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# A STUDY OF SIMPLE PREDICTORS IN IDENTIFYING BACTERIAL PNEUMONIA IN CHILDREN AGED 6 MONTHS TO 60 MONTHS

**Paediatrics**

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## ABSTRACT

Acute Respiratory Infections (ARI) have quite a high morbidity and mortality in children in developing countries. Our study concluded that hyper-reactive airway disease can be differentiated from pneumonia, to a reasonable extent on the basis of clinical features like fever, RR, and simple investigation like leukocyte count. This may help in rational management with antibiotics, bronchodilators and steroids in these children. This study offers possibility of redefining the current algorithm by incorporating simple predictors that have potential application to the para-medical personnel. In this context, the feasibility of simplified delivery of aerosolized bronchodilator therapy through a metered dose inhaler and nebulizer merits exploration. Prevention of over-use of antibiotics and the obvious economic advantage are the major advantages of the refined / re-defined algorithm used.

## KEYWORDS

Simple predictors, Bacterial pneumonia,Children aged 6 months to 60 months.

## INTRODUCTION

Acute Respiratory Infections (ARI) have quite a high morbidity and mortality in children in developing countries. On an average, children below 5 years of age suffer about 5 episodes of ARIs annually regardless of, where they live, or what their economic situation is.Acute respiratory infections (ARIs) are classified as upper respiratory tract infection (URIs) or lower respiratory tract infections (LRIs). The World health organization with estimates that 2 million children under five die of pneumonia in each year (Bryce and others 2005).They include Rhinitis (Common cold), sinusitis, ear infections, acute pharyngitis or tonsillo pharyngitis, epiglotitis and laryngitis of which ear infections and pharyngitis cause the more severe complications (deafness and acute rheumatic fever respectively). Acute Pharyngitis is caused by viruses in more than 70 percentage of cases in young children. Acute ear infection occurs with upto 30 percent of URIs. In developing countries with inadequate medical care, it may lead to perforated eardrums and chronic discharge in later childhood and ultimately to hearing impairment or deafness. The common LRIs in children are pneumonia and bronchiolitis. Both bacteria and viruses can cause pneumonia. Bronchiolitis occurs predominantly in the first year of life with decreasing frequency in the second and third years.

### Interventions:

Interventions to control ARIs can be divided into four basic categories: Immunization against specific pathogens.Early diagnosis and treatment of disease.Improvement in nutrition.Safer environments.

### Vaccinations:

Widespread use of vaccines against measles, diphtheria, pertussis, Hib, pneumococcus, and influenza have the potential to substantially reduce the incidence of ARIs in children in developing countries. The initial guidelines for detecting pneumonia based on rapid breathing were developed in Papua New Guinea during the 1970s. WHO recommends a respiratory rate cut-off of 50 breaths per minute for infants aged 2 through 11 months and 40 breaths per minute for children age 12 months to 5 years. The choice of an antimicrobial drug for treatment is based on the well established findings that most childhood bacterial pneumonia are caused by S. pneumoniae or H. influenza. WHO has technical documents to help assess the relevant factors in selecting first and second line antimicrobials and comparisons of different microbials in relation to their antibacterial activity, treatment efficacy and toxicity.

### Study Justification:

Most of the fevers with respiratory illness are virus associated and self limiting. Routine blood investigation and radiological imaging are not required and increases the cost of the treatment. This study is expected to describe the distribution of disease in fever with respiratory distress in tertiary care hospital, to find additional markers to identify and predict pneumonia in children with tachypnoea.

### Aim Of The Study:

To re-define or refine tachypnea as a specific indicator of bacterial pneumonia. To identify other clinical predictors for identifying bacterial pneumonia.

## MATERIAL AND METHODS

The study was designed to be done in two phases. In the first phase it is to be carried out as a descriptive study of children presenting with fever and respiratory distress in the OPD to identify the specific markers for bacterial pneumonia. In the second phase presenting clinical features in children with radiological pneumonia will be analysed to validate the findings from Phase I(100 Children).

### Inclusion Criteria:

Children in the age group 6 months to 5 years with pneumonia as defined by the WHO i.e. children with the following symptoms:Fever <5 days and Cough & cold < 1 week,Age specific tachypnea with or without lung signs (wheeze or crepts) i.e. ≥50 breaths/min in 2 months to 11 months, ≥40 breaths/min in 12-60 months,Indrawing of chest.

### Exclusion Criteria:

Child with severe illness as defined by WHO like not able to take oral feed, stridor in a calm child, severe malnutrition, convulsions, abnormal sleepy, Children with an established diagnosis of bronchial asthma, Children who had similar illness in the last 2 weeks, Antibiotics used in the last 2 weeks. Children with established diagnosis of other chronic illness like congenital heart disease, tuberculosis.Immunodeficient children, or on steroid therapy.Children with respiratory failure. Children who were intubated and ventilated. Children requiring inotropic support.

### Manoeuvre:

Children in the age group of 6 months to 5 years satisfying the above criteria were enrolled in this phase of the study. A lower age limit of 6 months was used because the diagnosis of hyper-reactive airway disease below this age is uncommon and the likelihood of pneumonia is more in younger infants. Children attending the out-patient department on a fixed day of the week (Monday) and who come under the study population during the study period were admitted and recruited in the study and informed verbal consent for participation was taken from the parents.

### Clinical and Investigative Evaluation:

The detailed clinical evaluation of these subjects, done by a single

observer was recorded on the proforma. Special emphasis was given to symptoms like cough, fever, nasal discharge, tachypnea, chest indrawing, and refusal of feeds.

**On physical examination:**
The following were specifically looked for, Toxic look (investigator's impression),Temperature: Axillary temperature (in degree Celsius) was recorded for 3 minutes.Pulse rate: Counted by palpating radial pulse for 60 seconds. Respiratory rate: Counted by observing the movement of chest and abdomen for 60 seconds in an awake but quite child. Chest indrawing by observing the inward movement of the bony structure of the lower chest wall during inspiration.Nasal discharge if present was classified into watery, mucopurulent or purulent.Examine chest to look especially for breath sounds and added sounds like crepitations and wheeze. For wheeze, it was also ascertained prior to auscultation, whether the sound was audible without the stethoscope. i) Abdomen- Liver and spleen were noted. ii) Other systemic examination was also conducted.Investigations performed in all subjects include chest roentgenogram and total count and peripheral smear.

**Treatment:**
All cases admitted were given supportive treatment, which include-oxygen, if not maintaining saturation,antipyretics, if febrile, intravenous fluids, if not able to take orally,bronchodilators (aerosolized beta-2-agonist), or steroids if wheeze is present.Normal saline nasal drops if nasal symptoms are present,The cases were monitored for any worsening or improvement every 6$^{th}$ hourly on day 1 and vital parameters were monitored. When the clinical condition is not improving or x-ray chest suggests pneumonia, antibiotics were started.

**Radiological Evaluation:**
Evaluation of the chest was done by a radiologist who was unaware of the clinical diagnosis.

**Phase – II(**50 children).

**Inclusion criteria:**
Children of both sexes in the age group 6 months to 60 months with radiologically diagnosed pneumonitis and pneumonia

**Exclusion criteria:**
Child with severe illness as defined by WHO like not able to take oral feed, stridor in a calm child, severe malnutrition, convulsions, abnormal sleepy, Children with an established diagnosis of bronchial asthma, Children who had similar illness in the last 2 weeks, Antibiotics used in the last 2 weeks. Children with established diagnosis of other chronic illness like congenital heart disease, tuberculosis. Immunodeficient children, or on steroid therapy. Children with respiratory failure, Children who were intubated and ventilated, Children requiring inotropic support.

**Manoeuvre:**
Children attending the out-patient department on a fixed day of the week (Monday) and who come under this study population during the study period were admitted and recruited in the study and informed verbal consent for participation was taken from the parents. Their clinical profiles were recorded as in phase I. All children coming under this study population were given antibiotics and supportive treatment. The cases were monitored for any worsening or improvement every 6$^{th}$ hourly on day 1 and vital parameters were monitored.

**Diagnostic Definitions:Pneumonia:**
Fever of more than 100$^{o}$F with cough alongwith respiratory distress, crepts, and/or wheeze and Chest X-ray evidence of pneumonia.

**Asthma:**
First attack of wheeze after 1 year of age fulfilling following criteria: wheeze, Absence of pulmonary infiltrates on chest x-ray, Absence of polymorphonuclear leucocytosis or bandemia on peripheral smear. Rapid clinical improvement on bronchodilator therapy without antibiotics.

**Bronchiolitis:**
According to the WHO guidelines, the first attack of wheeze in early infancy is regarded as bronchiolitis. This definition of bronchiolitis was utilized if the peripheral smear failed to reveal a polymorphonuclear response or bandemia or an X ray evidence of bow sign was present.

**Statistical Analysis:**
Results were tabulated and percentage proportion for epidemiological and clinical symptomatolgy were arrived. For both groups comparative student's 't' test was used to compare the data between the pneumonia group and no pneumonia group. p-value $<0.05$ was considered significant. Receiver- operator characteristic (ROC) curve done for temperature, respiratory rate and leucocyte count was done to define cut-off point to predict pneumonia using SPSS software.

## RESULTS

**In Phase – I:**
Children recruited with WHO defined pneumonia – 100 and Children with WHO defined pneumonia having x-ray evidence of pneumonia – 5.In

**Phase – II:**
Children identified to have x-ray evidence of pneumonia 50.In WHO defined pneumonia group, 39 children (39%) were between 6 months to 11 months, and 61 children (61%) were between 12-60 months. In radiologically defined pneumonia group, 23 children (46%) were in the age group 6-11 months and 27 children (54%) were in the age group 12 months to 60 months.There was equal distribution of the study population between both the sexes. No sexual preference was noted in ARIs. In child with WHO defined pneumonia, there were 56 males (56%) and 44 females (44%). In radiologically defined pneumonia group, there were 26 male children (52%) and 24 female children (48%). The male female ratio was 56:44 (1.27:1) in the phase I study, and 52:48 (1.08:1) in the phase II study. This difference is not statistically significant.

**Clinical Examination:**
In Phase I study group, tachypnea and cough were present in all children. Fever was present in 63% and subcostal and intercostal retractions were identified in 68%. Wheeze and crepitations are seen in 82% and 88% respectively. Majority of the children had nasal block or nasal discharge (76%). The above-said symptoms were significantly higher in the phase I study than the phase II study. In phase II study, cough, tachypnea and crepitations were seen in all children. Fever was the predominant symptom in 86% and retractions in 76% of the study population. In WHO defined pneumonia group, leucocytosis was present in 22 children.(22%) In radiologically defined pneumonia group, 36 children (72%) have leukocytosis.Comparisons of children with no pneumonia and pneumonia In view of the fact that majority of the x rays were normal and we have a group where there is a x ray evidence of pneumonia, an attempt was made to define those who are likely to have bacterial pneumonia with the three parameters namely, respiratory rate, fever and leukocytosis.Mean respiratory rate for 6-11 months were $55 \pm 2$ in no pneumonia group and $56 \pm 2$ in pneumonia group. Mean temperature for 6-11 months were $37 \pm 0.7$ in no pneumonia group and $38.2 \pm 0.5$ in pneumonia group. Mean leukocyte count for 6-11 months were $14418 \pm 2568$ in no pneumonia group and $17708 \pm 1750$ in pneumonia group.Mean respiratory rate for 12-60 months were $44 \pm 2$ in no pneumonia group and $46 \pm 2$ in pneumonia group. Mean temperature for 12-60 months were $37.2 \pm 0.8$ in no pneumonia group and $38.2 \pm 0.4$ in pneumonia group. Mean leukocyte count for 12-60 months were $12016 \pm 2638$ in no pneumonia group and $15304 \pm 2148$ in pneumonia group.The ROC was developed to predict the cut-off values for respiratory rate, temperature and leukocytosis.

**Outcome:**
Children with no pneumonia treated only with supportive care showed symptomatic improvement in wheeze and respiratory distress in 10-14 hrs with quick response to bronchodilators and in bronchiolitis within 24-48 hrs and in bronchopneumonia within 2-4 days. No deaths were observed in both the study groups.

## DISCUSSION

Pneumonia was mainly diagnosed by clinicians based on clinical findings and x-ray evidence. Majority of the children in developing countries do not have access to either a skilled person or to radiological investigations. By the time they reach either of these, it is too late for the child with many fold increase in risk of mortality.It was such a scenario that various clinical parameters were assessed by various group of researchers, age specific tachypnea was identified as the single most sensitive indicator of pneumonia. This has been proved in

study conducted by V.P.Reddaiah and S.K.Kapoor in AIIMS in India. 47.7% of pneumonia occur in infants. 87.7% occurred in children below 3 years. Males had a relatively higher incidence of pneumonia (0.32 Vs 0.27). And it has been confirmed by this study. In our study, the infants constituted 46% of the total pneumonias and the 12 to 60 month age group constituted 54%. There is no sex prediction for the affliction with airway illness. Clinical triad of fever, breathlessness, and cough is common to both the groups as proved by our study. However among the No pneumonia group, fever, wheeze, and nasal discharge seem to be the commonest presentation. N.Shimojo et al study found that the association of wheezing illness with allergic rhinitis is about 35 to 48%. Three clinical parameters respiratory rate, fever and one lab parameter, leukocytosis are found to be significantly different between pneumonia and no pneumonia group especially after nebulisation. Thus if tachypnea, which is a simple clinical parameter which can be easily practised in primary care settings can be redefined and temperature, again a simple clinical parameter which can be easily practised to identify bacterial pneumonias, it could cause a significant reduction in cost of management and over-use of antibiotics and better utilization of supportive therapy. Receiver-operator characteristic curve was developed for the parameters of tachypnea, fever and leukocytosis. For the children 6-11 months, respiratory rate of 53.5 and above was found to predict pneumonia with a sensitivity of 83% and specificity 68.9% (95% C.I = 0.72, 0.93) (p-value:0.00). For children 12-60 months cut-off rate of 43.5 with a sensitivity of 80.8% and specificity of 45.5% (95% C.I. = 0.56, 0.81) (p-value:0.01).For children 6-11 months, temperature 37.6ºc and above was found to best predictor of pneumonia with sensitivity of 88% and specificity of 73.3% (95% C.I. = 0.79, 0.90) (p-value: 0.00). For children 12-60 months, the best cut-off value of temperature at 36.6ºc and above with sensitivity of 92% and specificity of 67.3% (95% C.I.=0.74, 0.91) (p-value:0.00). For children 6-11 months, leukocytosis of 16250 and above was found to predict pneumonia with sensitivity of 75% and specificity of 80% (95% C.I.= 0.76, 0.94) (p- value: 0.00). For the children 12 months to 60 months, leukocytosis of 13650 and above with sensitivity of 73% and specificity of 74.5% (95% CI=0.74, 0.91) (p-value = 0.00). The similar study done by Naresh Kumar et al in a tertiary care hospital found that 88% infants having bronchopneumonia had fever >100ºF and only 12% infants had temperature <100ºF. Presence of fever >100ºF had a sensitivity of 88% and specificity of 76% in the diagnosis of bronchopneumonia in a child having respiratory distress and wheeze. Leukocyte count was elevated in 17500 in 36 children in 50 cases of bronchopneumonia with sensitivity of 72% and specificity of 100%. Hence it is concluded by the study that any child <1 year presenting with respiratory rate ≥54 / minute and having temperature of 37.6ºc and above more likely suffer from pneumonia especially if rate is counted after nebulisation. Similarly any infant presenting with running nose, audible wheeze, respiratory rate <54, temperature <37.6°C is likely to present with viral or allergic airway disease.

## CONCLUSION

Our study concluded that hyper-reactive airway disease can be differentiated from pneumonia, to a reasonable extent on the basis of clinical features like fever, RR, and simple investigation like leukocyte count. This may help in rational management with antibiotics, bronchodilators and steroids in these children. This study offers possibility of redefining the current algorithm by incorporating simple predictors that have potential application to the para-medical personnel. In this context, the feasibility of simplified delivery of aerosolized bronchodilator therapy through a metered dose inhaler and nebulizer merits exploration. Prevention of over-use of antibiotics and the obvious economic advantage are the major advantages of the refined / re-defined algorithm used.

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