ❑ Responds to voice ❑
Responds to pain ❑ Unresponsive ❑

30. Has the patient been prescribed and taken antibiotics in the 24 hours before this admission?

❑Yes ❑ No ❑Don't Know

31. If yes, what is the name of the antibiotic? _____

Part Three

Fill as appropriate

RISC SCORE			Patient's points
Severity of respiratory signs on physical exam	If O2≤90%	3 points	
IF O2 saturation >90% with chest Wall indrawing		2points	
Presence of wheeze		-2points	
Refusal to feed		1 point	
GROWTH STANDARDS			
Weight For Height Z Score			
	Z≤-3	2 Points	
	-2≤Z<-3	1 Point	
	Z≥-2	0 Points	
TOTAL POINTS		6	

APPENDIX 5: FOLLOW-UP QUESTIONNAIRE

PART TWO: Outcome

33. What was the outcome?

□ Discharge □ Death □ Mechanical ventilation

34. Number of Days from Admission to outcome _____

APPENDIX 6: CONSENT FORM

STUDY TITLE

PERFORMANCE OF THE RESPIRATORY INDEX OF SEVERITY IN CHILDREN (RISC) SCORE TO PREDICT POOR OUTCOMES IN CHILDREN ADMITTED LOWER RESPIRATORY TRACT INFECTIONS AT KENYATTA NATIONAL HOSPITAL.

INVESTIGATORS: DR MICHUKI MAINA, PROF E. OBIMBO, DR. G IRIMU, DR. A LAVING

CONTACT TELEPHONE OF PRINCIPAL INVESTIGATOR: DR MICHUKI MAINA 0722 248890

Dear **Parent/Guardian**,

I am a postgraduate student at the University of Nairobi, College of Health Sciences, pursuing studies leading to specialization in Paediatrics and Child Health. I wish to request for your permission, for you and your child to participate in a study that will form part of my degree work

The study will involve requesting you to answer some questions from a structured questionnaire. This will be recorded and analyzed for research purposes only. Your identity and that of your child will be kept confidential.

The results of the study shall be used tool guide policy makers and other stakeholders on how to improve delivery of services.

Your participation is purely voluntary, there is no monetary gain and you may withdraw from the study at any stage, without any penalty.

It will not cost you anything to participate in this study.

If you have any questions about the study or about the use of the results you can contact the principal investigator, Dr Michuki Maina by calling 0722248890.

If you have any questions on your rights as a research participant you can contact the Kenyatta National Hospital Ethics and Research Committee (KNH- ESRC) by calling 2726300 Ext. 44355.

Consent Form: Participant's Statement:

I _____ having received adequate information regarding the study research, risks, benefits hereby AGREE / DISAGREE (Cross-out as appropriate) to participate in the study with my child. I understand that our participation is voluntary and that I am free to withdraw at any time. I have been given adequate opportunity to ask questions and seek clarification on the study and these have been addressed satisfactorily.

Parents/ Guardians Signature: _____ Date _____

I _____ declare that I have adequately explained to the above participant, the study procedure, risks, and benefits and given him /her time to ask questions and seek clarification regarding the study. I have answered all the questions raised to the best of my ability.

Interviewers Signature _____ Date _____

Jina langu ni Michuki Maina. Mimi ni mwanafunzi wa udakitari chuo kikuu cha Nairobi ili nifuzu kama dakitari mtaalamu wa magonjwa ya watoto.Naomba ruhusa yako ili kumhusisha mtoto wako katika utafiti. Utafiti huu unawahusisha watoto walio na magonjwa ya kifua na shida za kupumua.

Kwenye utafiti huu, utahitajika kujibu maswali kuhusu mtoto wako. Mambo yote kumhusu mtoto wako utakayotwambia yatahifadhiwa kwa siri na hakuna yeyote atakayejulishwa bila ruhusa yako. Utafiti huu unatarajia kuboresha matibabu ya mtoto wako na watoto wote wanotibiwa humu nchini.

Kumhusisha mtoto wako kwenye utafiti huu ni kwa hiari na hautalazimishwa. Uko huru kukataa ama kujiondoa hata kama ulikuwa umesajilishwa hapo awali.

Mtoto wako hatanyimwa matibabu yoyote kwa sababu ya utafiti huu.na utafiti huu hautakugharimu pesa yoyote.

Ikiwa una swali lolote kuhusu huu utafiti wasiliana nami kwa simu nambari 0722 248890

Ikiwa una maswali yoyote kuhusu haki zako ama za mtoto wako katika utafiti huu unaweza wasiliana na kitengo maalum cha utafiti cha Hosipitali ya Kenyatta kupitia nambari ya simu 2726300 Ext. 44355.

Ruhusa /Ridhaa Mimi _____ nimeelezewa kwa kina kuhusu utafiti huu, nimelezewa faida na hatari za kujihusisha na utafiti huu. Nimekubali /nimekataa kumhusisha mtoto wangu kwa huu utafiti.

Nimejihusisha kwa huu utafiti kwa hiari yangu na naelewa ya kwamba niko huru kukataa kuhusika na ninaweza jitoa wakati wowote

Sahihi ya mzazi ama mlezi_____ tarehe _____

Mimi _____ na dhibitisha ya kwamba nimemwelezea kwa kina kuhusu utafiti huu, nimeeleze faida na hatari za kuhusishwa kwenya utafiti huu. Nimeshughulikia maswali ama wasiwasi wowote wa mzazi/mlezi kuhusu utafiti huu

Sahihi ya dakitari /mpelelzi _____ tarehe _____

UNIVERSITY OF NAIROBI
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KENYATTA NATIONAL HOSPITAL
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Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/157

6th June 2013

Dr. Maina Jackson Michuki
University of Nairobi
Dept. of Paediatrics & Child Health

Dear Dr. Maina

RESEARCH PROPOSAL: PERFORMANCE OF A MODIFIED RESPIRATORY INDEX OF SEVERITY IN CHILDREN [RISC] SCORE TO PREDICT POOR OUTCOMES IN CHILDREN ADMITTED WITH LOWER RESPIRATORY TRACT INFECTIONS AT KENYATTA NATIONAL HOSPITAL (P213/5/2013)

This is to inform you that the KNH/UoN-Ethics & Research Committee (KNH/UoN-ERC) has reviewed and **approved** your above proposal. The approval periods are 6th June 2013 to 5th June 2014.

This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH/UoN ERC before implementation.
c) Death and life threatening problems and severe 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.
d) 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.
e) 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*).
f) Clearance for export of biological specimens must be obtained from KNH/UoN-Ethics & Research Committee for each batch of shipment.
g) 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 **www.uonbi.ac.ke/activities/KNHUoN.**

Yours sincerely

PROF. M. L. CHINDIA
SECRETARY, KNH/UON-ERC

c.c. Prof. A.N. Guantai, Chairperson, KNH/UoN-ERC
The Deputy Director CS, KNH
The HOD, Records, KNH
Principal College of Health Sciences, UON
Supervisors: Dr. Elizabeth Maleche Obimbo, Dr.Grace W. Irimu, Dr. Ahmed Laving