# Acute Respiratory Tract Infection among Children in Rural Parts of Ballabgarh - A Community Based Study

**A dissertation submitted in partial fulfilment of the requirements**

**for the award of**

**Post-Graduate Diploma in Health and Hospital Management**

**by**

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**May,2013**

## Certificate of Internship Completion

**Date:** 27-04-13

**TO WHOM IT MAY CONCERN**

This is to certify that **Dr. Vaibhav Rastogi** has successfully completed his 3 months internship in our organization from January 01, 2013 to April 01, 2013. During this intern he has worked on – **"Study of Acute Respiratory Tract Infection among children in rural parts of Ballabgarh - A Community based study (Age group < 10 years)"** under the guidance of me and my team at AIIMS.

We wish him/her good luck for his/her future assignments.

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## Certificate of Approval

The following dissertation titled **"Study of Acute Respiratory Tract Infection among children in rural parts of Ballabgarh - A Community based study ( Age group < 10 years)"** is hereby approved as a certified study in management carried out and presented in a manner satisfactory to warrant its acceptance as a prerequisite for the award of **Post-Graduate Diploma in Health and Hospital Management** for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein but approve the dissertation only for the purpose it is submitted.

Dissertation Examination Committee for evaluation of dissertation.

| Name | Signature |
|---|---|
| DR. BRIJENDER SINGH DHILLON | |
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| | |

## Certificate from Dissertation Advisory Committee

This is to certify that **Dr. Vaibhav Rastogi**, a graduate student of the **Post- Graduate Diploma in Health and Hospital Management**, has worked under our guidance and supervision. He is submitting this dissertation titled **"Study of Acute Respiratory Tract Infection among children in Rural parts of Ballabgarh - A Community based study (Age group < 10 years)"** in partial fulfilment of the requirements for the award of the **Post- Graduate Diploma in Health and Hospital Management**.

This dissertation has the requisite standard and to the best of our knowledge no part of it has been reproduced from any other dissertation, monograph, report or book.

17/05/2013

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## FEEDBACK FORM

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**Dissertation Organisation:** AIIMS.

**Area of Dissertation:** Health Research.

**Attendance:** Very Regular.

**Objectives achieved:** During the posting he was responsible for Supervisory field surveillance & reporting. He did this very well.

**Deliverables:** Report of field surveillance. & its presentation

**Strengths:** Hardworking, intelligent.

**Suggestions for Improvement:** Needs to be more academic if he is interested in continuing an academic career.

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**Date:** Delhi
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**ABSTRACT**

## Acute Respiratory Tract Infection among Children in Rural Parts of Ballabgarh – A Community Based Study

by

Dr. Vaibhav Rastogi

Acute respiratory tract Infection (ARI) comprises of upper respiratory and lower respiratory tract (also known as pneumonia) infections. Pneumonia is the leading single cause of childhood mortality. The disease accounts for 19 per cent deaths in children less than 5 years. Pneumonia kills more children than any other illness, more than measles, malaria and AIDS combined. Globally 156 million new pneumonia cases are reported every year in the developing world. This study tries to find the current incidence of acute respiratory tract infection in different age groups of children with special emphasis on acute lower respiratory infections and hospitalization due to ALRI. This study was conducted in four villages of Haryana where every under 10 years of child was weekly screened for ARI by field workers and assessed by nurses for ALRI (IMNCI guidelines). In this study it was found that about 88-90 % of ARI episodes are acute upper respiratory tract infections and 10 to 12 % of them are lower respiratory tract infections. The incidence of ALRI was highest till 2 years of age and then decreases as the child age progresses. The hospitalization rate due to pneumonia was 36-50 percent of all the total children who get hospitalised in less than 2 years of age. Hence pneumonia is still one of the major cause of morbidities in early childhood especially in infants and children less than 2 yrs as found in the study.

# ACKNOWLEDGEMENT

I have taken efforts in this project. However, it would not have been possible without the kind support and help of many individuals in the organization. I would like to extend my sincere thanks to all of them.

I am highly indebted to **Dr. Anand Krishnan (Additional Professor)** and **Dr. Debjani** (Senior Research Officer)**,** for their guidance and constant supervision as well as for providing necessary information regarding the project & also for their support in completing the project.

I am also grateful to each member of my project team for their constant support and help.

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# Table of Contents

# List of Figures

# List of Tables

# ABBREVIATIONS

| | | |
|---|---|---|
| 1. | ARI | Acute Respiratory Tract Infection |
| 2. | AURI | Acute Upper Respiratory Tract Infection |
| 3. | ALRI | Acute Lower Respiratory Tract Infection |
| 4. | Hib | Hemophilus Influenzae Type B |
| 5. | IMNCI | Integrated Management of Neonatal and Childhood Illnesses |
| 6. | HIV | Human Immunodeficiency Virus |
| 7. | WHO | World Health Organisation |
| 8. | PHC | Primary Healthcare Centre |
| 9. | CRHSP | Comprehensive Rural Health Centre |
| 10. | AIIMS | All India Institute of Medical Sciences |

# PART 1- INTERNSHIP REPORT

## 1.1 **ABOUT THE ORGANIZATION**

### 1.1.1 History

AIIMS was created in 1956 to serve as a nucleus for nurturing excellence in all aspects of health care. Creating a country imbued with a scientific culture was Jawaharlal Nehru's dream, and immediately after independence he prepared a grand design to achieve it. Among the temples of modern India which he designed, was a centre of excellence in the medical sciences. Nehru's dream was that such a centre would set the pace for medical education and research in Southeast Asia, and in this he had the wholehearted support of his Health Minister, Rajkumari Amrit Kaur.

The health survey and development committee ,chaired by Sir Joseph Bhore, an Indian Civil Servant ,had in 1946 already recommended the establishment of a national medical centre which would concentrate on meeting the need for highly qualified manpower to look after the nation's expanding health care activities . The dreams of Nehru and Amrit Kaur and the recommendations of the Bhore Committee converged to create a proposal which found favor with the government of New Zealand. A generous grant from New Zealand under the Colombo Plan made it possible to lay the foundation stone of All India Institute of Medical Sciences (AIIMS) in 1952.The AIIMS was finally created in 1956,as an autonomous institution through an Act of Parliament ,to serve as a nucleus for nurturing excellence in all aspect of health care.

All-India Institute of Medical Sciences was established as an institution of national importance by an Act of Parliament with the objects to develop patterns of teaching in Undergraduate and Post-graduate Medical Education in all its branches so as to demonstrate a high standard of Medical Education in India; to bring together in one place educational facilities of the highest order for the training of personnel in all important branches of health activity; and to attain self-sufficiency in Post-graduate Medical Education.

The Institute has comprehensive facilities for teaching, research and patient-care. As provided in the Act, AIIMS conducts teaching programs in medical and para-medical courses both at undergraduate and postgraduate levels and awards its own degrees. Teaching and research are conducted in 42 disciplines. **In the field of medical research AIIMS is the**

**lead, having more than 600 research publications by its faculty and researchers in a year.** AIIMS also runs a College of Nursing and trains students for B.Sc.(Hons.) Nursing post-certificate) degrees.

### 1.1.2 Departments

Twenty-five clinical departments including four super specialty centers manage practically all types of disease conditions with support from pre- and Para-clinical departments. However, burn cases, dog-bite cases and patients suffering from infectious diseases are not entertained in the AIIMS Hospital. **AIIMS also manages a 60-bedded hospital in the Comprehensive Rural Health Centre at Ballabgarh in Haryana and provides health cover to about 2.5 lakh population through the Centre for Community Medicine**. The Comprehensive Rural Health Services Project (CRHSP), Ballabgarh, situated in the state of Haryana in Northern India, was started in 1965 by the All India Institute of Medical Sciences in collaboration with the state government of Haryana. The field practice area of the project comprises of 28 villages catering to a population of 87052. Health Management System (HMIS) is a computerized management system introduced in the project in 1988. Demographic data, Maternal and Child Health Services data, and data pertaining to various health services provided in the area are stored.

### 1.1.3 Objectives of AIIMS

- To develop a pattern of teaching in undergraduate and postgraduate medical education in all its branches so as to demonstrate high standard of medical education to all medical colleges and other allied institutions in India.
- To bring together in one place educational facilities of the highest order for the training of the personnel in all important branches of the health activity to attain self sufficiency in postgraduate in medical education.

### 1.1.4 Functions of AIIMS

- Undergraduate and postgraduate teaching in medical and related physical biological sciences.
- Nursing and dental education

- Innovations in education.
- Producing medical teachers for the country.
- Research in medical and related sciences.
- Health care : preventive, promotive and curative; primary, secondary & tertiary.
- Community based teaching and research.

## 1.2 **AREAS ENGAGED IN AND TASKS UNDERTAKEN**

### 1.2.1 Routine or general management

Involved as a Research Officer in the project named "Epidemiological study of Respiratory pathogens in Acute respiratory tract infections among children in India" funded by CDC, Atlanta and INCLEN Trust International, India.

**Roles and responsibilities in the project**

- Operational Aspects of study
- Co ordination
- Supervision and Quality control
- Reporting and Technical issues

### 1.2.2 In The In-Depth Study

As a trainee worked on the project "Epidemiological Study of Respiratory Pathogens in Acute Respiratory tract infection among Children in India".

**Roles and responsibilities in the project**

- Development of standard operating procedures for field activities.
- Training of staff such as nurse, research officers.
- Organize timely procurements of study consumable items and ensure their regular supply.
- Liaise with SRO non medical for issues of sample collection and sample transport.
- Meet key community leaders and members from study area villages and secure their co-operation.
- Supervision of research officers, nurses , data managers.
- Prepare minutes of review meeting and submit to the Principal Investigator for finalization.
- Conduct review literature related to study.

## 1.3 Reflective Learning during Internship

- Designing tools for the survey
- Understanding the process of designing of community mobilization plan.
- Procedures for budgeting of community camps.

# PART 2- DISSERTATION REPORT

# Acute Respiratory Tract Infection among Children in Rural Parts of Ballabgarh – A Community Based Study

# CHAPTER 1- INTRODUCTION

## 1.1 Introduction

Acute respiratory tract infection (ARI) comprises of upper respiratory and lower respiratory tract (also known as pneumonia) infections. Pneumonia is the leading single cause of childhood mortality. The disease accounts for 19 per cent deaths in children in less than 5 years of age. Pneumonia kills more children than any other illness, more than measles, malaria and AIDS combined. Globally 156 million new pneumonia cases are reported every year in the developing world. As many as 8.7 per cent of these cases are severe enough to be life-threatening and require hospitalization. India accounts for the maximum 43 million new cases followed by China (21 million cases) and Pakistan (10 million cases). Pneumonia is estimated to kill 410,000 children in India every year.[1] .

Haemophilus influenza and Streptococcus pneumonia are the main causes of bacterial pneumonia and estimated to be the causative organisms for more than 50% of all childhood pneumonias. In addition some diseases, like measles and pertussis (whooping cough) can lead to pneumonia as a complication.[1]

It has been shown through various studies that mortality due to pneumonias could be decreased by interventions like prevention of pneumonia through immunization, early diagnosis and optimal case management, exclusive breastfeeding for six months, reducing indoor air pollution, preventive antibiotic treatment in HIV infected children and zinc supplementation.

## 1.2 RATIONALE OF THE STUDY

There is a need to undertake periodic surveys in various parts of the country to determine the incidence of ARI associated morbidity and mortality in children in order to plan, organise and evaluate the health services. The Government of India in its policy document of Health For All By 2000 A.D. recommends the ARI control programme to reduce infant and pre-school child mortality. There are few cohort studies which have been done on acute respiratory tract infections in rural community. Majority of studies are case-control studies which have been done in hospital setting. Hence there are many knowledge gaps associated with acute respiratory tract infections among children. Moreover ARI affects children till 10 years of age but major studies have been done in under 5 children hence to find the disease burden we have taken children below 10 years of age.

## 1.3 PROBLEM STATEMENT

The study tries to answer the following questions:

- ✓ What is the current incidence of acute respiratory tract infections among children (under 10) in rural community.
- ✓ Incidence of pneumonia among children (under 10) in rural community.
- ✓ To know how many children get hospitalized due to pneumonia.

## 1.4 REVIEW OF LITERATURE

Acute respiratory tract infection (ARI) is defined as an acute illness of the respiratory tract caused by an infectious agent transmitted from person to person. The onset of symptoms is typically rapid, over a period of hours to several days. Symptoms may include fever, cough, and often sore throat, coryza, shortness of breath, wheezing, or difficulty breathing.

Acute respiratory tract infection (ARI) can occur in any part of the respiratory system, from the middle ear to the nose to the lungs and are the major cause of under-five mortality worldwide. Acute upper respiratory infections (AURI) are those infections that affect the upper airways. These include acute manifestations of nasopharyngitis, pharingitis, sinusitis, middle ear infection, rhinitis, tonsillitis, epiglottitis, laryngitis and tracheitis. Acute lower respiratory infections (ALRI) are as those infections that affect the lower airways. These include acute manifestations of bronchitis, bronchiolitis, pneumonia, any combination of these, or any of these along with upper respiratory infections, including influenza. About 85-88% of ARI episodes are acute upper respiratory infections and 12 to 15 % of them are lower respiratory tract infections.[1] Acute respiratory infection (ARI) is the leading cause of death among children under five years of age in developing countries.

In the early 1970s Cockburn & Assaad[1] generated one of the earliest estimates of the worldwide burden of communicable diseases. In a subsequent review, Bulla & Hitze[2] described the substantial burden of acute respiratory infections and, in the following decade, with data from 39 countries, Leowski[3] estimated that acute respiratory infections caused 4 million child deaths each year – 2.6 million in infants (0–1 years) and 1.4 million in children aged 1–4 years. In the 1990s, also making use of available international data, Garenne et al.[4] further refined these estimates by modelling the association between all-cause mortality in children aged less than 5 years and the proportion of deaths attributable to acute respiratory infection. Results revealed that between one-fifth and one-third of deaths in preschool children were due to or associated with acute respiratory infection. The 1993 World Development Report[5] produced figures showing that acute respiratory infection caused 30% of all childhood deaths.

The increasing focus on the reduction of child mortality arising from the Millennium Declaration and from the Millennium Development Goal (MDG) 4 of "reducing by two-

thirds, between 1990 and 2015, the under-five mortality rate",[6] has generated renewed interest in the development of more accurate assessments of the number of deaths in children aged less than 5 years by cause. Moreover, the monitoring of the coverage of interventions to control these deaths has become crucial if MDG 4 is to be achieved; thus a more accurate establishment of the causes of deaths in children aged less than 5 years becomes crucial. In 2001, WHO established the Child Health Epidemiology Reference Group (CHERG) – a group of independent technical experts, to systematically review and improve data collection, methods and assumptions underlying the estimates of the distribution of the main causes of death for the year 2000.

**Incidence of clinical pneumonia**

Rudan et al.[8] calculated and published the first global estimate of the incidence of clinical pneumonia in children aged less than 5 years for the year 2000. This estimate was based on the analysis of data from selected 28 community-based longitudinal studies done in developing countries that were published between 1969 and 1999. These studies were the only sources meeting the predefined set of minimum-quality criteria for inclusion in the analysis.[8] The estimated median incidence for developing countries was 0.28 episodes per child-year, with an interquartile range 0.21–0.71 episodes per child-year.[8] The variation in incidence between the selected studies was very large, most probably due to the distinct study designs and real differences in the prevalence of risk factors in the various study settings. Given the substantial uncertainty over the point estimate. The ranges obtained by the main appraisal and two ancillary assessments overlapped between the values of 148 and 161 million new episodes per year. Giving most weight to the estimate obtained through the main approach, the analyses suggested that the incidence of clinical pneumonia in children aged less than 5 years in developing countries worldwide is close to 0.29 episodes per child-year. This equates to 151.8 million new cases every year, 13.1 million (inter quartile range: 10.6–19.6 million) or 8.7% (7–13%) of which are severe enough to require hospitalization.[8] In addition, a further 4 million cases occur in developed countries worldwide. The regions and their populations are defined by WHO region and child and adult mortality stratum [22].

It is of major public health interest to assess the distribution of these estimated 156 million episodes by regions and countries to assist planning for preventive interventions and case

management at community and facility levels, including vaccine and antibiotic needs and delivery. The 15 countries account for 74% (115.3 million episodes) of the estimated 156 million global episodes. More than half of the world's annual new pneumonia cases are concentrated in just five countries where 44% of the world's children aged less than 5 years live: India (43 million), China (21 million) and Pakistan (10 million) and in Bangladesh, Indonesia and Nigeria (6 million each).

Country estimates of the number of clinical pneumonia cases among children aged less than 5 years as assembled into six WHO regions (African Region, Region of the Americas, South-East Asia Region, European Region, Eastern Mediterranean Region and Western Pacific Region) as well as into developing and developed regions. Estimates of clinical pneumonia incidence are highest in South-East Asia (0.36 episodes per child-year), closely followed by Africa (0.33 episodes per child-year) and by the Eastern Mediterranean (0.28 episodes per child-year), and lowest in the Western Pacific (0.22 episodes per child-year), the Americas (0.10 episodes per child-year) and European Regions (0.06 episodes per child-year).

When prevalence of exposure was set to 1% (an idealized scenario roughly similar to that in the most developed countries of the world), the incidence computed by the model was less than 0.05 episodes per child-year. This estimate is lower than those reported in two classic reports of clinical pneumonia incidence among children in the United States of America and in the United Kingdom in the 1970s and 1980s, respectively, and is close to our current estimate for the year 2000 for the European Region.[28,29] When the prevalence of exposure was set to 99% (an unrealistic scenario at the country level, even for the poorest countries of the world) the incidence computed by the model was about 0.77 episodes per child-year. This estimate is slightly above the upper limit of individually reported pneumonia incidence from the 28 community-based studies from the developing world (75% inter quartile range estimate of 0.71 episodes per child-year). The model yields plausible estimates over a wide range of values of risk-factor prevalence, supporting its use for calculating the distribution of clinical pneumonia episodes.

**Under-five mortality**

Several attempts to understand worldwide child pneumonia mortality have been made over the past 30 years.[3–5,7,30] Despite the difficulties of producing estimates with available evidence, pneumonia has consistently been estimated as the leading single cause of childhood mortality. Some of the complexities for developing these estimates include large differences in case definition of pneumonia between studies, low specificity of verbal autopsies in community-based studies, the fact that similar symptoms from both pneumonia and malaria lead to death, difficulties in distinguishing pneumonia from sepsis in neonates and the synergy between several disorders leading to a single death.[31]

Two recent estimates of the total number of deaths due to clinical pneumonia have been made by CHERG. A single-cause model derived from 40 studies published between 1961 and 2000 and based on the relationship between the proportional mortality due to respiratory infections and the overall mortality in children aged less than 5 years, estimated the number of deaths attributable to childhood pneumonia to be 1.9 million in 2000.[7]However, the data sources used to model the relationship between pneumonia proportional mortality and all-cause mortality were not representative of the whole world as most of the studies were from Latin America and only a few data points were from countries with very high all-cause mortality. Moreover, many of them had been done more than three decades ago, in the 1960s and 1970s. A multiple-cause model that analysed 38 more recent studies (average mid study surveillance year of 1990) from sub-Saharan Africa and south Asia, in countries with mortality rates for children aged less than 5 years of at least 26 per 1000 live births, predicted a similar number of deaths attributable to pneumonia (i.e. approximately 1.8 million under-5 pneumonia deaths in these two regions in the year 2000).[32]

Some evidence suggests, however, that both models underestimate the number of deaths attributable to clinical pneumonia in children aged less than 5 years. Many neonatal deaths have been attributed to severe infections[33]that have not been taken into account in these models. The exact proportion of pneumonia among these infections has not been clearly established because of the difficulties in distinguishing causes among severe infections in newborns. However, at least another 300 000 deaths caused by pneumonia are likely to occur worldwide during the neonatal period (Lawn J, personal communication).

AFR, African Region; AMR, Americas Region; EMR, Eastern Mediterranean Region; EUR, European Region; SEAR, South-East Asia Region; WPR, Western Pacific Region.

The interquartile range for available case-fatality ratios was 1.3–2.6%, leading to an estimated 1.96–3.92 million expected deaths from pneumonia per year based on the basis of observed incidence.[8] Therefore, two lines of evidence both indicate that there are more than 2 million deaths due to pneumonia each year in children aged less than 5 years.

The relative importance of the different causes of death in children aged less than 5 years varies across regions of the world, although the major causes, such as pneumonia, remain the same. As with the incidence of pneumonia, mortality is unequally distributed.[6] The proportion of pneumonia-attributed deaths varies widely between WHO regions and significantly increases in relative importance in regions that have inefficient health systems.

The African Region has, in general, the highest burden of global child mortality. Although it comprises about 20% of the world's population of children aged less than 5 years,[22] it has about 45% of global under-5 deaths and 50% of worldwide deaths from pneumonia in this age group.[34] By contrast, less than 2% of these deaths take place in the European Region and less than 3% in the Region of the Americas. More than 90% of all deaths due to pneumonia in children aged less than 5 years take place in 40 countries. Even more striking is the fact that, according to the official estimates from WHO for the year 2000, two-thirds of all these deaths are concentrated in just 10 countries[34]: India (408000 deaths), Nigeria (204000), the Democratic Republic of the Congo (126000), Ethiopia (112000), Pakistan (91000), Afghanistan (87000), China (74000), Bangladesh (50000), Angola (47 000) and Niger (46000).

Although the absolute number of deaths provides important information regarding the global magnitude of the problem, it does not take into account the size of the population at risk and hence does not reflect the risk of death. For instance, while China has the seventh highest absolute number of pneumonia deaths in children aged less than 5 years, the mortality is about 8.6 per 10 000, whereas several countries have rates above 100 per 10 000.

Beyond inter-country inequities, further critical inequities are present within countries, where children from the poorest families, living in rural areas and whose mothers are less educated,

are those more likely to die from pneumonia. Data on the distribution of causes of death within countries from the demographic and health surveys done in Bangladesh in 2004 show differentials in mortality due to acute respiratory infections by divisions, place of residence (rural/urban) and mother's education. Deaths due to acute respiratory infections were proportionately more common in the Sylhet division and least common in Rajshahi, with a 1.4-fold difference between the two. These infections were also a more common cause of death in rural (22.3%) than in urban (16.8%) areas. Furthermore, acute respiratory infection was associated with a large proportion of deaths among children of mothers with no education.[35]

**Causes of pneumonia in children**

Childhood clinical pneumonia is caused by a combination of exposure to risk factors related to the host, the environment and infection. To identify the former two categories of causal factors for development of pneumonia at the community level. There is established categories of risk factors for childhood pneumonia: definite (most evidence consistently pointing to the role of the risk factor); likely (most evidence consistently pointing to the role, but with some opposing findings; or scarce but consistent evidence of the role); and possible (with sporadic and inconsistent reports of the role in some contexts). These risk factors for development of pneumonia, related to the host or the environment, are -

**Definite risk factors**

Malnutrition (weight-for-age)

Low birth weight (≤ 2500 g)

Non-exclusive breastfeeding (during the first 4 months of life)

Lack of measles immunization (within the first 12 months of life)

Indoor air pollution

Crowding

**Likely risk factors**

Parental smoking

Zinc deficiency

Mother's experience as a caregiver

Concomitant diseases (e.g. diarrhoea, heart disease, asthma)

Possible risk factors

Mother's education

Day-care attendance

Rainfall (humidity)

High altitude (cold air)

Vitamin A deficiency

Birth order

Outdoor air pollution

Before vaccines were available, the cause of childhood pneumonia was a matter of great interest as specific therapy was available for pneumococcal pneumonia of certain serotypes, requiring not only an etiological diagnosis for effective therapy, but also pneumococcal serotyping. Studies from that era identified *Streptococcus pneumoniae* (pneumococcus) and *Haemophilus influenzae* as the main bacterial causes of pneumonia, with some severe cases caused by *Staphylococcus aureus* and *Klebsiella pneumoniae*.[36] In the modern era, the causes of pneumonia in developing countries is based on two types of study. The first type consists of prospective hospital-based studies that have relied on blood cultures and, in some studies, of percutaneous lung aspiration.[37] Some other studies also examined nasopharyngeal specimens for virus identification.[38]This approach lacks sensitivity for the identification of bacterial cause. Attempts to augment culture-based methods with various indirect markers of bacterial cause have been largely unsuccessful as the tests employed have been unable to distinguish between carriage of pneumococcus and *H. influenzae*, which is usual for children in developing countries, and invasive disease.[39] The second type of study is the vaccine trial, in which the burden of pneumonia prevented by a specific vaccine is presumed to be a minimum estimate of the burden of pneumonia due to the organism against which the vaccine is directed.[40]

In prospective, microbiology-based studies, the leading bacterial cause is pneumococcus, being identified in 30–50% of pneumonia cases.[36,37,41–45] The second most common organism isolated in most studies is *H. influenzae* type b (Hib; 10–30% of cases), followed by *S. aureus* and *K. pneumoniae*. In addition, lung aspirate studies have identified a significant fraction of acute pneumonia cases to be due to *Mycobacterium tuberculosis*, which is

notoriously difficult to identify in children.[45] Controversy surrounds the role of three important organisms, non-typable *H.influenzae* (NTHI), *S.aureus* & non-typhoid *Salmonella* spp. NTHI was found to be an important pathogen in a lung aspirate study from Papua New Guinea,[43] whereas in a series of lung aspirate studies from the Gambia, and in most blood culture-based studies, Hib was the main type of *H. influenzae* identified.[37] Studies from Pakistan found NTHI to be a common blood culture isolate,[46,47] but this has not been replicated elsewhere. The first major study of the modern era that used lung aspiration on over 500 children in Chile, including normal controls, found *S. aureus* to be the main pathogen.[48] This finding has not been replicated in more recent studies, although a recently completed WHO study of very severe (hypoxaemic) pneumonia in seven countries found *S. aureus* in 47 of the 112 cases (42% of cases) in which a bacterium was identified, making it the second largest cause.[49] The role of non-typhoid *Salmonella* spp. is also unclear. Studies from Africa have shown bacteraemia caused by non-typhoid *Salmonella* spp. to be common[50,51] and often associated with malaria. Although the work of Graham et al.[52] in Malawi has implicated non-typhoid *Salmonella* spp. in radiological pneumonia cases, the role of these organisms in pneumonia is still unclear, as blood-culture studies have focused on children with fever and fast breathing and, therefore, may have identified children with bacteraemia only.[53]

The two causes of bacterial pneumonia that are vaccine-preventable are Hib and pneumococcus.[54–60] In both cases, the vaccines will prevent most pneumonia due to each pathogen, and microbiological methods will detect only a few cases. Thus, the vaccine probe concept has emerged to describe studies that are designed to determine the burden of pneumonia that can be prevented by the vaccine, and is therefore attributable to the organism. These studies have used the WHO definition of radiological pneumonia as the main outcome. For Hib, two randomized controlled trials,[54,55] one open trial,[56] a case–control study with random allocation of vaccine[57] and several other case–control studies have led to the conclusion that, in developing countries with a high burden of pneumonia, 15–30% of radiological pneumonia cases, and probably the same proportion of pneumonia deaths, are due to Hib. For pneumococcus, three randomized controlled trials in developing countries have shown that the nine-valent pneumococcal conjugate vaccine can prevent 20-35% of radiological pneumonia cases and probably similar proportion of pneumonia deaths.[58–60]

The newer pneumococcal vaccines covering 10–13 serotypes will likely extend this protection considerably. In addition, one of the vaccines contains elements that may prevent non-typable *H. influenzae* pneumonia as well. Thus, future pneumococcal vaccines may prevent 30–50% of radiological and fatal pneumonia. WHO has recently established modelled estimates of the number of pneumonia cases and deaths that are attributable to these organisms on a country-by-country basis. These estimates will be available soon (Kate O'Brien, Thomas Cherian and Maria D Knoll, personal communications).

Pneumonia etiology studies that incorporate viral studies show that respiratory syncytial virus is the leading viral cause, being identified in 15–40% of pneumonia or bronchiolitis cases admitted to hospital in children in developing countries, followed by influenza A and B, parainfluenza, human metapneumovirus and adenovirus.[38,61,62] In the prospective microbiology-based studies, viral causes of pneumonia are identified by rapid diagnostic tests (such as indirect immunofluorescence, enzyme-linked immunosorbent assay, polymerase chain reaction, viral culture on upper respiratory secretions – such as in nasopharyngeal aspirates – or by viral serology in paired samples).[38,61] It will be some time before any of these causes are preventable by routine immunization.

Weber et al.[38] made the most informative overview of respiratory syncytial virus. Because this virus is fragile, it is difficult to detect and its importance is probably underestimated. It was found in substantial frequency in all climatic and geographical areas, with sharp peaks of activity over a period of 2–4 months, but its seasonality varies considerably between regions. The peaks typically occur in the cold season in temperate climates and in the rainy season in tropical climates. Disease burden estimates from vaccine-probe studies are not yet available as for Hib and pneumococcus, but such data may become available from monoclonal antibody trials, which show high efficacy against severe disease caused by respiratory syncytial virus. Primary respiratory infection by this virus increases the risk of secondary bacterial pneumonia and viral or bacterial coinfection is a common finding in young children with pneumonia in developing countries (approximately 20–30% of episodes).[41,46.] Furthermore, episodes of wheezing due to reactive airways are more common after such episodes. Some two-thirds of the episodes are seen in the first year of life, with 1.5–1.8 times greater frequency in boys than in girls. This implies that any vaccination efforts would need

to be made early in life. The risk of pneumonia or bronchiolitis caused by respiratory syncytial virus is highest among children aged less than 2 years with the most severe disease occurring in infants aged 3 weeks to 3 months.[63,64] A recent postmortem study of lung tissue samples from 98 Mexican children aged less than 2 years who died of pneumonia, which used nested polymerase chain reactions, showed that 30% were positive for respiratory syncytial virus: 62% of those with histopathological diagnosis of viral pneumonia and 25% with diagnosis of bacterial pneumonia.[65] This study reaffirmed the role of respiratory syncytial virus as a very significant and potentially deadly pathogen that causes childhood pneumonia, both alone and through mixed infections with bacterial causes.

In recent years, the HIV epidemic has also contributed substantially to increases in incidence and mortality from childhood pneumonia. In children with HIV, bacterial infection remains a major cause of pneumonia mortality, but additional pathogens (e.g. *Pneumocystis jiroveci*) are also found in HIV-infected children,[66,67] while *M. tuberculosis* remains an important cause of pneumonia in children with HIV and uninfected children.[63] Available vaccines have lower efficacy in children infected with HIV, but still protect a significant proportion against disease.[67] Antiretroviral programmes can reduce the incidence and severity of HIV-associated pneumonia in children through the prevention of HIV infection, use of co-trimoxazole prophylaxis and treatment with antiretrovirals.[67]

Other organisms, such as *Mycoplasma pneumoniae*, *Chlamydia* spp., *Pseudomonas* spp., *Escherichia coli*, and measles, varicella, influenza, histoplasmosis and toxoplasmosis, also cause pneumonia. Most of them are not preventable, but immunization against measles, influenza and possibly use of bacille Calmette–Guérin (BCG) have probably contributed substantially to decreasing the pneumonia burden. There are few data on the causes of neonatal pneumonia in developing countries, but studies of neonatal sepsis suggest that these include Gram-negative enteric organisms, particularly *Klebsiella* spp, and Gram-positive organisms, mainly pneumococcus, group b *Streptococcus* and *S. aureus*.[68]

## 1.5 OBJECTIVE

### General Objective:

To study acute respiratory tract infections among children (under 10) in rural parts of Ballabgarh.

### Specific objective

1. To estimate incidence of acute respiratory tract infections among children (under 10) in rural community.
2. To estimate incidence of acute lower respiratory tract infections (ALRI) among children (under 10) in rural community.
3. To estimate the hospitalization rate among ALRI patients.

# CHAPTER 2 - DATA AND METHODS

**Study design-** Community based Prospective Longitudinal study

**Study Area-** 4 villages of Ballabgarh (Faridabad district)

**Study Population-** It included all children below 10 years of age.

**Sample Size-** 3197 (All children below 10 years of age were included in the study)

**Incidence of ALRI in various age groups:** The sample size calculation is based on study question to estimate burden of ARI due to specific major agents among under 5 children: influenza, RSV, human meta-pneumoviruses (HMPV), pneumococcus and *H. influenzae*. Various studies among under-five children have established an incidence of pneumonia as 0.25-0.5 episodes per child per year in the South-Asia region.[69,70] We hypothesize that any pathogen which is responsible for at-least 10% of pneumonias would be significant for development of targeted intervention and treatment strategies. Thus the sample size calculations have been done to establish the incidence rates of these important pathogens with a minimum expected incidence of 0.035 child/year (10% of 0.35 pneumonia incidence). If any pathogen has higher incidence, then the calculated sample size would also be adequate. Assuming a 5% probability of type-I error and relative error of 20%, we need a sample of approx 2800 child years to establish the correct incidence rates.

**Study tool**

The study was done by using a community based questionnaire. It was pilot tested and then modified accordingly. The questionnaire included questions on five symptoms of Acute respiratory tract infections namely cold, cough, sore throat, rapid breathing and ear discharge/pain.

**Methods of Data collection:**

Data collection was done in a time period of from August 2012 to March 2013.

***Community Cohort:***

Enrollment and baseline data collection: Informed consent was obtained from eligible individuals in the study area. The demographic data was collected for once during the start of the study and at enrollment for new-enrollees throughout the study period.

Weekly Data Collection Trained field workers conducted house to house surveillance by weekly visit to all enrolled houses. They enquired about occurrence of ARI in last one week among under-10 residents who have consented for participation. The ARI case definitions that have been used for screening are described below.If any eligible member satisfies the criteria of ARI, s/he will be subjected to further examination by trained nurse.

Based on the examination, the nurse will classify the ARI as per Integrated Management of Neonatal and Childhood Illnesses (IMNCI) / Integrated Management of Adolescent and Adult Illnesses (IMAI) guidelines and manage accordingly. This will include provision of appropriate antibiotics. The patients requiring medical attention will be referred to the PHCs or Ballabgarh Hospital.

In case a patient is known to have been admitted in a hospital, then efforts will be made to visit the patient for data collection and sample collection in the hospital if the same is located within Ballabgarh / Faridabad area.

The following clinical data was collected from each patient as per a structured interview schedule

- Clinical History including date of onset of symptoms: fever, cough, cold, shortness of breath, sore throat, wheeze, chills, night sweats, body ache, head ache, running nose, ear ache/discharge, abdominal pain, diarrhea, vomiting, feeding, altered sensorium
- Physical Examination
- Vital signs: Pulse, Respiratory Rate, Oxygen saturation
- Limited respiratory examination: Chest indrawing, Wheezing

Follow-up information: for Outcome

- If in follow-up visit, patient still has symptoms
- Fresh clinical examination
- Management
- Subsequent follow-up

Referral for management and TB workup at PHC will be done if symptoms persist beyond 2 weeks

**Case Definitions:**

**Acute Respiratory Infections (ARI)Screening Criterion:** Since we are relying on para-medical workers to do patient screening, we have adopted a simpler case definition: "History of new onset (between previous 7 days) of one or more of Cough: Sore Throat (Over 2 years); Ear-ache; Running Nose/Coryza ; Rapid breathing / Shortness of breath" This should enable us to capture most cases of acute respiratory illnesses. we are not including fever in our definition since fever is often absent in upper respiratory infections. This definition of ARI that is adapted from the European CDC case definition of ARI which is "sudden onset of symptoms and at least one of the following four respiratory symptoms (Cough, Sore throat, Shortness of breath, Coryza) and clinician's judgement that the illness is due to an infection. Similar criteria have also been used previously by the BOSTID investigators.

**Acute Lower Respiratory Infections (ALRI):** The case definition of ALRI is based on the Integrated Management of Neonatal and Childhood Illnesses which is an Indian adaptation of Integrated Management of Childhood Illnesses and on Integrated Management of Adolescent and Adult Illnesses. These case definitions vary by the age group

0-2 Months Age Group: Presence of any one of the following:

Fever > 37.5º C; Low Body Temperature < 35.5 º C)

Fast Breathing ≥60 breaths/minute

Severe Chest indrawing

Diagnosis of Lower Respiratory Infection by treating physician (includes Pneumonitis, Bronchitis, Brochiolitis, WLRI, LRTI, Laryngitis, bronchopneumonia, pleuritis, pleural effusion)

2month – 5 years Age Group: Presence of any one of the following

Fast Breathing ( ≥50 breaths/minute in child 2months - <12 months of age; ≥40 Breaths/minute in child 12 months – 5 years of age)

Chest Indrawing

Stridor in calm child

Diagnosis of Lower Respiratory Infection by treating physician (includes Pneumonitis, Bronchitis, Brochiolitis, WLRI, LRTI, Laryngitis, bronchopneumonia, pleuritis, pleural effusion etc.)

> 5year Age Group: Presence of any one of the following:

- Presence of any two of
  - ✓ Fast Breathing ( ≥30 breaths/minute in 5yrs - <12 yrs of age; ≥20 breaths/minute in ≥ 12 years of age)
  - ✓ Night Sweats
  - ✓ Chest pain
- Diagnosis of Lower Respiratory Infection by treating physician (includes Pneumonitis, Bronchitis, Bronchiolitis, Acute exacerbation of COPD, LRTI, Laryngitis, bronchopneumonia, pleuritis, pleural effusion)

These will be utilized for identification of ALRI patients among ARI patients in the community cohort. These ALRI patients would require additional clinical evaluation and additional sample collections apart from the naso-pharyngeal swabs. These screening criteria would also be utilized for identification of eligible patients in hospitals.

**Data Management and analysis**

Data was entered into SQL version 4.1.9 and Epi-info version 6.0 . Data was then exported to Microsoft Access and Excel and then analysed.

To calculate the incidence the following steps were followed as detailed below.

Since it is a weekly surveillance every child who was screened by field worker contributed one week. This means if 90 children were screened in one week then total weeks of surveillance contributed by them is 90. In other words we have 90 child weeks which can be converted to child years by dividing 90 by 52 (Number of weeks in a year) that is 1.73 child years. Now if 20 children were found to be having ARI then to calculate incidence per child year the following formula will be used:

$$\textbf{Incidence of ARI} = \frac{\textbf{Number of ARI cases}}{\textbf{Total child years}} = \frac{\textbf{20}}{\textbf{1.73}} = \textbf{11.56 per child year}$$

Hospitalisation Rates: During surveillance all the children who were hospitalized were found actively and a separate form was filled to know the cause of hospitalization. Hence we found all the children who were hospitalized and then the number of children who were hospitalized due to ALRI. Hospitalization rate was then calculated utilizing the child years.

# CHAPTER 3- RESULTS

## 3.1 Demographic Profile of Cohort

**Table 3.1 Population of Study villages (At start of study)**

| VILLAGE | HOUSES | CHILDREN (Under 10 yrs) | MALE | FEMALE |
|---|---|---|---|---|
| Village 1 | 433 | 537 | 290 | 247 |
| Village 2 | 554 | 642 | 357 | 285 |
| Village 3 | 510 | 1202 | 599 | 560 |
| Village 4 | 370 | 448 | 215 | 201 |
| Total | 1867 | 2754 | 1461 | 1293 |

**Table 3.2 Age-wise Population of Children in Villages as on 31st March 2013**

| Age | Total Population |
|---|---|
| Less than 2 Months | 63 |
| 2 Months - < 1 yr | 274 |
| 1yr - < 2 yr | 331 |
| 2 yr - < 5 yr | 949 |
| 5 yr - 10 yr | 1501 |
| Total | 3118 |

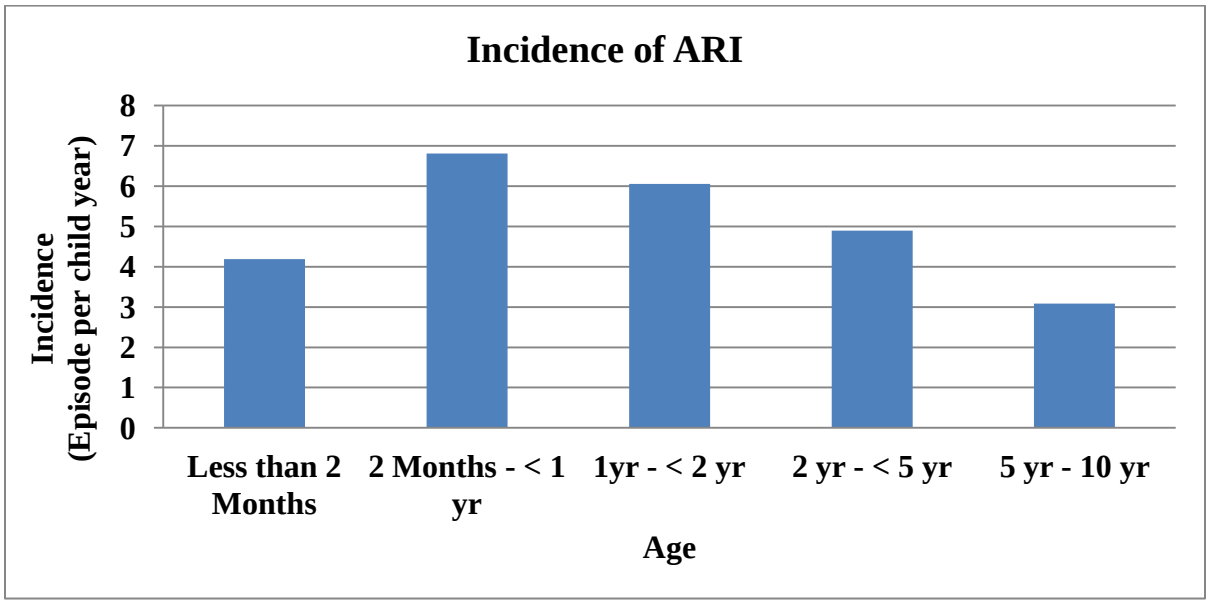
**Interpretation:** The study population was dynamic as the children can come into the study or move out. Reasons for moving out of the study were death, migration outside the village and refusal of consent. Reasons for coming into the study were new birth and in-migration.

### 3.2 Findings

| Age | Total Weeks of Surveillance | Total ARI Cases | Incidence (Episode per child year) |
|---|---|---|---|
| Less than 2 Months | 944 | 76 | 4.1864 |
| 2 Months - < 1 yr | 8516 | 1115 | 6.8084 |
| 1yr - < 2 yr | 11169 | 1301 | 6.0571 |
| 2 yr - < 5 yr | 31812 | 2995 | 4.8956 |
| 5 yr - 10 yr | 49859 | 2958 | 3.0850 |
| Under 10 yr | 102300 | 8445 | 4.2927 |

**Table 3.3 Incidence of Acute Respiratory Tract Infection (ARI) in Children**

**Interpretation:** The highest incidence of ARI is in infants and children in the age group of 1-2 year which is as high as 6.8 episodes per child year and decreases with age.



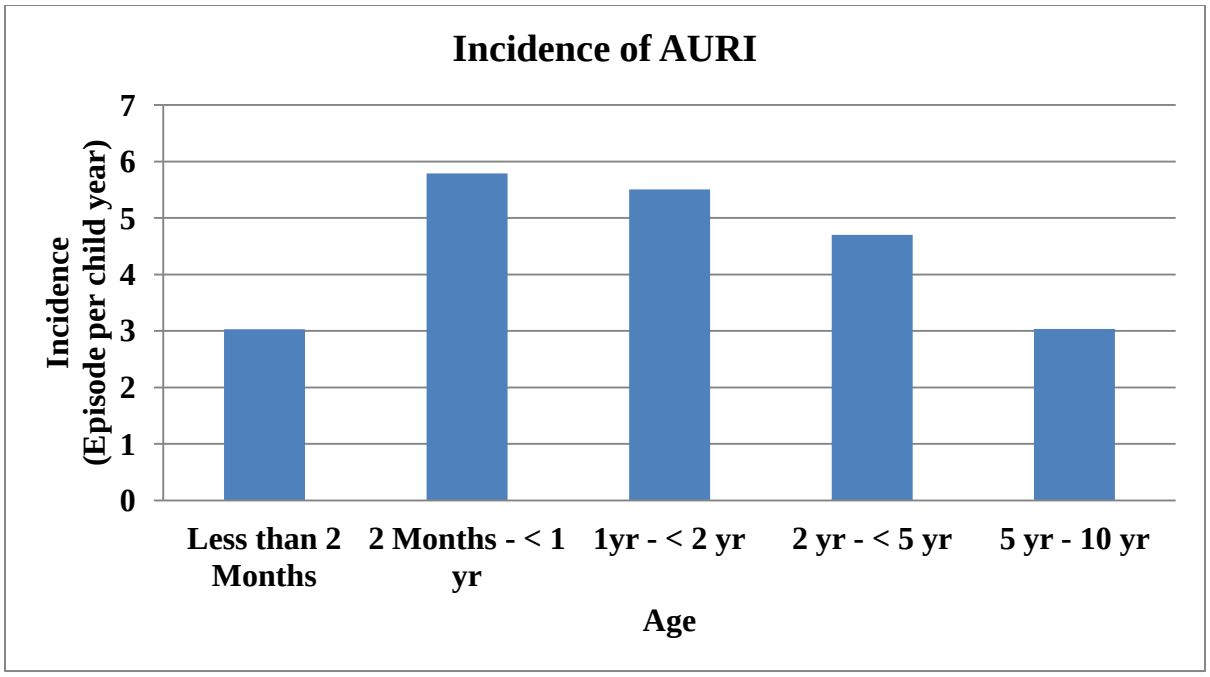

**Graph 3.1 Incidence of Acute Respiratory Tract Infection in Children.**

**Interpretation:** The above graph shows that children in age group of 2 months to 2 year have highest incidence of ARI.

| Age | Total Weeks of Surveillance | Total AURI Cases | Incidence (Episode per child year) |
|---|---|---|---|
| Less than 2 Months | 944 | 55 | 3.0297 |
| 2 Months - < 1 yr | 8516 | 948 | 5.7886 |
| 1yr - < 2 yr | 11169 | 1182 | 5.5031 |
| 2 yr - < 5 yr | 31812 | 2877 | 4.7028 |
| 5 yr - 10 yr | 49859 | 2910 | 3.0350 |
| Under 10 yr | 102300 | 7972 | 4.0522 |

**Table 3.4 Incidence of Acute Upper Respiratory Tract Infection (AURI) in Children**

**Interpretation:** The above table shows the incidence of Acute upper respiratory tract infection in different age groups. The incidence is highest in age group 2 months to 2 years.



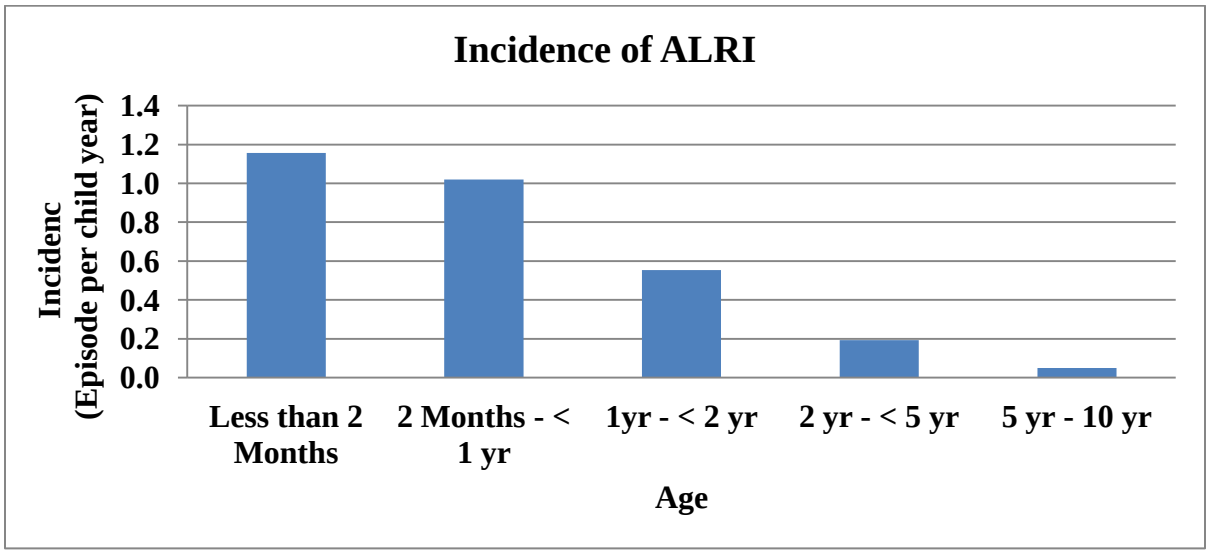

**Graph 3.2 Incidence of Acute Upper Respiratory Tract Infection (AURI) in Children**

**Interpretation:** The above graph shows the incidence of Acute upper respiratory tract infection in different age groups. The incidence in age group of less than 2 months is comparable with 5 to 10 years age group.

| Age | Total Weeks of Surveillance | Total ALRI Cases | Incidence (Episode per child year) |
|---|---|---|---|
| Less than 2 Months | 944 | 21 | 1.1568 |
| 2 Months - < 1 yr | 8516 | 167 | 1.0197 |
| 1yr - < 2 yr | 11169 | 119 | 0.5540 |
| 2 yr - < 5 yr | 31812 | 118 | 0.1929 |
| 5 yr - 10 yr | 49859 | 48 | 0.0501 |
| Under 10 yr | 102300 | 473 | 0.2404 |

**Table 3.5 Incidence of Acute Lower Respiratory Tract Infection (ALRI) in Children**

**Interpretation:** The incidence of ALRI in highest in infants which is more than 1 episode per child per year which means that every child has probability of having an average of one episodes of ALRI in that whole year which is high.



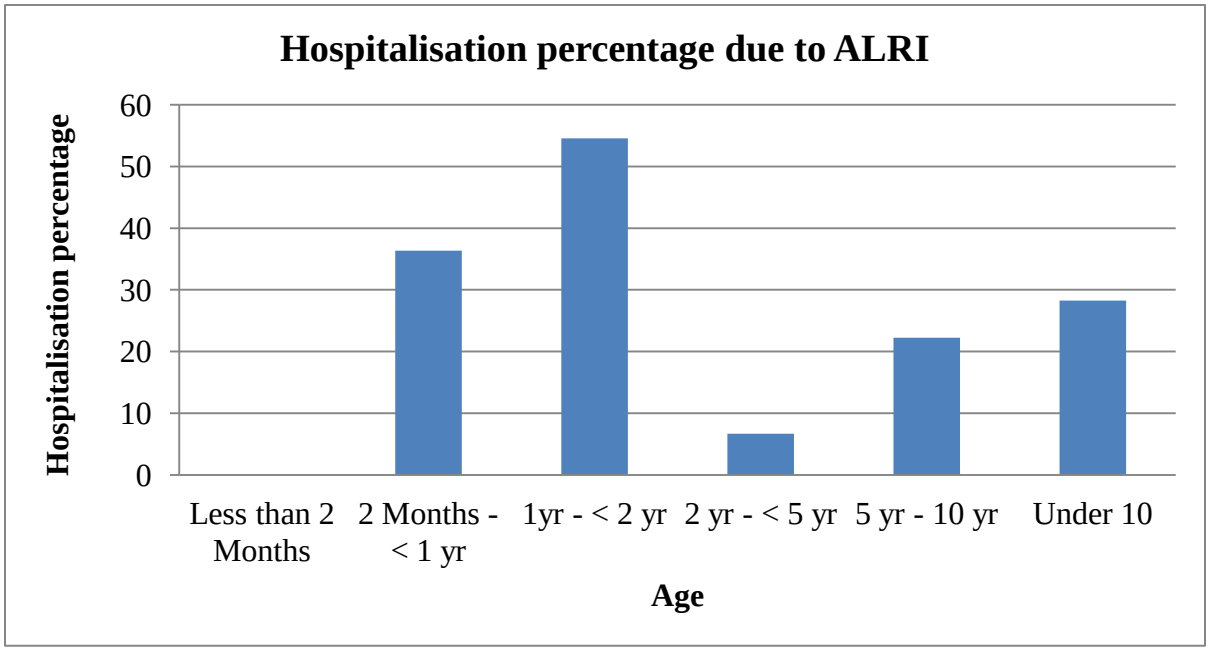

**Graph 3.3 Incidence of Acute Lower Respiratory Tract Infection (ALRI) in Children**

**Interpretation:** The incidence of ALRI decreases with age – highest in infants and lowest in age group 5 – 10 years. Hence morbidity due to ALRI is more common in under 2 years of age.

| Age | Child years | Child hospitalised | | Hospitalisation Rate (Per 1000 child year) | |
|---|---|---|---|---|---|
| | | ALRI | Total | ALRI | Total |
| Less than 2 Months | 18.15 | 0 | 0 | 0 | 0 |
| 2 Months - < 1 yr | 163.77 | 4 | 11 | 24.42 | 67.17 |
| 1yr - < 2 yr | 214.79 | 6 | 11 | 27.93 | 51.21 |
| 2 yr - < 5 yr | 611.77 | 1 | 15 | 1.63 | 24.52 |
| 5 yr - 10 yr | 958.83 | 2 | 9 | 2.09 | 9.39 |
| Under 10 | 1967.31 | 13 | 46 | 6.61 | 23.38 |

**Table 3.6 Hospitalisation rate due to Acute Lower Respiratory Tract Infection (ALRI)**

**Interpretation:** The average hospitalization rate due to ALRI is 36 to 54 percent of the total child hospitalized in the age group of 2 months to 2 years which means pneumonia is still one of the major causes of hospitalisation in children less than 2 years.




**Graph 3.4 Hospitalization percentage due to Acute Lower Respiratory Tract Infection (ALRI) in Children**

**Interpretation:** The above graph shows that of all the children who get hospitalised 36-54% get hospitalised due to pneumonia in age group less than 2 years.

# CHAPTER 4 – DISCUSSION

About 156 million new episodes of childhood clinical pneumonia occur globally each year of which more than 95% of them in developing countries. Of all the pneumonia cases occurring in those countries, 8.7% are severe enough to be life-threatening and require hospital admission. About 2 million pneumonia deaths occur each year in children aged less than 5 years, mainly in the African and South-East Asia Regions. The main bacterial causes of clinical pneumonia in developing countries are *S. pneumoniae* and Hemophilus Influenzae, and the main viral cause is respiratory syncytial virus (RSV), but estimates of their relative importance vary in different settings. Globally, RSV may cause as many as 0.5 million deaths in children each year.[14] In developing countries relatively few studies have been performed of the viral causes of ARI outside the setting of urban hospitals. This is true for India, the second most populous country in the world. In addition, 70% of the population of India is rural, and urban hospital results cannot be assumed to represent ARI epidemiology for the entire population. In this study a prospective, longitudinal, community based surveillance of under 10 children was carried in rural parts of Haryana. The study population was rural and of lower socioeconomic status and in these aspects is typical of the majority of the Indian population. In the present study we have analysed results from the period of August 2012 to March 2013 which was less than a year. Hence results may vary since in this part of the year incidence of Acute respiratory infections is usually high. The incidence rates in the present study are higher than those recently reported from other developing countries. The total ARI incidence rate of 4300 per 1000 children per year was little higher as compared to the 3700 previously reported from the same region. The incidence rate per 1000 children for ALRI were 600 in Philippines and 240 in the present study. Other developing countries either reported either lower incidence rates with 100 in Thailand, 191 in Indonesia 270 in Nigeria or higher with 4200 in Uruguay and 1800 per 1000 children in Colombia.[17.18] In the current study higher rates of ALRI were observed in the first year of life (188), as compared to the under 5 (425) or under 10 (473). The highest rates of ALRI generally occur in the first year of life. However, in the BOSTID studies the Philippines and Colombia reported higher ARI rates in the 12–23 months as compared to the 0–11 months groups, and the ALRI rates

in the Philippines and Guatemala were similar for the two age groups. Because standard definitions were used and a stable cohort was followed prospectively these data include denominator information typically unavailable from hospital-based studies. These data will be useful for planning the study of future acute respiratory tract infections for development of vaccines or other interventions to reduce the disease due to ALRIs. However, additional studies with a larger population will be required to more precisely define ARI and ALRI disease burden.

# CHAPTER 5- CONCLUSION

Pneumonia or ALRI is still one of the major cause of morbidities in early childhood especially in infants and children less than 2 yrs as found in the study. Moreover it is also a major cause of hospitalization in children less than 2 years of age. The highest incidence of ARI is in infants and children in the age group of 1-2 year and decreases with age. The incidence of ALRI in highest in infants which is more than 1 episode per child per year which means that every child has probability of having an average of one episodes of ALRI in that whole year.

**Limitations of the study**

- Duration of the study was limited due to time constraint.
- The study population was dynamic due to migration, births and deaths.
- The study was limited to four villages due to longitudinal nature and management related issues.
- Although many risk factors are associated with ARI their association could not studied due to lack of resources.

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# ANNEXURES