

## Clinical profile and radiological evaluation of severe pneumonia in children, age 2 months up to 5 years: a descriptive cross-sectional study

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### Abstract

Acute respiratory illness, primarily pneumonia, is the main cause of mortality in children under five years in most developing countries - result in 1.9 million deaths each year. To reduce mortality from these diseases, WHO introduced case management guidelines based on simple clinical signs for diagnosing pneumonia followed by empirical treatment with antibiotics. For management purposes, pneumonia is subclassified according to its severity by using general danger sign, chest indrawing or fast breathing. But these factors are influenced by malaria, meningitis, hyperactive airway disorder, bronchiolitis and fever. So clinical profile and their chest radiographs were analyzed in children aged 2-59 months who presented to a health facility with severe pneumonia using WHO guidelines. The purpose was to observe the clinical profile, evaluate radiological features of severe pneumonia and also to correlate the efficacy of clinical criteria with that of radiological findings. The study was conducted under the department of Pediatrics, Mymensingh Medical College Hospital and the samples were collected from the Inpatient department of Pediatrics in this hospital. It was a cross sectional observational study. 100 consecutive samples were collected from mothers with their children aged 2-59 months who met the inclusion criteria. Out of 100 children 56 were male and 44 were female children and male female ratio was 1.3:1. Majority (66%) of the children were partially immunized, 37% children were fully immunized and only 7% children were unimmunized as per EPI schedule. 42% of the children were malnourished and 13% were severely malnourished. Regarding clinical presentation all the patients presented with fever with cough (100%), 88% with difficult breathing, 11% had wheeze and 25% presented with general danger signs. Among the physical signs' temperature raised in 92%, Chest indrawing in 88%, flaring of alae nasi 78%, central cyanosis in 15%, pallor in 28%, stridor in 3%, bulged fontanel in 2% cases and BCG scar present in 65% of the cases. Clinical diagnosis of the studied cases revealed bronchiolitis in 31%, lobar pneumonia in 23%, bronchopneumonia in 27%, asthma in 12% and pulmonary tuberculosis in 7% cases. Routine examination of blood revealed 70% children were mild to moderately pale, 63% leukocytosis, 52% neutrophilic leukocytosis, 15% lymphocytic leukocytosis, ESR was raised in 52% of cases. Chest X-ray showed normal skiagram in 36%, consolidation in 23%, bronchopneumonia in 16%, nonspecific infection in 17% and hilar lymphadenopathy in 7% cases. 12% patients responded with ampicillin alone, 30% required gentamicin in addition, 39% required cloxacillin in addition to ampicillin and gentamicin, only ceftriaxone in 12% and 7% cases required anti tubercular treatment. Steroid used in 30% cases and bronchodilator in 42% cases. Immediate hospital outcome of these patients showed 78% cases improved, 12% patients left hospital against medical advice and 8% patients died in the hospital.

CBMJ 2018 July: vol. 07 no. 02 P: 24-33

**Key words:** Pneumonia, Chest indrawing, Fast breathing, Chest X-ray.

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## Introduction

Every year more than 10 million children in developing countries die before they reach their fifth birth day. Seven in 10 of these deaths are due to acute respiratory infections (mostly pneumonia), diarrhea, measles, malaria or malnutrition and often to a combination of these conditions.<sup>1</sup> In Bangladesh, common illnesses in children under 5 years of age include fever (40.1%), acute respiratory infections (mostly pneumonia), diarrhea (7.5%), and malnutrition (45%) and often in combination.<sup>2</sup>

Every year between October and March there is a high incidence of respiratory infection in both children and adults in the countries of the northern hemisphere. Indeed, respiratory illnesses account for more disability than any other infections. The attack rate is higher among the children than the adults and is especially severe on those under 3 years.<sup>3</sup>

Most children have about four to six acute respiratory infections each year. Children with respiratory infections make up a large portion of patients seen by health worker in health centers. These infections tend to be even more frequent in urban communities than in rural areas.<sup>4</sup> One third of hospital outpatient comprise of acute respiratory infections and nearly 30% of them are being admitted to the hospital for pneumonia.<sup>5</sup>

In Bangladesh, under five mortality rate is about 65 & 13% of under-fives go for care seeking with acute respiratory infections.<sup>6</sup> While there have been decline in child mortality from all causes in Bangladesh, many children still don't access to preventive and curative services delivered by trained health care providers. Of 17 million under five children in Bangladesh, about 380 thousand die annually. Of them 100 thousand die of pneumonia, 50 thousand die of diarrhea, 20 thousand die of measles and another 20 thousand die of neonatal tetanus.<sup>7</sup> So we can see the leading cause of death in under five children is Pneumonia.

Pneumonia is a major killer disease in under five children still having difficulties in diagnosing clinically as well as radiologically. Pneumonia is an important cause of morbidity and mortality in young children in developing countries, with an estimated 1.9 million deaths occurring in children under five years.<sup>8</sup> Approximately 95% of pneumonia related deaths occur in developing countries, and the youngest age groups have the highest risk of death.<sup>9</sup>

Pneumonia is defined as an acute inflammation of parenchyma of lungs associated with recently developed radiological pulmonary shadowing which is either segmental or affecting more than one lobe.<sup>10</sup> The current WHO definition of very severe pneumonia is a clinical diagnosis based on the presence of cough or difficulty breathing plus at least one of the following : central cyanosis, inability to breastfeed or drink, or vomiting everything, convulsions, lethargy or unconsciousness or severe respiratory distress. Severe respiratory distress is defined as the presence of head nodding in addition to other signs of respiratory distress such as chest indrawing and tachypnea.<sup>11</sup>

Pneumonia may be caused by bacterial (*Strep. Pneumoniae*, *H. influenzae*, *Staph. Aureus*, *Kl. Pneumoniae*), Viral (Respiratory Syncytial virus, Influenza virus, Para influenza virus, Measles virus, & Varicella virus), Chlamydia (*Chlamydia Pneumoniae*), *Mycoplasma Pneumoniae*, *Rickettsia (Coxiella burnetti)*<sup>12</sup> and some other nonspecific causes (e.g., Aspiration pneumonia, Hydrocarbon pneumonia, Loeffler's pneumonia etc.).<sup>13</sup> Compared to pneumonia in children in developed countries in developing countries bacterial pathogens are more common, with *Strep. Pneumoniae* and *H. influenzae* are the main bacteria identified.<sup>14</sup>

Pneumonia can be classified in different ways. Thus, classification can be made according to etiological agents (e.g., *Pneumococcal*, *Staphylococcal*), or the gross anatomic distribution of the disease

(e.g., lobular bronchopneumonia or lobar pneumonia), or according to WHO classification.<sup>13</sup>

Most cases of Pneumonia can be detected by using a simple protocol to look for fast breathing & chest indrawing.<sup>15</sup> According to IMCI from 2 months up to 5 years of age Pneumonia are classified as Severe Pneumonia or Very Severe Disease, Pneumonia & No Pneumonia, cough or cold. In Severe Pneumonia or Very Severe Disease there must be any general danger sign (not able to drink or breastfeed, vomits everything, convulsion, lethargic or unconscious) or chest in-drawing (lower chest goes in when the child breaths in) or stridor (harsh noise during inspiration) in calm child. In Pneumonia there must be fast breathing ( $\geq 50$  breaths/min in 2 months up to 12 months,  $\geq 40$  breaths/min in 12 months up to 5 years). In No Pneumonia, cough or cold there is either no sign of Pneumonia or Very Severe Disease.<sup>16</sup>

Typical features of Bacterial Pneumonia are fever, cough, dyspnea, abnormal chest radiograph (infiltration, hilar lymphadenopathy, pleural effusion) and Viral Pneumonia are upper respiratory infection prodrome (fever, coryza, cough, hoarseness), wheezing or rales, myalgia, malaise, headache (older children).<sup>17</sup>

In the diagnosis of acute lower respiratory tract infections, we are to depend mainly on good clinical history, thorough physical examination, examination of blood TC, DC, & culture, X-ray of the chest, microscopic & culture of sputum & pharyngeal secretion, pleural fluid (if present) studies are done. Invasive diagnostic procedure (transtracheal aspiration, bronchial brushing or washing, lung puncture, open or thoracoscopic lung biopsy in critically ill patient) may be done for the etiological diagnosis of pneumonia.<sup>17</sup> After introduction of WHO ARI management plan many physicians in developing countries are reluctant to follow traditional examination (inspection, palpation, percussion, and auscultation) and confines their examination to inspection only. This trend should be

abandoned otherwise proper diagnosis of many respiratory diseases will be missed.<sup>13</sup> But most of these investigations are expensive & due to lack of facilities & so many limitations it was not possible to do all the tests needed for all the cases in all places of the country. But radiological evaluation is possible in all health complexes in our country. There are some limitations to detect Pneumonia clinically as clinical presentation of Bronchiolitis and Asthma are same as that of Pneumonia. We can only differentiate them by doing radiological investigation.<sup>17</sup>

As it is stated that Pneumonia is associated with recently developed radiological shadowing, it is essential to do the radiological investigation to detect Pneumonia.<sup>13</sup> In some cases, Bacterial and Viral Pneumonia can be established radiologically. Not only that, some specific Pneumonia (e.g., in *Staphylococcal* pneumonia pneumatocele is pathognomic) can also be identified radiologically. Complications of Pneumonia (e.g., Pleural effusion, Pneumothorax etc.) are common in bacterial Pneumonia. Without radiological evaluation, complications cannot be diagnosed precisely. So, to reduce morbidity and mortality from Pneumonia precise diagnosis by doing radiological evaluation is necessary.<sup>12</sup>

Pneumonia case management which relies on early diagnosis and prompt empiric antibiotic therapy has been effective, reducing pneumonia related death by 47%.<sup>18</sup>

Much work has not been done in Bangladesh to find out the clinical criteria for acute lower respiratory tract infections and its radiological evaluation. This study was done with the aim of diagnosis of ARI from symptoms and to correlate the efficacy of clinical criteria with that of radiological finding.

## Methods

It was a Cross sectional, observational study done in department of Pediatrics, Mymensingh Medical College Hospital from 1st November 2006 to 30th April 2007. Children of age between 2 months up to 5 years of age, had the onset of respiratory symptoms within the last seven days, and had not been treated with antibiotics for the present illness were included in the study. ARI associated with other diseases, and patients presented with only cough and cold with general danger signs were excluded from the study. According to prevalence of ARI, the sample size was 173 but due to time and economical constraint, only 100 consecutive cases were taken for this study who fulfilled the inclusion and exclusion criteria as well as gave the informed voluntary consent to participate in the study.

The interview was taken by the investigator himself using a preset questionnaire. Immediately after admission a detailed history was taken from the attendant mother and a thorough meticulous physical examination was done. After that, blood sample was sent for routine examination and a Chest X-ray was done within 24 hours of admission. Other investigations were sent according to patients' clinical condition by the consulting physician. Then monitoring was done regarding treatment, clinical improvement or deterioration and immediate hospital outcome.

## Results

Table- 1: Age and sex distribution of the studied cases (n=100)

Age	Male	Female	Total
2 months - <1 year	38 (38%)	30 (30%)	68 (68%)
1 year - <3 years	10 (10%)	8 (8%)	18 (18%)
3 years - 5 years	8 (8%)	6 (6%)	14 (14%)

Table 1 shows the number and percentage of children according to their age and sex. Maximum number (68%) of children were in between the age 2 months to 1 year. Children between 1 - 3 years was 18% and 3 - 5 years was 14%. Male: female ratio was 1.3: 1.

Table-2: Immunization status of studied children (n=100)

Immunization status	Number of children	Percentage
Completely immunized	37	37%
Partially immunized	66	66%
Not immunized	7	7%

Table 2 shows the immunization pattern of the studied children. Majority (66%) of children were partially immunized and only 7% children were unimmunized.

Table-3: Relationship between feeding pattern and severe pneumonia (n=100)

Feeding Pattern	Percentage
Exclusive breast feeding	34
Formula only	13
Partial breast feeding	12
Breastfeeding & Complementary feeding	31
Family food only	10

Table 3 shows that it was more common in exclusive breastfed babies (34%) and then in breastfed with complementary fed babies (31%), formula fed babies (13%) and partial breast-fed babies (12%) in descending order of frequencies.

Figure 1: Nutritional status of studied cases (n=100)

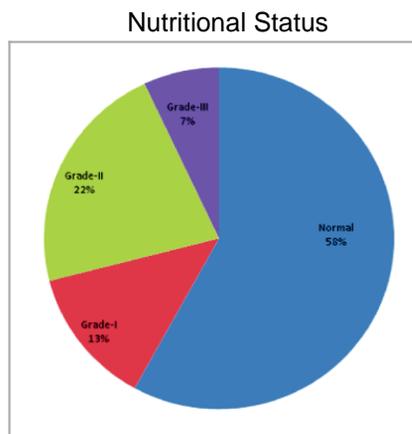


Figure 1 shows that majority (58%) of the cases occurred in normally healthy children and 42% in malnourished children among them 22% were moderately malnourished.

Table-4: Clinical Presentations of studied cases (n=100)

Symtoms	Number of Patients	Percentage
General danger sign		25%
Unable to drink or breastfeed	10	
Vomits everything	7	
Convulsion	2	
Lethargy/unconsciousness	6	
Fever	100	100%
Cough	100	100%
Difficult breathing	88	88%
Nasal discharge	33	33%
Wheeze	11	11%
Earache	5	5%

Table 4 shows all the patients presented with fever with cough (100%), 88% with difficult breathing and 25% presented with general danger signs.

Table-5: Physical signs of the studied cases (n=100)

Sign	Number of Patients	Percentage
Temperature (>1000 F)	92	92%
Fast breathing	76	76%
Chest indrawing	88	88%
Central cyanosis	9	9%
Flaring of alae nasi	78	78%
Stridor	3	3%
Inflamed tonsils	11	11%
Pallor (moderate to severe)	28	28%
Dehydration	5	5%
BCG Scar	65	65%
Skin rash	0	0%
Bulged fontanel (<2 years)	2	2%

Table 5 shows the physical signs. Among then temperature raised in 92%, Chest indrawing in 88%, flaring of alae nasi 78%, central cyanosis in 9%, pallor in 28%, stridor in 3% and bulged fontanel in 2% cases.

Table 6: Chest examination findings of studied case (n=100)

	Number of Patients	Percentage
<b>Inspection</b>		
Fast Breathing	76	76%
Chest Indrawing	88	88%
Restricted Movement	48	48%
<b>Palpation</b>		
Position of trachea: Central	100	100%
Apex beat position: Normal	100	100%
<b>Vocal fremitus</b>		
Increased	23	23%
Decreased	00	00%
<b>Percussion</b>		
Resonant	61	61%
Hyper resonant	10	10%
Dull	29	29%
<b>Auscultation</b>		
Vesicular breath sound	49	49%
Bronchial breath sound	23	23%
Rhonchi	43	43%
Crepitation	55	55%
Vocal resonance: increased	23	23%

Table 6 showed fast breathing in 76%, Chest Indrawing in 88%, Restricted Chest Movement in 48%, Position of trachea and apex beats were normal in all cases, Vocal fremitus increased in 23%, Percussion note resonant in 61%, hyper resonant in 10% and dull in 29% cases, in auscultation vesicular breath sounds in 49%, bronchial breath sounds in 23%, rhonchi in 43% and Crepitation in 55% cases. Vocal resonance increased in 23% cases.

Table- 7: Clinical Diagnosis (n=100)

Diagnosis	Number of Patients	Percentage
Bronchopneumonia	27	27%
Lobar pneumonia	23	23%
Bronchiolitis	31	31%
Asthma	12	12%
Pulmonary Tuberculosis	7	7%

Table 7 shows the clinical diagnosis of the studied cases which revealed bronchiolitis in 31%, lobar pneumonia in 23%, bronchopneumonia in 27%, asthma in 12% and pulmonary tuberculosis in 7% cases.

Table 8: Blood examination findings (n=100)

Investigations	Number of Patients	Percentage
Hemoglobin level		
40% - 60%	12	12%
60% - 70%	58	58%
70% - 80%	30	30%
Total count of WBC		
<11000/cm <sup>3</sup>	37	37%
11000 -15000/cm <sup>3</sup>	35	35%
>15000/cm <sup>3</sup>	28	28%
Differential count of WBC		
Normal	33	33%
Neutrophilia	52	52%
Lymphocytosis	15	15%
Others	00	00%
ESR in 1st hour		
Normal	58	58%
Raised	52	52%

Table 8 shows 70% children were mild to moderately pale, 63% leukocytosis, 52% neutrophilic leukocytosis, 15% lymphocytic leukocytosis, ESR was raised in 52% of cases.

Table- 9: Radiological diagnosis of studied cases (n=100)

Radiological Findings	Number of Patients	Percentage
Normal	36	36%
Nonspecific infection	17	17%
Consolidation	23	23%
Bronchopneumonia	16	16%
Hilar lymphadenopathy	07	7%
Large emphysema	01	1%

Table 9 shows the radiological diagnosis of the studied cases which revealed normal skiagram in 36%, consolidation in 23%, bronchopneumonia in 16%, nonspecific infection in 17% and hilar lymphadenopathy in 7% cases.

Table-10: Drugs used in studied cases (n=100)

Name of drugs	Number of Cases	Percentage
Inj. Ampicillin	12	12%
Inj. Ampicillin + Inj. Gentamicin	30	30%
Inj. Ampicillin+Gentamicin+Cloxacillin	39	39%
Inj. Ceftriaxone	12	12%
Anti TB	7	7%
Inj. Dexamethasone/Inj. Hydrocortisone	30	30%
Salbutamol	42	42%

Table 10 shows drug treatment in which 12% responded with ampicillin alone, 30% required gentamicin in addition, 39% required cloxacillin in addition to ampicillin and gentamicin, only ceftriaxone in 12% and 7% cases required anti tubercular treatment. Steroid used in 30% cases and bronchodilator in 42% cases.

Table- 11: Immediate Hospital outcome of studied cases (n=100)

Outcome	Number of Cases	Percentage
Improved	80	80%
LAMA*	12	12%
Death	8	8%

\*LAMA= left against medical advice

Table 11 shows the immediate hospital outcome of these patients in which 80% cases were improved, 12% patients left hospital against medical advice and 8% patients died in the hospital.

Table- 12: Duration of hospital stay of studied cases (n=100)

Days	Number of Cases	Comment
0 - 7	72	Improved (59), Death (6), LAMA (7)
7- 14	19	Improved (14), Death (1), LAMA (4)
>14	9	Improved (7), Death (1), LAMA (1)

Table 12 shows majority of patient (6%) died in the first week and 59% improved within the first week, also 7% patient required more than 2 weeks to recover.

## Discussion

Acute respiratory infections (ARI) have been studied in many developed and developing countries of the world. In this study it was found that the incidence of severe pneumonia was significantly higher (68%) in under one year of age group than in the older age group children. This result conforms with the findings of the other studies.<sup>19,20,21</sup>

A study in Eastern Highland in Papua New Guinea supported by WHO and Board of Science and Technology for International Development (BOSTID) showed incidence of 73% among under one year age.<sup>22</sup> There was male preponderance (56%) in this study which is also supported by other studies.<sup>19,23,24</sup> Male preponderance could be due to the prevalent of cultural practices of seeking medical care more frequently for males than females.<sup>25</sup> Male-female ratio was approximately 1.3:1 in the study. Akbar et al<sup>26</sup> in their study found ratio of 2:1, Hossain<sup>27</sup> found it 1.7:1 and Rahman<sup>20</sup> found it 1.2:1.

Fever, cough, difficult breathing, nasal discharge were most frequent symptoms observed in this study. In this study, history of fever was present in 100% but on examination it was 92%. Studies of Rahman<sup>20</sup> and Akbar et al<sup>26</sup> showed incidence of fever in 84% and 95% respectively. Fever was found in 80% of cases of lobar pneumonia by Campbell et al.<sup>28</sup>

Difficult breathing was present 88% in this study. Similar results were found in other studies.<sup>26,29</sup> Unable to drink or breastfed and wheezing were present in 10% and 11% respectively which is consistent with the findings of other studies carried out in Bangladesh (Community based studies).<sup>20,21,26</sup>

Convulsion is one of the danger sign in both age groups. It may be due to severe pneumonia, hypoxia, sepsis, meningitis or cerebral malaria (in an area with falciparum malaria).<sup>30</sup> In this study 2% of children had convulsion. 6% patient were lethargic/unconscious. Lumber puncture was done and CSF finding were normal

in these cases. They were treated with conventional antibiotics but all were expired within first three days of admission. Ahmed<sup>21</sup> and Rahman<sup>20</sup> in their studies showed convulsion 6% and 1.4% respectively.

In this study, 88% had chest indrawing irrespective of age of the patient. Rahman<sup>20</sup> in his study found it 35.14%.

Respiratory rate varies in different age group and different grades of severity. Respiratory rate is the most valuable clinical index of biochemical alterations like acidosis, hypercapnia and hypoxia.<sup>31</sup> In this study, fast breathing was present in 76% cases. In Campbell's study,<sup>28</sup> fast breathing was present in 84% cases. Rahman<sup>20</sup> found it 70.79% in his study. These are almost similar with this study.

Central cyanosis is one of the cardinal sign for diagnosis of severe pneumonia or very severe disease. In this study, central cyanosis was present in 9% cases. In Studies by Shann et al,<sup>32</sup> Rahman<sup>20</sup> central cyanosis were present in 16%, 15% and 3.8% respectively. These findings are also very much consistent with this study.

Flaring of alae nasi is another sign of respiratory distress. In this study flaring of alae nasi present in 78% cases.

Many risk factors are associated with increased risk of ARI morbidity and mortality. Severe pneumonia associated with malnutrition has mortality risk of 2-3 times higher than that of healthy children. Present study shows 42% of our children had malnutrition and 7% had severe malnutrition. Hossain<sup>27</sup> and Rahman<sup>33</sup> found 84%, 68% and 58% malnutrition in their study respectively. Severe pneumonia was also occurred increased frequency in partially immunized or non-immunized children.

In this study, percussion note was impaired in 29%, hyper resonant in 10% and normal in 61% cases. On auscultation, it was found that bronchial breath sound in 23%,

crepitation in 55%, rhonchi in 43% and vocal resonance increased in 23% cases. Findings from several developing countries, Selwyn<sup>25</sup> showed crepitation in 72-94 cases. In studies done in Bangladesh crepitations were found in between 81.88 to 92% cases.<sup>34</sup>

In this study, routine blood examination showed that 70% children had Hb below 70%. Study by Rahman<sup>20</sup> showed that 57.73% and 28% children had Hb level below 60%. In the present study, maximum children were anemic because they were very sick and malnourished.

Leukocytosis (>11x10<sup>9</sup>/L) was present in 63% cases where as Rahman<sup>20</sup> demonstrated leukocytosis in 74% and 67.32% respectively. Neutrophilic leukocytosis (>60%) was present in 52% and lymphocytic leukocytosis present in 15% cases in this study. But Rahman<sup>20</sup> demonstrated 46% lymphocytic leukocytosis. ESR raised in 52% cases.

Bhatri, et al<sup>34</sup> showed normal chest radiograph in 16.9%, lobar consolidation in 51.8% and pneumonia with different and prominent broncho vascular markings in 31.4% in case of severe pneumonia.

Perihilar prominence and/or hilar lymphadenopathy occurred in 24.1% cases. Roentgenogram of the chest revealed features of consolidation in 23%, bronchopneumonia in 16%, nonspecific infection in 17%, hilar lymphadenopathy in 7% and normal in 36% cases. Akbar et al<sup>26</sup> showed patchy opacity and consolidation in 46% and 24% respectively. Rahman<sup>20</sup> demonstrated patchy opacity and consolidation in 49.99% and 35.52% respectively.

Management of severe pneumonia was done according to the recent WHO, ARI guidelines and also other recommended injectable antibiotics. Patients with unable to drink, severe chest indrawing and cyanosis were managed by humidified oxygen. The average duration of hospital stay for pneumonia was six days in a study done at

Riadh by Sameeh S. et al.<sup>35</sup> Average hospital stay in this study was 7 days which was similar to other studies.<sup>20</sup>

Sameeh S. et al<sup>35</sup> shows ALRTI mortality rate 0.69% of all hospitalized in Riadh, which is nearly double the rate of 0.36% reported in New York. Farida H et al<sup>36</sup> shows mortality 6.8% in Bangladesh in her study. It is worth mentioning that overall mortality rates in developing countries, estimated by some investigators, are 10-50 times greater than those of developed countries. In the present study, case fatality rate was 8% but Akbar et al<sup>26</sup> and other studies carried out in Bangladesh case fatality varied from 4-8%. Paisley<sup>37</sup> states that mortality from pneumonia in Bangladesh varies between 10-30%. Case fatality in children with ALRTI in different hospital-based studies carried out by BOSTID range from 3.2 - 15.8%.<sup>22</sup>

## Conclusion and Recommendation

It is important that presentations and treatment of severe pneumonia in adult and pediatric are different. Chest X-ray as a routine should be done in all severe pneumonia cases to specify type of pneumonia and its complications. Though pneumonia can be classified according to IMCI guideline, if facility is available, chest X-ray should be done in all suspected cases of severe pneumonia.

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